

# INSECTS OF HAWAII

*A Manual of the Insects of the Hawaiian Islands,  
including an Enumeration of the Species and Notes on  
their Origin, Distribution, Hosts, Parasites, etc.*

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VOLUME 9

MICROLEPIDOPTERA

PART I

MONOTRYZIA, TINEOIDEA, TORTRICOIDEA,  
GRACILLARIOIDEA, YPONOMEUTOIDEA, and  
ALUCITOIDEA

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THIS WORK IS DEDICATED TO  
THE STAFF OF THE BRITISH MUSEUM (NATURAL HISTORY)  
WITHOUT WHOSE GENEROUS HELP NONE OF THE VOLUMES  
OF INSECTS OF HAWAII COULD HAVE BEEN WRITTEN

Nothing can be unworthy of being investigated by man,  
which was thought worthy of being created by God.

Boyle

**IN MEMORIAM**

CHARLES MONTAGUE COOKE, Jr., 1874–1948  
CYRIL EUGENE PEMBERTON, 1886–1975  
ROBERT CYRIL LAYTON PERKINS, 1866–1955  
OTTO HERMAN SWEZEY, 1869–1959  
FRANCIS XAVIER WILLIAMS, 1882–1967

*My ever more lonely path grows dimmer as the brilliant  
lights that have illumined it fade from sight as Time's  
relentless current bears her glorious products swiftly away.*

Definitive works, by their nature, are often long in coming. Because they are compiled by perfectionists they are apt to remain for years an ever-increasing mass of unrelated fact, always growing yet always lacking the final impetus needed to precipitate themselves into the finality of print. The author is always his own hardest taskmaster and is ever reluctant to close the door and finish his work to date, fearing that if he does so his survey will be incomplete and in his eyes worthless. This is natural pessimism—the greatest knowledge always has a better understanding of what there still is to be learnt.

Keith Schackleton

There is no science to which the adage, *Dies diem docet*, is more strikingly applicable than to Natural History. New discoveries are daily made, and will be made, it is probable, to the end of time; so that whoever flatters himself that he can produce a perfect work in this department will be miserably disappointed.

Kirby and Spence

Taxonomy is considered a branch of biology, but it might equally well be regarded as a special kind of detective work. One gathers evidence from diverse sources and tries to build a case for the natural classification of a group. On occasion the . . . evidence does not fit together into a convincing picture. On occasion—but all too rarely—the evidence leads on into broader problems than originally supposed and provides new insights into biological phenomena.

Howard Evans

Verify what I have written, and correct me where I am wrong. The only way by which science can progress is from corrected errors to corrected errors.

Auguste Forel

## PREFACE TO VOLUME 9

This volume continues my study of the Hawaiian Lepidoptera from Volumes 7 (*Macrolepidoptera*) and 8 (*Pyraloidea*) of *Insects of Hawaii*. Volume 7 should be consulted for an introduction to the Lepidoptera, history of Hawaiian Lepidopterology and other subjects which will not be repeated here. Reference should be made to Volume 1 (Introduction) for a detailed outline of the plan and scope of the series, discussions of the geology of the Hawaiian Archipelago, dispersal, distribution, evolution, general comments and acknowledgements.

This ninth volume of *Insects of Hawaii* contains information concerning 681 kinds of Microlepidoptera. These moths are included in 80 genera (compared with 46 genera containing 158 kinds of Macrolepidoptera in Volume 7 and 44 genera containing 226 kinds of pyraloid moths in Volume 8). Of these totals of Microlepidoptera, 605 of the species are endemic and 76 are foreign; 14 of the genera are endemic and 65 are non-endemic. The 605 endemic species are members of only eight families, and more than one-half of the endemic species are contained in only one genus—*Hyposmocoma* of the Cosmopteriginae.

During the course of this research, it has been found that an unusually large percentage of the names of the Hawaiian Lepidoptera require change, and entomologists in Hawaii will note herein many changes in the names of genera and species with which they have long been familiar. It is now possible more clearly to see the relationship borne by the Hawaiian fauna to those of other parts of the world.

I have now treated about 2,275 kinds of insects in the first nine volumes of *Insects of Hawaii*. Hardy *et al.* have added about 850 in the first three volumes on the Diptera (Volumes 10, 11 and 13 of the series). Thus, more than 3,100 kinds of insects have been discussed in these books. More than 3,000 species remain to be included in future volumes.

The previously published volumes of the series are: 1—*Introduction* (geology, evolution, distribution, analyses of the biota, etc.); 2—*Apterygota, Orthoptera, Isoptera, Embioptera, Zoraptera, Corrodentia, Mallophaga, Anoplura, Odonata, and Thysanoptera*; 3—*Heteroptera*; 4—*Homoptera: Auchenorrhyncha*; 5—*Homoptera: Sternorrhyncha*; 6—*Ephemeroptera, Neuroptera, Trichoptera and Supplement to Volumes 1 to 5*; 7—*Macrolepidoptera*; 8—*Lepidoptera: Pyraloidea*; 10—*Diptera: Nematocera—Brachycera (except Dolichopodidae)*, by D. E. Hardy; 11—*Diptera: Brachycera II—Cyclorrhapha I*, by Hardy, Kohn and Beyer; 11—*Supplement*, by J. M. Tenorio; 12—*Diptera: Cyclorrhapha II, Drosophilidae*, by Hardy. Dr. Hardy and collaborators have in press Volumes 13—*Diptera: Cyclorrhapha III* and 14—*Diptera: Cyclorrhapha IV*, which will treat the remaining Diptera.

During more than 40 years, I have assembled extensive manuscripts for the following five volumes on the Coleoptera: 15—*Adephaga and water beetles*; 16—*Brachelytra*; 17—*Serricornia and Clavicornia*; 18—*Phytophaga and Lamellicornia*; 19—*Rhynchophora and Strepsiptera*, and the following four volumes on the Hymenoptera: 20—*Ichneumonoidea*; 21—*Chalcidoidea*; 22—*Cynipoidea*,

*Serphoidea*, *Proctotrupoidea*, *Scolioidea*, *Bethyloidea*; 23—*Vespoidea*, *Sphecoidea*, *Apoidea*. It is a tragic loss that so much of my life was poured into the preparation of the manuscripts for those proposed volumes to no avail. It must remain for other workers to complete those planned volumes and also to prepare the proposed Volume 24 on the Arachnida and other groups. Several persons have been invited to join the project, but, excepting for the Diptera, the invitations have not been fruitful.

This volume has been written in part for non-specialists and students and to enable all who have reason to use it to acquire a better understanding of the remarkable Hawaiian fauna. Consequently, there has been included material that experienced lepidopterists may find redundant or extraneous. Descriptive matter in this text, as in my other volumes of *Insects of Hawaii*, is intended largely to be incorporated into the keys, supplemented by the many illustrations, and separate descriptions are not given under all headings. If further descriptive details are required, the original descriptions may be consulted. Fortunately, most original descriptions of Hawaiian Microlepidoptera are included in *Fauna Hawaiiensis* and the *Proceedings of the Hawaiian Entomological Society*. This text was written with the understanding that those two invaluable works should be used in conjunction with it. Also, this is a companion to Volume 7, *Macrolepidoptera*, and Volume 8, *Pyraloidea*, and those two volumes belong with this volume to form a planned unit.

The major purpose of these volumes is to take stock of the known Hawaiian insects and to facilitate their identification. It has never been my intention to describe many new species in these books, although I have examined large numbers of new species during the course of the writing. Had I described the multitudes of new species I have seen, or could assemble, my studies of only a few of the orders of insects could have been completed, and I might still be working on the Hemiptera more than 40 years after I began this project. I am fully aware of the descriptive work which remains to be done on many hundreds of unnamed species, but I must leave the task of making them known to other workers who will follow me.

This book leaves much undone. It might better have been entitled *An Introduction to the Study of the Hawaiian Microlepidoptera*. I have done little more than to scratch the surface of a large and difficult complex of problems. To produce a modestly comprehensive text would require, in addition to museum and laboratory studies, that the author be given opportunity of adequate residence on the various Hawaiian islands and his working time devoted solely to this complex project and be given freedom and facilities to carry out extensive and intensive work in fields and forests throughout the islands as demanded by the research itself. This I have been unable to do.

The Hawaiian Lepidoptera are worthy of several long lifetimes of concentrated, continued research, and many volumes would be required to treat them adequately. This marvel of time and creation warrants such study. It is impossible to unravel many intricate problems without detailed studies of life histories of many species. The habits and hostplants of most species remain unknown; the eggs, larvae and pupae of only a small number of species have been collected and almost none have been reported upon adequately. There are many species remaining undescribed—possibly several hundred. Many of

the described species are known from only one or a few specimens, and many of the preserved representatives are in poor condition or are fragmentary (as the photographs of the types bear witness). The all-important genitalia of many species have not been available for study, because the abdomens of many specimens have been broken off and lost. Workers are cautioned that the series of specimens, including the type series, of most species in collections must be re-examined with extreme care in the light of new knowledge. Many of the type series include two or more species even when all of the specimens have been collected at the same place. I have found as many as seven or eight distinct species mixed under one name.

All of my texts require testing and improvement by use; they should have been used for several years in manuscript before being published. That has not been possible, and they must contain errors which could have been avoided had conditions for their preparation been more favorable. Under the circumstances, a more adequate monograph cannot now be presented. I leave hundreds of questions unanswered.

The identification of Microlepidoptera is difficult, even for the expert with long experience. There are many inherent difficulties in the Hawaiian fauna which make the problems of identification unusually complex. A large number of illustrations (nearly 5,000 drawings and photographs) is included here to assist identification, but the illustrations must be used with care and caution. The photomicrographs might be compared with x-ray photographs, and their interpretation frequently may require experience gained only from detailed study and long familiarity with the subject. A student may be led far astray by the misinterpretation of illustrations, and I cannot urge too strongly that extreme care must be taken by all who attempt the determination of Microlepidoptera. It will not be possible to determine many species from this text alone, and this fault I deeply regret. It is hoped, however, that if the reader cannot identify given species he will be able at least to place them close to the groups to which they belong. He may then have to consult specialists or compare his material with the types before he can be positive of the correct identification. The ways that one may be confused are numerous. Many species resemble one another so closely that groups of them easily may be considered as representing a single species before they are studied carefully. Many other species display bewildering variation, and a series of specimens of one species may appear to represent several.

The genitalia of almost none of the endemic Hawaiian Microlepidoptera have been illustrated heretofore. One of the major goals of this text has been to illustrate the genitalia of as many species as possible. It is regretted that material has not been available to make possible an absolutely complete set of illustrations for every species. The abdomens of many old specimens were decomposed or molded in damp Hawaii before Dr. Perkins was able to have them transported to England, and, of course, it is impossible to make good microscope preparations from such material. It is astonishing, however, in the light of the extraordinary difficulties confronting him in the Hawaiian mountains, that Dr. Perkins was able to get most of his collections to England in an excellent state of preservation. It should be noted that almost every



specimen was relaxed and remounted after the collections were received in England, and one does not know what damage may have occurred in the process.

It has been my plan in these volumes to use illustrations in place of words as extensively as possible. It has not, however, always been possible to prepare adequate illustrations. Some of the accompanying illustrations are poor, and some may be misleading, because it is not possible to obtain perfect pictures from imperfect specimens. The photographs do, however, portray the specimens in their condition as I found them. Adequate time, talent and funds have not been available for repeat photography to attempt to obtain better pictures of some of the specimens. Many species are represented in collections by unique types or other specimens in poor condition, improperly mounted, fragmentary, moldy or partly decomposed. Some of the specimens lack abdomens, and it has been impossible to illustrate their genitalia, which would display unknown diagnostic characters. Many of the specimens in Hawaiian collections, especially those formerly in the Experiment Station, Hawaiian Sugar Planters' Association, have become badly faded by being left exposed to the tropical sun. Many specimens should have been remounted before being photographed, but time and assistance for such work was not available. Many of the photomicrographs should have been supplemented by drawings, because it is not always possible to show all essential features of a convex, complicated genital system in a simple photograph. Black and white photographs of the moths are partly unsatisfactory and cannot possibly convey to the reader a true picture of these interesting, highly varied and often beautiful insects. Every species should have been reproduced in color as are those in the eight color plates appended hereto that were prepared by Dr. and Mrs. Klaus Sattler after this text was completed. Walsingham did figure almost every species he described by exquisite colored illustrations. Although painter Frohawk, lithographer Wendel and printer Trap made a magnificent contribution in their colored plates, the individual figures vary in accuracy. Many of the *Fauna Hawaiiensis* figures are excellent, but others are inaccurate. Some of the specimens the artist had to work with were imperfect, and he was forced to make various reconstructions, some of which are misleading. Many of the colored figures in *Fauna Hawaiiensis* bear little resemblance to the photographs of the same specimens included here. Hence, workers are cautioned to use all illustrations with the greatest of care. The original colored paintings used by Walsingham are preserved in excellent condition in the Entomology Library of the British Museum (Natural History).

In previous volumes of *Insects of Hawaii*, I have tried to give complete keys to all of the species, but I have found it impossible to adhere to that policy in this volume because of lack of time, lack of support and lack of material.

In many ways, the preparation of this text has been like the opening of a series of "Pandora's boxes". One difficulty after another has been encountered at almost every research probe. An attack on one problem often has led to the exposure of a series of unsuspected problems. Although many doors have been opened by this work, I do not yet know enough to tell much of what may lie beyond the opened doors.

## ACKNOWLEDGEMENTS

Work began on *Insects of Hawaii* soon after my return from Bishop Museum's unforgettable, remarkably successful, Mangarevan Expedition to south-eastern Polynesia in 1934. I was then greatly encouraged, stimulated and aided by my beloved friend and mentor, the late Dr. Charles Montague Cooke, Jr., whose example and spirit still guide me. The task continued during my many years at the Bishop Museum in Honolulu and later also in association with the Experiment Station, Hawaiian Sugar Planters' Association, until I resigned in protest in 1954 following administrative changes which resulted in the work on this series of books being ordered abandoned. During my service with the Experiment Station, C. E. Pemberton was my immediate superior officer, and he always gave the project his strongest support and contributed much toward the successful progress of my work.

A large part of the basic cataloging, abstracting and preliminary work on all of the proposed volumes of this series was done during the long nights when I was confined to my home in Honolulu by the many months of "black out" during the Second World War. Continuation and completion of the work on this volume, and its publication, were made possible by the National Science Foundation. Most of the writing was done at the British Museum (Natural History) and at my former home at Peterborough, New Hampshire, from which base I profited greatly by the facilities provided by the Museum of Comparative Zoology, Harvard University. The task was completed and the proofs read at my present position as Curator of Weevils in Canberra, thanks to the generous cooperation of Dr. D. F. Waterhouse, Chief, Division of Entomology, Commonwealth Scientific and Industrial Research Organization.

As stated in Volume 7, from the time of my arrival in Honolulu in 1934, Otto H. Swezey was a close friend, honored associate and a constant contributor to the progress of this series. He was greatly interested in the work, and his continued encouragement and support of my project was stimulating and valued most highly. His death in 1959, at age 90, closed an outstanding era of Hawaiian entomology. Much of what is recorded herein regarding the habits and early stages of the Hawaiian Lepidoptera has come from Dr. Swezey's research during nearly 50 years of devoted service to Hawaiian entomology. No other person or combination of persons has contributed so much to our knowledge of the biologies of Hawaiian Lepidoptera as has Dr. Swezey. My debt to him is great, and these book are in large part a tribute to him. Further comment about Dr. Swezey is in the section on the history of Hawaiian lepidopterology on page 28 of Volume 7. It may be said that two men made it possible for me to prepare this text: Dr. Perkins, that extraordinary naturalist who made the remarkable basic collection, and Dr. Swezey who followed him and concentrated his activities on assembling data on life histories, hostplants and parasites.

In 1939 I invited the late August Busck, then at the United States National Museum, to come to Honolulu with the hope and expectation that he would be able to make a major contribution toward a revision of the Hawaiian Microlepidoptera. Most unhappily, this was not to be. I have used the limited

number of microscope slide preparations made by Busck, and some of the drawings prepared for him by J. F. G. Clarke (these are labeled JFGC on the plates herein).

I am deeply indebted to the National Science Foundation for their generous support and for their broad understanding of the many problems involved in this project. This volume has been saved from oblivion because of the support of the Foundation. The Foundation also rescued from loss my Volumes 6, 7 and 8 and enabled them to be completed and published.

This volume could never have been completed without the exceptional cooperation of the Trustees, Directors, Keepers (N. D. Riley, W. E. China, J. P. Doncaster, and Paul Freeman), and the able staff of the British Museum (Natural History). To all of them I am most deeply indebted. In my field of research, the collections and libraries of the Natural History Museum are the finest and best organized in the world. It is there, too, that the great, historically invaluable Hawaiian collections of the devoted, indefatigable Dr. R. C. L. Perkins and most of the type specimens of Hawaiian Microlepidoptera are stored and maintained in excellent condition. There, too, is the extraordinary Meyrick collection, and now the comprehensive, beautiful collections of Hawaiian Lepidoptera made by Klaus and Edith Sattler. All who use this text are under an additional obligation to the Natural History Museum staff for their exceptional generosity in supplying most of the photographs used herein.

From 1949, when our extended residences in England began, J. D. Bradley [then a member of the staff of the British Museum (Natural History) and now with the Commonwealth Institute of Entomology], to the close of the work on this book, contributed an extraordinary amount of assistance to the project. He made hundreds of dissections, generously answered innumerable questions and assisted me in a singular manner. I am deeply obligated to Dr. Bradley without whose help I could not have accomplished what I have.

In 1941, when I was working on this text at the United States National Museum, J. F. G. Clarke generously assisted me in many ways. Later, we worked together for extended periods in London, and he continued his help and encouragement throughout the course of my work.

After Klaus Sattler joined the British Museum (Natural History), we developed a close friendship. He became greatly interested in my project and contributed major assistance. His interest in the Hawaiian fauna deepened, and this led us to plan a major program of field work in Hawaii. The proposal was generously approved by the British Museum authorities, and in 1973 the Sattler family spent several remarkably successful months collecting on several of the Hawaiian islands. In 1976 the Sattlers returned to continue their intensive and extensive field surveys using equipment and facilities that were unknown or unavailable to Perkins and Swezey. Their collections are without doubt the largest and finest of their kind ever assembled, and they increase the value of the holdings of the British Museum enormously. The specimens were returned to the Museum in beautiful condition and have been meticulously prepared by Dr. Sattler, as the colored photographs of a few of them appended hereto will attest. It is my hope that Klaus Sattler will prepare a supplementary volume to the Lepidoptera section of *Insects of Hawaii*

in which he will incorporate the mass of new data he and his wife have assembled.

Other members of the staff of the British Museum who have assisted me in ways too numerous to mention include former Keeper N. D. Riley, to whom I am especially deeply indebted for much help and great kindness over many years (he rendered major assistance with numerous problems concerning suprageneric categories during the latter stages of the preparation of this text), present Keeper Paul Freeman, D. S. Fletcher, I. W. B. Nye, J. F. Perkins (son of R. C. L. Perkins), W. H. T. Tams, W. G. Tremewan, P. E. S. Whalley, librarians B. J. Clifton and P. Gilbert, photographers J. V. Brown, P. J. Green and M. G. Sawyers whose numerous illustrations adorn these pages. Arthur Smith, skilled entomological illustrator, now retired from the British Museum, has contributed greatly to the value of this text by preparing scores of beautifully executed drawings which are signed with his initials "AS".

To the Museum of Comparative Zoology, Harvard University, I am indebted for the extended use I made of their excellent library over a period of many years, beginning in 1941.

At the United States National Museum, in addition to J. F. G. Clarke whom I have already mentioned, D. R. Davis, W. D. Duckworth, Ron Hodges, and the late August Busck and Carl Heinrich assisted me in various ways.

J. W. Beardsley, formerly with the Experiment Station, Hawaiian Sugar Planters' Association, and now Professor at the University of Hawaii, rendered major assistance by sending material for study and for supplying much information.

C. J. Davis and his associates at the Hawaii Department of Agriculture supplied photographs and material for study and assisted in various ways.

Ian Common, CSIRO, Canberra, helped me with several problems and supplied some of the illustrations from his monographs for use here.

Margaret MacKay, now retired from the Entomology Research Institute, Ottawa, has made a major contribution to this work by loaning various of her meticulously prepared plates of the details of larvae and pupae in addition to preparing several excellent, highly instructive new plates for this text.

I am indebted to Miss J. C. Cardale, my colleague at CSIRO, Canberra, for her greatly valued aid with the laborious task of proofreading.

To my wife, Hannah, is owed a very special debt. The personal and financial sacrifices she has endured throughout the many years of our struggle to prepare *Insects of Hawaii* have been numerous. Her support for my work has been continuous and exemplary.

The assistance given by other persons to this project is acknowledged in appropriate places in the text.

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The world cries out for major monographic works. Scientists lament *ad nauseum* the lack of them. The preparation of definitive work demands enormous personal sacrifice from a special breed of men willing to dedicate their lives to such research and, often criticized severely, prepared to divorce themselves from many of the ordinary "pleasures of life". The reason that large monographs are rarely begun and more rarely completed rests largely upon

the lack of understanding and foresight of administrators. It is enough that institutions demand of scientists that they conduct competently their intricate researches and convey their results, opinions, suggestions and conclusions to the world in publications of high standard. It is too much to ask that in addition they perform innumerable other tasks and shoulder the responsibility of finding means to finance the work and its publication. Nature allows a man only a few years in which to make his contribution to knowledge and the advancement of science. It is in the interest of all that the scientist be guided and assisted in all ways to make the most fruitful use of his few and precious years.

Much of the work for this volume was done under duress, uncertainty, unhappiness and the cloud of continued threat that my lifetime's research would have to be abandoned. Many years that should have been among the most productive of my life were lost to *Insects of Hawaii* because of lack of interest and support. Under such unsatisfactory conditions, the products of my labor have not been what I had hoped they would be. I have tried to do the impossible in attempting to write the volumes I had planned under the conditions in which most of the work has been done. It is the greatest defeat of my life that circumstances beyond my control make it impossible to accomplish the work I set out to do so long ago. An enormous series of tasks remain. I must leave it with the hope that other workers may be able to carry the project forward in the future.

This book was brought to a premature close and submitted for publication in 1970 (with the promise that it would be published without delay) because of necessity and not by choice. I have had opportunity only to lay a foundation for the study of the extraordinary Hawaiian Microlepidoptera, and I regret most deeply that I have not been able to contribute more to *Insects of Hawaii* than I have. *Hinc illae lacrimae!*

*Then I looked on all the works that my hands had wrought, and on the labour that I had laboured to do: and, behold, all was vanity and vexation of spirit, and there was no profit under the sun.*

Ecclesiastes 2:11.

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# **INSECTS OF HAWAII**



Observations on the life-histories of Lepidoptera have convinced me, that most, if not all, species may be recognized by their behaviour in any one or more of their metamorphic stadia, regardless of anatomical similarities or dissimilarities. In every instance where closely allied species were intensively studied, the significant factor for their recognition was found in their behaviour. It is undoubtedly true that comparative morphology is the foundation of taxonomy, but in this and other insect groups, it can only be considered a basic prelude to taxonomic reality. The presence of many sibling species suggests that in the process of organic evolution, behaviour patterns often evolve prior to the anatomical alterations that inevitably follow, and help to define the biological units that comprise the present cross section of evolutionary development. Behaviour patterns, although more realistic taxonomically, are not exempt from the variation that exists in all taxonomic characters. These patterns are slowly changing in accord with the development of [organic] evolution, and, like any other specific character, they must be evaluated and defined on the basis of discontinuous variation. (T.N. Freeman, 1960: 7)

# CONSPECTUS OF THE FAMILIES AND GENERA OF MICROLEPIDOPTERA IN HAWAII

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It will be noted from an examination of the foregoing list that only eight families of Microlepidoptera—the Opostegidae, Tortricidae, Gracillariidae, Lyonetiidae, Yponomeutidae, Carposinidae, Scythrididae, and Gelechiidae—are represented in the endemic fauna.

# CHECKLIST OF THE INSECTS TREATED IN THIS VOLUME

Order **LEPIDOPTERA**, continued from Volume 8  
Suborder MONOTRYSIA Börner

Superfamily NEPTICULOIDEA (Stainton)

Family OPOSTEGIDAE Meyrick

Genus **OPOSTEGA** Zeller

**callosa** Swezey

**dives** Walsingham

**filiforma** Swezey

**maculata** Walsingham

**peleana** Swezey

**serpentina** Swezey

Superfamily ADELOIDEA (Herrich-Schäffer)

Family INCURVARIIDAE Spuler

Subfamily PRODOXINAE (Riley)

Genus **TEGETICULA** Zeller

Species?

Suborder DITRYSIA Börner, continued

Series HETEROCERA Boisduval, continued

Superfamily TINEOIDEA (Latreille)

Family TINEIDAE (Latreille)

Subfamily TINEINAE (Latreille)

Genus **CRYPSTHYRODES** Zimmerman

**obumbrata** (Butler)

Genus **NIDITINEA** Petersen

**spretella** (Denis and Schiffermüller)

Genus **TINEA** (Linnaeus)

**pellionella** (Linnaeus)

Genus **TINEOLA** Herrich-Schäffer

**bisselliella** (Hummel)

Genus **PRAEACEDES** Amsel

**thecophora** (Walsingham)

Genus **HEREOECA** Hinton and Bradley

**allutella** (Rebel)

Genus **TRICHOPHAGA** Ragonot

**mormopis** Meyrick

Genus **MONOPIS** Hübner

**crocicapitella** (Clemens)

**meliorella** (Walker)

**monachella** (Hübner)

Subfamily DRYADAULINAE Bradley

Genus **CHOROPLECA** Durrant

**advena** Zimmerman

**terpsichorella** (Busck)

Subfamily NEMAPOGONINAE Zagulyaev

Genus **NEMAPOGON** Schrank

**granellus** (Linnaeus)

Subfamily ERECHTHIINAE (Meyrick)

Genus **NEODECADARCHIS** Zimmerman

**flavistriata** (Walsingham)

Genus **LEPIDOBREGMA** Zimmerman

**minuscula** (Walsingham)

Genus **PANTHEUS** Zimmerman

**penicillatus** (Swezey)

Genus **DECADARCHIS** Meyrick

**kerri** (Swezey)

**simulans** (Butler)

Genus **ERECHTHIAS** Meyrick

**zebrina** (Butler)

Genus **MECOMODICA** Zimmerman

**fullawayi** (Swezey)

Subfamily SETOMORPHINAE Walsingham

Genus **SETOMORPHA** Zeller

**rutella** Zeller

Genus **LINDERA** Blanchard

**tessellatella** Blanchard

Subfamily HIEROXESTINAE (Meyrick)

Genus **OPOGONA** Zeller

**aurisquamosa** (Butler)

**omoscopa** (Meyrick)

**purpuriella** Swezey

Superfamily TORTRICOIDEA (Latreille)

Family TORTRICIDAE (Latreille)

Subfamily TORTRICINAE (Latreille)

Genus **CROESIA** Hübner

**zimmermani** Clarke

Genus **SPHETERISTA** Meyrick

**argentinotata** (Walsingham)

**cassia** (Swezey)

**flavocincta** (Walsingham)

**flavopicta** (Walsingham)

**fulva** (Walsingham)

**glaucoviridana** (Walsingham)

**infaustana** (Walsingham)



**ochreocuprea** (Walsingham)  
**otheoheana** (Swezey)  
**pernitida** (Walsingham)  
**pleonectes** (Walsingham)  
**pterotropiana** (Swezey)  
**reynoldsiana** (Swezey)  
**tetraplasandra** (Swezey)  
**urerana** (Swezey)  
**variabilis** (Walsingham)  
**xanthogona** (Walsingham)  
**species?**

Genus **EPIPHYAS** Turner

**postvittana** (Walker)

Genus **PARARRHAPTICA** Walsingham

**capucina** (Walsingham)  
**chlorippa** (Meyrick)  
**dermatopa** (Meyrick)  
**falerniana** (Walsingham)  
**fuscocinerea** (Swezey)  
**fuscoviridis** (Walsingham)  
**leopardella** (Walsingham)  
**leucostichas** (Meyrick)  
**lichenoides** (Walsingham)  
**longiplicata** (Walsingham)  
**lysimachiae** (Swezey)  
**lysimachiana** (Swezey)  
**notocosma** (Meyrick)  
**perkinsiana** Walsingham  
**punctiferana** (Walsingham)  
**pycnomias** (Meyrick)  
**sublichenoides** (Swezey)  
**subsenescens** (Walsingham)  
**trochilidana** (Walsingham)

Genus **PARAPHASIS** Walsingham

**perkinsi** Walsingham

Genus **PANAPHELIX** Walsingham

**asteliana** Swezey  
**marmorata** Walsingham

Genus **MANTUA** Zimmerman

**fulvosericea** (Walsingham)

Genus **BRADLEYELLA** Zimmerman

**chlorocalla** (Walsingham)  
**metallurgica** (Walsingham)  
**phyllanthana** (Swezey)  
**semicinereana** (Swezey)  
**thoracina** (Walsingham)

Genus **AMORBIA** Clemens

**emigratella** Busck

Subfamily OLETHREUTINAE (Hübner)

Genus **ECCOPTOCERA** Walsingham

**foetorivorans** (Butler)  
**osteomelesana** (Swezey)  
**new species 1**  
**new species 2**  
**new species 3**  
**new species 4**  
**new species 5**  
**new species 6**  
**new species 7**  
**new species 8**  
**new species 9**

Genus **BACTRA** Stephens

Subgenus **CHILOIDES** (Butler)

**straminea** (Butler)  
**venosana** (Zeller)

Genus **CRYPTOPHLEBIA** Walsingham

**illepida** (Butler)  
**ombrodelta** (Lower)

Genus **MACRAESTHETICA** Meyrick

**rubiginis** (Walsingham)

Genus **CYDIA** Hübner

**chlorostola** (Meyrick)  
**conspicua** (Walsingham)  
**crassicornis** (Walsingham)  
**falsifalcella** (Walsingham)

**new species 5**  
**new species 6**  
**new species 7**  
**new species 8**  
**new species 9**

## Superfamily YPONOMEUTOIDEA (Stephens)

### Family YPONOMEUTIDAE Stephens

Genus **PRAYS** Hübner

**fulvocanella** Walsingham  
**new species 1**  
**new species 2**  
**new species 3**  
**new species 4**  
**new species 5**  
**new species 6**

Genus **PLUTELLA** Schrank

**capparidis** Swezey  
**xylostella** (Linnaeus)

Genus **ACROLEPIA** Curtis

**aiea** Swezey  
**assectella** (Zeller)  
**aureonigrella** Walsingham  
**beardsleyi** Zimmerman  
**nothocestri** Busck

### Family SCHRECKENSTEINIIDAE Fletcher

Genus **SCHRECKENSTEINIA** Hübner

**festaliella** Hübner

### Family PTEROPHORIDAE Latreille (See Volume 8, p. 388)

Genus **MEGALORHIPIDA** Amsel

**defectalis** (Walker)

Genus **LIOPTILODES** Zimmerman

**parvus** (Walsingham)

Genus **LANTANOPHAGA** Zimmerman

**pusillidactyla** (Walker)

Genus **ANSTENOPTILIA** Zimmerman

**marmorodactyla** (Dyar)

Genus **STENOPTILODES** Zimmerman

**littoralis littoralis** (Butler)

**littoralis rhynchophora** (Meyrick)

**taprobanes brachymorpha** (Meyrick)

## Superfamily ALUCITOIDEA (Linnaeus)

### Family CARPOSINIDAE Walsingham

Genus **CARPOSINA** Herrich-Schäffer

**achroana** (Meyrick)

**atronotata** (Walsingham)

**benigna** Meyrick

**bicincta** (Walsingham)

**cervinella** (Walsingham)

**corticella** (Walsingham)

**crinifera** (Walsingham)

**dispar** (Walsingham)

**distincta** (Walsingham)

**divaricata** (Walsingham)

**ferruginea** (Walsingham)

**gemmata** (Walsingham)

**glauc**a Meyrick

**gracillima** (Walsingham)

**graminicolor** (Walsingham)

**graminis** (Walsingham)

**herbarum** (Walsingham)

**inscripta** (Walsingham)

**irrorata** (Walsingham)

**lacerata** Meyrick

**latifasciata** (Walsingham)

**mauii** (Walsingham)

**nigromaculata** (Walsingham)

**nigronotata** (Walsingham)

**olivaceonitens** (Walsingham)

**piperatella** (Walsingham)

**plumbeonitida** (Walsingham)

**punctulata** (Walsingham)

**pusilla** (Walsingham)

**pygmaeella** (Walsingham)  
**saurates** Meyrick  
**semitogata** (Walsingham)  
**solutella** (Walsingham)  
**subolivacea** (Walsingham)  
**subumbrata** (Walsingham)  
**tincta** (Walsingham)  
**togata** (Walsingham)  
**trigononotata** (Walsingham)  
**viridis** (Walsingham)  
**new species 1**  
**new species 2**  
**new species 3**  
**new species 4**  
**new species 5**  
**new species 6**  
**new species 7**  
**new species 8**  
**new species 9**  
**new species 10**

Family ALUCITIDAE (Linnaeus)

Genus **ALUCITA** (Linnaeus)

**objurgatella** (Walsingham)

Superfamily GELECHIOIDEA (Stainton)

Family SCYTHRIDIDAE (Staudinger and Rebel)

Genus **MAPSIDIUS** Walsingham

**auspicata** Walsingham  
**charpentierii** Swezey  
**chenopodii** Swezey  
**iridescent** Walsingham  
**quadridentata** Walsingham

Family AGONOXENIDAE Meyrick

Genus **AGONOXENA** Meyrick

**argaula** Meyrick

## Family CYCNODIIDAE Busck

Genus **SWEZEYULA** Zimmerman and Bradley**lonicerae** Zimmerman and Bradley

## Family GELECHIIDAE Stainton

## Subfamily OECOPHORINAE (Stainton)

Genus **ENDROSIS** Hübner**sarcitrella** (Linnaeus)

## Subfamily ETHMIINAE (Busck)

Genus **ETHMIA** Hübner**nigroapicella** (Saalmüller)

## Subfamily XYLORYCTINAE (Meyrick)

Genus **THYROCOPA** Meyrick**abusa** Walsingham**new species** from Nihoa**acetosa** Meyrick**adumbrata** Walsingham**albonubila** Walsingham**alterna** Walsingham**apatela** (Walsingham)**argentea** (Butler)**brevipalpis** (Walsingham)**cinerella** Walsingham**criminosa** Meyrick**decipiens** (Walsingham)**depressariella** Walsingham**epicapna** (Meyrick)**fraudulentella** Walsingham**geminipuncta** Walsingham**gigas** (Butler)**immutata** Walsingham**indecora** (Butler)**inermis** Walsingham**ingeminata** Meyrick**leonina** Walsingham

**librodes** Meyrick  
**mediomaculata** Walsingham  
**megas** Walsingham  
**minor** Walsingham  
**nubifer** Walsingham  
**pallida** Walsingham  
**peleana** Swezey  
**phycidiformis** (Walsingham)  
**pulverulenta** Walsingham  
**sapindiella** Swezey  
**seminatella** Walsingham  
**spilobathra** Meyrick  
**subahenea** Walsingham  
**sucosa** Meyrick  
**tessellatella** Walsingham  
**usitata** (Butler)  
**vagans** (Walsingham)  
**viduella** Walsingham

Subfamily BLASTOBASINAE Walsingham

Genus **BLASTOBASIS** Zeller

**inana** (Butler)

Subfamily CHRYSOPELEIINAE (Mosher)

Genus **ITHOME** Chambers

**concolorella** (Chambers)

Subfamily MOMPHINAE (Hübner)

Genus **CHEDRA** Hodges

**microstigma** (Walsingham)

**mimica** Zimmerman

Genus **BATRACHEDRODES** Zimmerman

**bedelliella** (Walsingham)

**ephelus** (Walsingham)

**lomentella** (Walsingham)

**sophroniella** (Walsingham)

**supercincta** (Walsingham)

**syrraphella** (Walsingham)

## Subfamily COSMOPTERIGINAE (Wocke)

Genus **TRISSODORIS** Meyrick**honorariella** (Walsingham)Genus **ANATRACHYNTIS** Meyrick**badia** (Hodges)**incertulella** (Walker)**rileyi** (Walsingham)Genus **ASYMPHORODES** Meyrick**dimorpha** (Busck)**triaula** (Meyrick)Genus **HYPOSMOCOMA** ButlerSubgenus **EUPERISSUS** (Butler)**adelphella** Walsingham**adolescens** Walsingham**agnetella** (Walsingham)**albocinerea** (Walsingham)**alticola** Meyrick**anthinella** (Walsingham)**argentea** Walsingham**argomacha** Meyrick**argyresthiella** (Walsingham)**arundinicolor** (Walsingham)**aspersa** (Butler)**auroargentea** Walsingham**barbata** Walsingham**basivittata** (Walsingham)**bitincta** (Walsingham)**brevistrigata** Walsingham**caecinervis** Meyrick**catapyrrha** (Meyrick)**centralis** Walsingham**centronoma** Meyrick**chilonella chilonella** Walsingham**chilonella percondita** Walsingham**chilonella triocellata** Walsingham**chilonella venosa** Walsingham**chloraula** Meyrick**cleodorella** (Walsingham)**columbella** (Walsingham)



**complanella** (Walsingham)  
**confusa** (Walsingham)  
**coprosmae** (Swezey)  
**corticicolor** (Walsingham)  
**cristata** (Butler)  
**cryptogamiella** (Walsingham)  
**cuprea** (Walsingham)  
**diffusa** (Walsingham)  
**digressa** (Walsingham)  
**discolor** Walsingham  
**divergens** (Walsingham)  
**dorsella** Walsingham  
**ekaha** Swezey  
**elegans** (Walsingham)  
**eleuthera** (Walsingham)  
**emendata** Walsingham  
**empetra** (Meyrick)  
**enixa** Walsingham  
**ensifer** Walsingham  
**epicharis** Walsingham  
**erebogramma** (Meyrick)  
**erismatias** Meyrick  
**exaltata** (Walsingham)  
**exornata** Walsingham  
**exsul** (Walsingham)  
**falsimella** Walsingham  
**ferruginea** (Swezey)  
**flavicosta** (Walsingham)  
**fluctuosa** (Walsingham)  
**fractivittella** Walsingham  
**fugitiva** (Walsingham)  
**fulvida** Walsingham  
**fulvocervina** Walsingham  
**fulvogrisea** (Walsingham)  
**fuscodentata** (Walsingham)  
**fuscofusa** (Walsingham)  
**fuscopurpurata** Zimmerman  
**hirsuta** (Walsingham)  
**homopyrrha** (Meyrick)  
**humerella** (Walsingham)  
**incongrua** (Walsingham)  
**inflexa** Walsingham  
**insinuatrix** Meyrick

**jugifera** Meyrick  
**kauaiensis** (Walsingham)  
**new species 14**  
**latiflua** Meyrick  
**lichenalis** (Walsingham)  
**lignicolor** (Walsingham)  
**limata** Walsingham  
**longitudinalis** Walsingham  
**new species 21**  
**lugens** Walsingham  
**lunifer** Walsingham  
**mactella** (Walsingham)  
**maestella** Walsingham  
**malacopa** Meyrick  
**margella** (Walsingham)  
**mediocris** (Walsingham)  
**mormopica** (Meyrick)  
**municeps** (Walsingham)  
**mystodoxa** Meyrick  
**nemo** (Walsingham)  
**nemoricola** (Walsingham)  
**nigrodentata** Walsingham  
**ningorella** (Walsingham)  
**ningorifera** (Walsingham)  
**nipholoncha** Meyrick  
**niveiceps** Walsingham  
**obliterata** Walsingham  
**obscura** Walsingham  
**ocellata** Walsingham  
**ochreovittella** Walsingham  
**oculifera** Walsingham  
**ossea** Walsingham  
**pallidipalpis** Walsingham  
**palmifera** (Meyrick)  
**palmivora** Meyrick  
**paltodorella** (Walsingham)  
**passerella** (Walsingham)  
**petalifera** (Walsingham)  
**petroptilota** (Walsingham)  
**phantasmatella** Walsingham  
**philocharis** (Meyrick)  
**pittospori** (Swezey)  
**plumbifer** (Walsingham)

**pluviella** (Walsingham)  
**poeciloceras** (Walsingham)  
**polia** (Walsingham)  
**prae fracta** (Meyrick)  
**pritchardiae** (Swezey)  
**psaroderma** (Walsingham)  
**pucciniella** Walsingham  
**puncticiliata** (Walsingham)  
**punctifumella** Walsingham  
**quadripunctata** Walsingham  
**quadristriata** Walsingham  
**radiatella** Walsingham  
**rediviva** (Walsingham)  
**repandella** (Walsingham)  
**roseofulva** Walsingham  
**rotifer** (Walsingham)  
**rusius** Walsingham  
**rutilella** (Walsingham)  
**sagittata** (Walsingham)  
**scandens** Walsingham  
**scepticella** Walsingham  
**sciurella** (Walsingham)  
**semifuscata** Walsingham  
**semiusta** (Walsingham)  
**sideroxyloni** (Swezey)  
**sordidella** (Walsingham)  
**spurcata** (Walsingham)  
**stigmatella** Walsingham  
**subargentea** Walsingham  
**subaurata** (Walsingham)  
**subburnea** (Walsingham)  
**sublimata** Walsingham  
**subnitida** Walsingham  
**subocellata** (Walsingham)  
**subsericea** Walsingham  
**new species 29**  
**sudorella** Walsingham  
**terminella** (Walsingham)  
**thermoxyla** Meyrick  
**tigrina** (Butler)  
**tischeriella** (Walsingham)  
**trichophora** (Walsingham)  
**tricincta** Walsingham

**trilunella** Walsingham  
**trivitella** (Swezey)  
**unicolor** (Walsingham)  
**veterella** (Walsingham)  
**vicina** Walsingham  
**new species 35**

Subgenus **HYPOSMOCOMA** Butler, *sensu stricto*

**abjecta** (Butler)  
**adjacens** (Walsingham)  
**admirationis** Walsingham  
**advena** Walsingham  
**albifrontella** Walsingham  
**albonivea** Walsingham  
**alliterata** Walsingham  
**alveata** (Meyrick)  
**anisoplecta** Meyrick  
**arenella** Walsingham  
**argentifera** (Walsingham)  
**atrovittella** Walsingham  
**auripennis** (Butler)  
**auropurpurea** Walsingham  
**bacillella** Walsingham  
**bella** Walsingham  
**belophora** Walsingham  
**bilineata** Walsingham  
**blackburnii** Butler  
**new species 1**  
**new species 2**  
**new species 3**  
**new species 4**  
**new species 5**  
**new species 6**  
**new species 7**  
**butalidella** Walsingham  
**calva** Walsingham  
**candidella** (Walsingham)  
**new species 8**  
**new species 9**  
**new species 10**  
**canella** Walsingham  
**carbonenotata** Walsingham  
**carnea** Walsingham  
**cincta** Walsingham

**cinereosparsa** Walsingham  
**commensella** Walsingham  
**communis** (Swezey)  
**conditella** Walsingham  
**new species 11**  
**continuella** Walsingham  
**coruscans** (Walsingham)  
**corvina** (Butler)  
**new species 12**  
**costimaculata** Walsingham  
**crossotis** Meyrick  
**cupreomaculata** Walsingham  
**discella** Walsingham  
**divisa** Walsingham  
**domicolens** (Butler)  
**elegantula** (Swezey)  
**empedota** Meyrick  
**endryas** Meyrick  
**evanescens** Walsingham  
**fallacella** Walsingham  
**ferricolor** Walsingham  
**fervida** Walsingham  
**filicivora** Meyrick  
**flavipalpis** (Walsingham)  
**fractinubella** Walsingham  
**fractistriata** Walsingham  
**new species 13**  
**fuscopurpurea** Walsingham  
**fuscotogata** Walsingham  
**geminella** Walsingham  
**genitalis** Walsingham  
**haleakalae** (Butler)  
**hemicasis** Meyrick  
**humero vittella** Walsingham  
**hygroscopa** Meyrick  
**illuminata** Walsingham  
**impunctata** Walsingham  
**indicella** Walsingham  
**intermixta** Walsingham  
**inversella** Walsingham  
**iodes** Walsingham  
**irregularis** Walsingham  
**lacertella** Walsingham  
**lactea** Walsingham

**lacticretella** Walsingham  
**lebetella** Walsingham  
**leporella** Walsingham  
**lignivora** (Butler)  
**new species 15**  
**new species 16**  
**new species 17**  
**lineata** Walsingham  
**liturata** Walsingham  
**new species 18**  
**lixiviella** Walsingham  
**new species 19**  
**longisquamella** (Walsingham)  
**new species 20**  
**lucifer** Walsingham  
**ludificata** Walsingham  
**lupella** Walsingham  
**malornata** Walsingham  
**new species 22**  
**marginenotata** Walsingham  
**mediella** Walsingham  
**mediospurcata** Walsingham  
**mesorectis** Meyrick  
**metallica** Walsingham  
**metrosiderella** Walsingham  
**mimema** Walsingham  
**new species 23**  
**mimica** Walsingham  
**modesta** Walsingham  
**montivolans** (Butler)  
**nebulifera** Walsingham  
**neckerensis** (Swezey)  
**nephelodes** Walsingham  
**niger** Walsingham  
**nigralbida** Walsingham  
**nigrescens** Walsingham  
**nividorsella** Walsingham  
**notabilis** Walsingham  
**numida** Walsingham  
**ochreocervina** Walsingham  
**ochreociliata** Walsingham  
**oxypetra** Meyrick  
**paradoxa** Walsingham

**new species 24****parda** (Butler)**partita** Walsingham**patriciella** Walsingham**persimilis** Walsingham**petroscia** Meyrick**phalacra** Walsingham**pharsotoma** Meyrick**picticornis** Walsingham**new subspecies? of picticornis****progressa** Walsingham**prophantis** Meyrick**propinqua** Walsingham**pseudolita** Walsingham**punctiplicata** Walsingham**quinquemaculata** Walsingham**rhabdophora** Walsingham**rubescens** Walsingham**sabulella** Walsingham**saccophora** Walsingham**new species 25****new species 26****new species 27****new species 28****saliaris** Walsingham**scapulella** (Walsingham)**schismatica** Walsingham**scolopax** Walsingham**semicolon** (Walsingham)**semifusa** (Walsingham)**sideritis** Walsingham**similis** Walsingham**somatodes** Walsingham**straminella** Walsingham**subcitrella** Walsingham**subflavidella** Walsingham**subscolopax** Walsingham**suffusa** (Walsingham)**suffusella** (Walsingham)**new species 30****new species 31****swezeyi** (Busck)**new species 32****syrrhaptēs** Walsingham

**tarsimaculata** Walsingham  
**tenuipalpis** Walsingham  
**tetraonella** Walsingham  
**thiatma** Meyrick  
**new species 33**  
**new species 34**  
**thoracella** Walsingham  
**tomentosa** Walsingham  
**torella** Walsingham  
**torquata** Walsingham  
**trifasciata** (Swezey)  
**trimaculata** Walsingham  
**trimelanota** Meyrick  
**tripartita** Walsingham  
**triptila** Meyrick  
**trossulella** Walsingham  
**turdella** Walsingham  
**unistriata** Walsingham  
**vermiculata** Walsingham  
**vinicolor** Walsingham  
**virgata** Walsingham

Subfamily GELECHIINAE (Stainton)

Genus **OECIA** Walsingham

**oecophila** (Staudinger)

Genus **DICHOMERIS** Hübner

**acuminatus** (Staudinger)

Genus **TRICHOTAPHE** Clemens

**aenigmatica** Clarke

Genus **CRASIMORPHA** Meyrick

**infuscata** Hodges

Genus **PHTHORIMAEA** Meyrick

**operculella** (Zeller)

Genus **KEIFERIA** Busck

**lycopersicella** (Walsingham)



Genus **SITOTROGA** Heinemann

**cerealella** (Olivier)

Genus **PECTINOPHORA** Busck

**gossypiella** (Saunders)

**scutigera** (Holdaway)

Genus **MERIMNETRIA** Walsingham

Subgenus **ARISTOTELIODES** Zimmerman

**arcuata** (Walsingham)

**compsodelta** (Meyrick)

**elegantior** (Walsingham)

**epermeniella** (Walsingham)

**gigantea** (Swezey)

**gratula** (Meyrick)

**homoxyla** (Meyrick)

**ichthyochroa** (Walsingham)

**lanaiensis** (Walsingham)

**maculaticornis** (Walsingham)

**mendax** (Walsingham)

**multiformis** (Meyrick)

**nigriciliella** (Walsingham)

**notata** (Walsingham)

**thurifica** (Meyrick)

**xylospila** (Meyrick)

**new species 1**

**new species 2**

**new species 3**

Subgenus **MERIMNETRIA** Walsingham

**flaviterminella** Walsingham

**straussiella** (Swezey)

Genus **AUTOSTICHA** Meyrick

**pelodes** (Meyrick)

Genus **STOEBERHINUS** Butler

**testaceus** Butler

## SUMMARY OF THE NOMENCLATORIAL CHANGES MADE IN THIS VOLUME

### TINEIDAE

*Crypsithyroides* Zimmerman, new genus, is erected (type-species: *Blabophanes obumbrata* Butler, 1881:396).

*Monopis obumbrata* (Butler, 1881:396, *Blabophanes*) is transferred to *Crypsithyroides*.

*Crypsithyris sladeni* Bradley, 1957:111, is a new synonym of *Crypsithyroides obumbrata* (Butler) Zimmerman.

*Tineola walsinghami* Busck, 1934:188, is a new synonym of *Phereoeca allutella* (Rebel).

*Tinea pachyspila* Meyrick, 1905:619, is a new synonym of *Phereoeca allutella* (Rebel, 1892:270), and a lectotype is designated.

*Neodecadarchis* Zimmerman, new genus, is erected (type-species: *Ereunetis flavistriata* Walsingham, 1907b:716).

*Ereunetis flavistriata* Walsingham, 1907b:716, is transferred to *Neodecadarchis*.

*Lepidobregma* Zimmerman, new genus, is erected (type-species: *Ereunetis minuscula* Walsingham, 1897b:155).

*Decadarchis minuscula* (Walsingham, 1897b:155, *Ereunetis*) is transferred to *Lepidobregma*.

*Pantheus* Zimmerman, new genus, is erected (type-species: *Ereunetis penicillata* Swezey, 1909d:13).

*Ereunetis penicillata* Swezey, 1909d:13, is transferred to *Pantheus*.

*Ereunetis kerri* Swezey, 1926b:77, is transferred to *Decadarchis*.

*Ereunetis incerta* Swezey, 1926b:77, is a new synonym of *Decadarchis kerri* Swezey.

*Mecomodica* Zimmerman, new genus, is erected (type-species: *Comodica fullawayi* Swezey, 1926b:77).

*Comodica fullawayi* Swezey, 1926b:77, is transferred to *Mecomodica*.

The subfamily name Setomorphinae Walsingham, 1891:81, is resurrected.

Hieroxestinae, new status for Hieroxestides Meyrick, 1893:478.

### TORTRICIDAE

### TORTRICINAE

*Croesia zimmermani* Clarke, new species, is described.

*Capua argentinotata* (Walsingham, 1907b:711, *Epagoge?*); *cassia* Swezey, 1912:183; *flavocincta* Walsingham, 1907b:704; *flavopicta* Walsingham, 1907b:703; *infaustana* (Walsingham, 1907b:709, *Epagoge*); *oheoheana* Swezey, 1933:301; *pernitida* (Walsingham, 1907b:710, *Epagoge?*); *pterotropiana* Swezey, 1933:301; *reynoldsiana* Swezey, 1920b:384; and *xanthogona* (Walsingham, 1907:710, *Epagoge?*) are transferred to *Spheterista* Meyrick.

*Capua santalata* Swezey, 1913f:276, is a new synonym of *Spheterista flavocincta* (Walsingham).

*Spheterista castaneana* (Walsingham, 1907b:705, *Capua*) is a new synonym of *Spheterista pleonectes* (Walsingham).

*Spheterista asaphopis* Meyrick, 1928c:96, is a new synonym of *Spheterista pleonectes* (Walsingham).

*Eulia capucina* (Walsingham, 1907b:701, *Tortrix*?); *chlorippa* Meyrick, 1928c:98; *dermatopa* Meyrick, 1928c:96; *falerniana* (Walsingham, 1907:701, *Tortrix*?); *fuscoviridis* (Walsingham, 1907b:693, *Archips*); *leopardella* Walsingham, 1907b:692; *leucostichas* Meyrick, 1932:258; *lichenoides* (Walsingham, 1907b:694, *Archips*?); *longiplicata* (Walsingham, 1907b:691, *Archips*); *lysimachiae* Swezey, 1933b:302; *notocosma* Meyrick, 1928c:97; *punctiferana* (Walsingham, 1907b:692); *pyncnomias* Meyrick, 1928c:97; *subsenescens* (Walsingham, 1907b:695, *Archips*?); and *trochilidana* (Walsingham, 1907b:693, *Archips*) are transferred to *Pararrhaptica* Walsingham.

*Archips fuscocinereus* Swezey, 1913f:275, and *sublichenoides* Swezey, 1913f:276, are transferred to *Pararrhaptica* Walsingham.

*Tortrix lysimachiana* Swezey, 1946:626, is transferred to *Pararrhaptica* Walsingham.

*Paraphasis* Walsingham, 1907b:730, is transferred from the Tineidae to the Tortricidae, Tortricinae.

*Mantua* Zimmerman, new genus, is erected (type-species: *Dipterina fulvosericata* Walsingham, 1907b:697).

*Bradleyella* Zimmerman, new genus, is erected (type-species: *Tortrix chlorocalla* Walsingham, 1907b:699).

*Eulia chlorocalla* (Walsingham, 1907b:699, *Tortrix*); *metallurgica* (Walsingham, 1907b:699; *Tortrix*); and *thoracina* (Walsingham, 1907b:700, *Tortrix*) are transferred to *Bradleyella* Zimmerman.

*Tortrix phyllanthana* Swezey, 1940b:462, and *semicinereana* Swezey, 1913f:276, are transferred to *Bradleyella* Zimmerman.

## OLETHREUTINAE

*Epagoge osteomelesana* Swezey, 1946:626, is transferred to *Eccoptocera* Walsingham.

*Adenoneura* Walsingham, 1907b:677, is reduced to a new synonym of *Cydia* Hübner.

*Adenoneura conspicua* (Walsingham, 1907b:648, *Enarmonia*?); *falsifalcellum* Walsingham, 1907:677; *gypsograptia* Meyrick, 1932:222; *latifemoris* Walsingham, 1907b:679; *montanum* Walsingham, 1907b:679; *obliqua* (Walsingham, 1907b:686, *Enarmonia*?); *parapteryx* Meyrick, 1932:222; *plicatum* Walsingham, 1907b:678; *rustipennis* (Butler, 1881:395, *Phoxopteryx*); and *storeella* (Walsingham, 1907b:686, *Enarmonia*?) are transferred to *Cydia* Hübner.

*Enarmonia crassicornis* Walsingham, 1907b:685, is transferred to *Cydia* Hübner.

*Laspeyresia chlorostola* Meyrick, 1932:226, is transferred to *Cydia* Hübner.

*Crocidosema blackburnii* (Butler, 1881:393, *Proteopteryx*) is removed from the synonymy of *Crocidosema plebejana* Zeller to full species status.

*Gysonoma leprarum* Walsingham, 1907b:676, is transferred to *Crocidosema*.

*Episimus utilis* Zimmerman, new species, is described.

**GRACILLARIIDAE**

- Parectopa mabaella* (Swezey, 1910a:89, *Gracilaria*) is transferred to *Caloptilia*.  
 Subgenus *Eophilodoria* Zimmerman is erected in *Philodoria* (type-species: *Gracilaria marginestrigata* Walsingham, 1907b:721).  
*Parectopa dubauticola* Swezey, 1940b:463; *dubautiella* (Swezey, 1913f:278, *Gracilaria*); *epibathra* (Walsingham, 1907b:722, *Gracilaria*); *haucicola* (Swezey, 1910d:106, *Gracilaria*); *hibiscella* (Swezey, 1913f:279, *Gracilaria*); *lipochaetaella* Swezey, 1940b:464; *marginestrigata* (Walsingham, 1907b:721, *Gracilaria*); *naenaeiella* Swezey, 1940b:462; *neraudicola* (Swezey, 1920b:385, *Gracilaria*); *nigrella* Walsingham, 1907b:721; *nigrelloides* Swezey, 1946:628; *pittosporella* Swezey, 1928d:189; *sciallactis* Meyrick, 1928c:104; *touchardiella* Swezey, 1928d:189; *ureraella* (Swezey, 1915e:94, *Gracilaria*); and *urerana* (Swezey, 1915e:95, *Gracilaria*) are all transferred to *Eophilodoria*.  
*Parectopa lipochaetae* Swezey, 1946:627, is a new synonym of *Philodoria* (*Eophilodoria*) *lipochaetaella* (Swezey, 1940b:464).  
*Elachista spilota* Walsingham, 1907b:513, is transferred to *Philodoria* (*Philodoria*).

**YPONOMEUTIDAE**

- Plutella albovenosa* Walsingham, 1907b:653, is a new synonym of *Plutella xylostella* (Linnaeus).  
*Acrolepia beardsleyi* Zimmerman, new species, is described.  
*Mapsidius* Walsingham, 1907b:650, is removed to the Scythrididae.

**CARPOSINIDAE**

- Carpósina nereitis* Meyrick, 1913b:75, is a new synonym of *Carpósina saurates* Meyrick.  
*Carpósina piperatella* (Walsingham), new combination, new status for *Heterocrossa corticella* variety *piperatella* Walsingham, 1907b:663.  
*Carpósina semitogata* (Walsingham), new combination, new status for *Heterocrossa corticella* variety *semitogata* Walsingham, 1907b:662.

**SCYTHRIDIDAE**

- Mapsidius* Walsingham, 1907b:650, is transferred from the Yponomeutidae to the Scythrididae.

**GELECHIIDAE**

The Oecophoridae, Ethmiidae, Xyloryctidae, Blastobasidae, Chrysopoleiidae, Momphidae, and Cosmopterigidae are each reduced to subfamily status within the Gelechiidae.

**XYLORYCTINAE**

- Hodegia* Walsingham, 1907b:488; *Ptychothrix* Walsingham, 1907b:489; *Psychra* Walsingham, 1907b:489; and *Catamempsis* Walsingham, 1907b:491, are all reduced to new synonyms of *Thyrocopa* Meyrick, 1883a:32.

*Hodegia apatela* Walsingham, 1907b:488; *Psychra brevipalpis* Walsingham, 1907b:490; *Psychra phycidiformis* Walsingham, 1907b:490; *Catamempsis decipiens* Walsingham, 1907b:491; and *Ptychothrix vagans* Walsingham, 1907b:489, are all transferred to *Thyrocopa*.

### BLASTOBASINAE

*Blastobasis explorata* Meyrick, 1918:158, is a new synonym of *Blastobasis inana* (Butler).

### MOMPHINAE

*Batrachedra microstigma* Walsingham, 1907b:510, is transferred to *Chedra*.

*Batrachedra cuniculator* Busck, 1914b:106, is a new synonym of *Chedra microstigma* (Walsingham).

*Chedra mimica* Zimmerman, new species, is described.

*Batrachedrodes* Zimmerman, new genus, is erected (type-species: *Batrachedra syrraphella* Walsingham).

*Batrachedra bedelliella* Walsingham, 1907b:509; *ephelus* Walsingham, 1907b:509; *lomentella* Walsingham, 1907b:511; *sophroniella* Walsingham, 1907b:511; *supercincta* Walsingham, 1907b:510; and *syrraphella* Walsingham, 1907b:509, are transferred to *Batrachedrodes*.

*Batrachedra ruficiliata* Walsingham, 1907b:510, is a new synonym of *Batrachedrodes sophroniella* (Walsingham).

### COSMOPTERIGINAE

*Diplosaridae* Meyrick, 1915:339; *Hypsmocomidae* Hampson, 1918:386; and *Hypsmocomini* Handlirsch, 1924:888, are all synonyms of Cosmopteriginae. *Trissodoris pansella* (Bradley), new status for *Trissodoris honorariella pansella* Bradley, 1957:100.

*Sathrobrotia* Hodges, 1962b:73, is a new synonym of *Anatrachyntis* Meyrick, 1915a:325.

*Sathrobrotia badia* Hodges, 1962b:76, and *rileyi* (Walsingham, 1882:198, *Batrachedra*) are transferred to *Anatrachyntis*.

*Pyroderces incertulella* (Walker, 1864a:658, *Gelechia*) is transferred to *Anatrachyntis*.

*Petrochroa dimorpha* Busck, 1914b:105, and *Aphthonetus triaula* Meyrick, 1935a:63, are transferred to *Asymphorodes*.

*Euperissus* Butler, 1881:401, is reduced to a subgenus of *Hypsmocomia*.

*Diplosara* Meyrick, 1883a:35; *Agonismus* Walsingham, 1907b:512; *Aphthonetus* Walsingham, 1907b:517; *Rhinomactrum* Walsingham, 1907b:531; *Neelysia* Walsingham, 1907b:533; *Dysphoria* Walsingham, 1907b:547; *Bubaloceras* Walsingham, 1907b:548; *Hyperdasysella* Fletcher, 1940:18 (= *Hyperdasys* Walsingham, 1907b:640, homonym); *Semnoprepia* Walsingham, 1907b:644; *Euhypsmocomia* Swezey, 1913f:277; *Petrochroa* Busck, 1914b:104; and *Phthoraula* Meyrick, 1935a:65, are all reduced to new synonyms of *Hypsmocomia* Butler, 1881:399.

*Agonismus argentiferus* Walsingham, 1907b:513; *coruscans* Walsingham, 1907b:513; and *flavipalpis* Walsingham, 1907b:512, are transferred to *Hypsmocomia*.

*Aphthonetus albocinerea* Walsingham, 1907b:527; *aspersa* (Butler, 1882:44, *Laverna*); *bitincta* Walsingham, 1907b:521; *columbella* Walsingham, 1907b:521; *confusa* Walsingham, 1907b:523; *corticicolor* Walsingham, 1907b:519; *diffusa* Walsingham, 1907b:527; *digressa* Walsingham, 1907b:522; *divergens* Walsingham, 1907b:520; *elegans* Walsingham, 1907b:530; *eleuthera* Walsingham, 1907b:522; *empetra* Meyrick, 1915a:339; *exsul* Walsingham, 1907b:526; *fluctuosa* Walsingham, 1907b:519; *fugitiva* Walsingham, 1907b:518; *hirsuta* Walsingham, 1907b:528; *humerebella* Walsingham, 1907b:528; *kauaiensis* Walsingham, 1907b:518; *lichenalis* Walsingham, 1907b:522; *mediocris* Walsingham, 1907b:517; *nemo* Walsingham, 1907b:526; *passerella* Walsingham, 1907b:520; *plumbifer* Walsingham, 1907b:524; *polia* Walsingham, 1907b:525; *prae fracta* Meyrick, 1935a:63; *puncticiliata* Walsingham, 1907b:529; *sagittata* Walsingham, 1907b:530; *sideroxyloni* Swezey, 1932:200; *spurcata* Walsingham, 1907b:523; *subocellata* Walsingham, 1907b:526; *trichophora* Walsingham, 1907b:524; and *veterella* Walsingham, 1907b:525, are transferred to *Hyposmocoma*.

*Bubaloceras pritchardiae* Swezey, 1933b:303, and *subeburneum* Walsingham, 1907b:549, are transferred to *Hyposmocoma*.

*Diplosara lignivora* (Butler, 1879b:273, *Scardia*) is transferred to *Hyposmocoma*.

*Dysphoria semicolon* Walsingham, 1907b:548, is transferred to *Hyposmocoma*.

*Elachista longisquamella* Walsingham, 1907b:514, is transferred to *Hyposmocoma*.

*Euhyposmocoma ekaha* (Swezey, 1910d:105, *Hyposmocoma*) is returned to *Hyposmocoma*, and *trivitella* Swezey, 1913f:278, is transferred to *Hyposmocoma*.

*Euperissus catapyrrha* Meyrick, 1935a:64, and *cristatus* Butler, 1881:402, are transferred to *Hyposmocoma*.

*Hyperdasyella arundinicolor* (Walsingham, 1907b:641, *Hyperdasys*); *cryptogamiella* (Walsingham, 1907b:642, *Hyperdasys*); *philocharis* (Meyrick, 1915a:344, *Hyperdasys*); *semiusta* (Walsingham, 1907b:640, *Hyperdasys*); and *unicolor* (Walsingham, 1907b:642, *Hyperdasys*) are transferred to *Hyposmocoma*.

*Neelysia agnetella* Walsingham, 1907b:538; *alveata* Meyrick, 1915a:339; *anthinella* Walsingham, 1907b:535; *argyresthiella* Walsingham, 1907b:544; *basivittata* Walsingham, 1907b:539; *cleodorella* Walsingham, 1907b:535; *complanella* Walsingham, 1907b:546; *cuprea* Walsingham, 1907b:532; *erebogramma* Meyrick, 1935a:64; *exaltata* Walsingham, 1907b:542; *fuscodentata* Walsingham, 1907b:534; *fuscofusa* Walsingham, 1907b:538; *incongrua* Walsingham, 1907b:546; *lignicolor* Walsingham, 1907b:533; *mactella* Walsingham, 1907b:545; *mormopica* Meyrick, 1935a:64; *municeps* Walsingham, 1907b:537; *nemicola* Walsingham, 1907b:544; *ningorella* Walsingham, 1907b:543; *ningorifera* Walsingham, 1907b:540; *palmifera* Meyrick, 1935a:63; *paltodorella* Walsingham, 1907b:537; *petalifera* Walsingham, 1907b:541; *pluviella* Walsingham, 1907b:540; *poeciloceras* Walsingham, 1907b:542; *psaroderma* Walsingham, 1907b:536; *rediviva* Walsingham, 1907b:543; *repandella* Walsingham, 1907b:536; *rotifer* Walsingham, 1907b:539; *sciurella* Walsingham, 1907b:546; *semifusa* Walsingham, 1907b:547; *subaurata* Walsingham, 1907b:541; *terminella* Walsingham, 1907b:547; *tigrina* (Butler, 1881:406, *Chrysoclista*); and *tischeriella* Walsingham, 1907b:545, are transferred to *Hyposmocoma*.

- Petrochroa communis* Swezey, 1946:627; *elegantula* Swezey, 1934:524; *neckerensis* Swezey, 1926b:78; *swezeyi* Busck, 1914b:105; and *trifasciata* Swezey, 1915e:97, are transferred to *Hypsmocoma*.
- Petrochroa nigrella* Swezey, 1940b:465, is a new synonym of *Hypsmocoma longisquamella* (Walsingham, 1907:514, "*Elachista*").
- Phthoraula homopyrrha* Meyrick, 1935a:65, is transferred to *Hypsmocoma*.
- Rhinomactrum rutellum* Walsingham, 1907b:531, and *scapulellum* Walsingham, 1907b:531, are transferred to *Hypsmocoma*.
- Semnoprepia coprosmae* Swezey, 1920b:382; *ferruginea* Swezey, 1915e:94; *fulvogrisea* Walsingham, 1907b:644; *fuscopurpurea* Swezey, 1915e:94; *margella* Walsingham, 1907b:645; *petroptilota* Walsingham, 1907b:645; and *pittospori* Swezey, 1920b:382, are transferred to *Hypsmocoma*.
- Hypsmocoma fuscopurpurata* Zimmerman, new name for *Hypsmocoma fuscopurpurea* (Swezey, 1915e:94, *Semnoprepia*), not of Walsingham, 1907b:582.
- Hypsmocoma adjacens* Walsingham, new status for *Hypsmocoma cincta* variety *adjacens* Walsingham, 1907b:567.
- Hypsmocoma candidella* Walsingham, new status for *Hypsmocoma lupella* variety *candidella* Walsingham, 1907b:564.
- Hypsmocoma flavicosta* Walsingham, new status for *Hypsmocoma exornata* variety *flavicosta* Walsingham, 1907b:551.
- Hypsmocoma scepticella dubia* Walsingham, 1907b:590, is a new synonym of *Hypsmocoma scepticella* Walsingham, 1907b:590.
- Hypsmocoma suffusa* Walsingham, new status for *Hypsmocoma domicolens* variety *suffusa* Walsingham, 1907b:563.
- Hypsmocoma suffusella* Walsingham, new status for *Hypsmocoma lupella* variety *suffusella* Walsingham, 1907b:564.
- Stagmatophora? sordidella* Walsingham, 1907b:516, is transferred to *Hypsmocoma*.

## GELECHIINAE

- Aristoteliodes*, new subgenus, is erected (type-species: *Aristotelia nigriciliella* Walsingham) within *Merimnetria* Walsingham, 1907b.
- Aristotelia arcuata* Walsingham, 1907b:482; *compsodelta* Meyrick, 1928:99; *elegantior* Walsingham, 1907b:481; *epermeniella* Walsingham, 1907b:480; *gigantea* Swezey, 1913:274; *gratula* Meyrick, 1928c:101; *homoxyla* Meyrick, 1928c:101; *ichthyochroa* Walsingham, 1907b:479; *lanaiensis* Walsingham, 1907b:481; *maculaticornis* Walsingham, 1907b:478; *mendax* Walsingham, 1907b:481; *multiformis* Meyrick, 1928c:101; *nigriciliella* Walsingham, 1907b:479; *notata* Walsingham, 1907b:480; *thurifica* Meyrick, 1928c:102; and *xylospila* Meyrick, 1928c:100, are transferred to *Aristoteliodes*.
- Aristotelia straussiella* Swezey, 1953:23, is transferred to *Merimnetria* Walsingham, 1907b, *sensu stricto*.
- Symmocini, new status for Symmocidae Gozmány, 1957:326.
- Dichomerini, new status for Dichomeridae Hampson, 1918:386.
- Chelariini, new status for Chelariinae Heslop, 1938:80.
- Aristoteliini, new status for Aristoteliinae Heslop, 1938:78.
- Autostichini, new status for Autostichinae LeMarchand, 1947:153.
- Metachandini, new status for Metachandidae Meyrick, 1911d:275.

## Order **LEPIDOPTERA**, continued from Volume 8

Families **OPOSTEGIDAE** through **GELECHIIDAE**

or

### **MICROLEPIDOPTERA**

The term Microlepidoptera, as usually used, has no phylogenetic significance; but its use is convenient for separating a large part of the order from the butterflies and groups of mostly larger moths such as the geometrids, noctuids, sphingids, and others. Many so-called Microlepidoptera are really large moths, but it is true that the majority of species assigned to the families constituting the Microlepidoptera are small to minute moths.

The term Microlepidoptera was originally used by German Lepidopterists about the middle of the last century as a literal translation of the much older, popular name, "Kleinschmetterlinge." It was used as a collective name for the five then recognized families of small moths: the Pyralids, the Tineids, the Tortricids, the Pterophorids and the Orneodids. At that time it was already recognized by leading workers, such as Zeller, Herrich-Schäffer and Stainton, that their division of the Lepidoptera into Macros and Micros was not a natural one, but this division has been retained in about the original sense even up to the present day in Germany.

Most modern students have discarded the name Microlepidoptera as untenable; first, because it is said to be a misnomer; second, because it could not be sharply defined as a natural group, if the original conception should be retained.

It is true that mere size does not make the distinction. Some large moths are included in the term, while many small Lepidoptera fall outside the conception. However, these exceptions form a small percentage of the whole and the bulk of the Microlepidoptera are truly micros in a literal sense.

The second objection, that the term is not definable as a natural group, is true if the original conception is strictly adhered to. The large Pyralid group has a quite separate origin from, and cannot properly be associated with, the rest of the Microlepidoptera, in the last century's sense. It has also been found that the *Ægeridæ* and the *Cossidæ*, which were originally classed as Macros, have their affinities with the Micros. But with these and a few other minor subtractions and additions the group becomes an undisputed natural one, and it seems unwise altogether to abandon such a long established, commonly used, descriptive name, which conveys a generally understood, even if not sharply defined conception. The term may conveniently be retained, if restricted to denote collectively the natural group of superfamilies considered in the present paper. This conception does not coincide with the term as used by Stainton and the other old authors, nor does it coincide with Hampson's and Dyar's superfamily *Tineoidæ*, differing from both mainly in the exclusion of the *Pyralidæ*, together with the smaller families of *Pyralid* origin.

The systematic arrangement of the Microlepidoptera has progressed along much the same lines as that of the other groups of insects from the time of Linnæus to the present day. It has developed from a system founded on external, easily observed characters, such as color and outline, to one founded on structure.

From Linnæus up through the illustrious series of old world scientists who worked with this group of insects, Fabricius, Schiffermüller, Ochsenheimer, Treitschke, Hübner, Haworth, Curtis, Stephens, Latreille, Duponchel, Guenée, and others, color and pattern, together with the form of wings, antennæ and palpi, were the main characters used for generic differentiation.

Herrich-Schäffer was the first to realize the systematic value of wing venation and his monumental work, *Die Schmetterlinge von Europa*, must be regarded as the cornerstone for the modern classification of Lepidoptera. So far in advance of its period was this work that very few contemporaneous and subsequent students realized it as anything but a laborious curiosity. There was a certain wondering admiration for it, but no actual belief in its practical value and no desire to go to the trouble of using it. Even such an enthusiastic student as Stainton took no pains to go into the subject, though he probably realized its eventual value. He had his artist make most careful plates of wing venation for his *Insecta Britannica*, but neither here nor in his later works, did he ever use the venation in his generic tables of definition.

Neither did Zeller and Walker take much advantage of Herrich-Schäffer's good work, but continued to make genera on "obvious" characters; among which they and others naturally included secondary male sexual characters, a procedure which has unfortunately been followed up to a quite recent time.



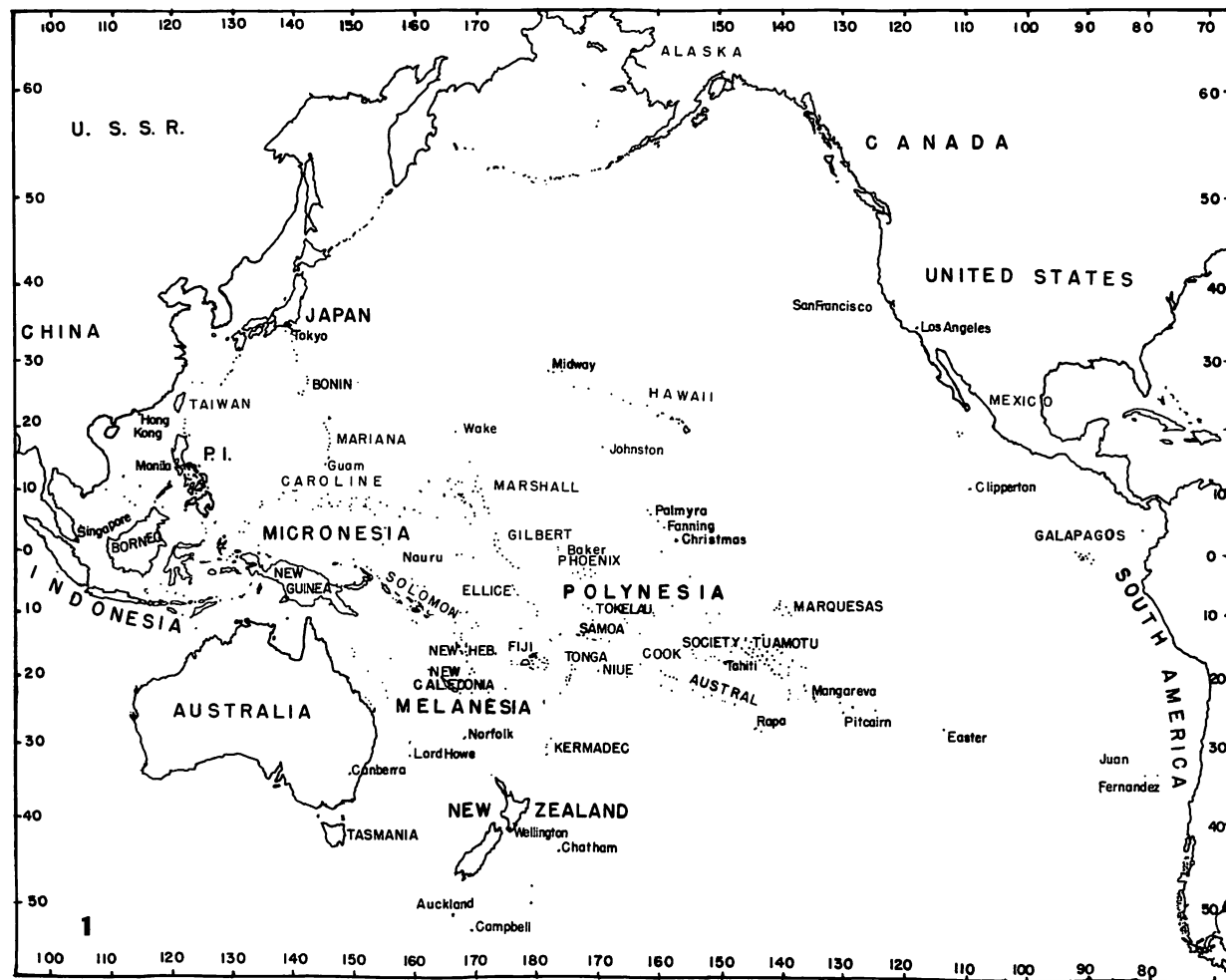


Figure 1—The Pacific Ocean area. (Map by E. H. Bryan, Jr., Bishop Museum.)

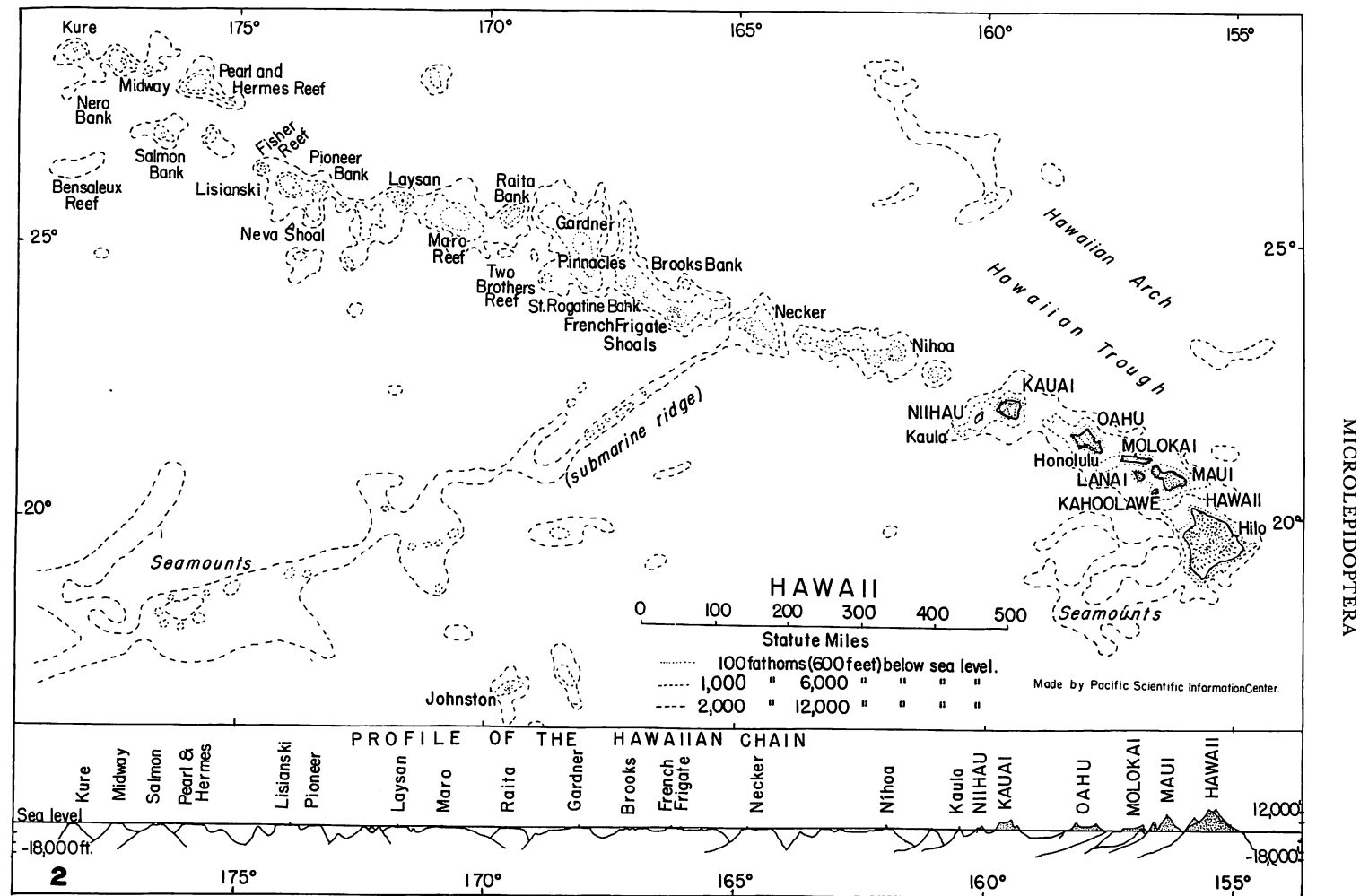


Figure 2—The Hawaiian archipelago. (Map by E. H. Bryan, Jr., Bishop Museum. For St. Rogatine, read St. Rogatien.)

Heinemann, Lederer and Wocke followed Herrich-Schäffer's lead, but without advancing beyond his recognition of the venation as an aid to classification, and they and other workers of the period continued to be influenced by Zeller, who was the object of a cult entirely out of proportion to his merits as a systematist.

Our American pioneers in the Microlepidoptera, Brackenridge-Clemens, and in a less degree, Chambers, had a keen appreciation of the value of wing venation as a generic character and drew, for example, far more advantage from Stainton's plates than did Stainton himself.

Walsingham began his career as a Microlepidopterist as a disciple of Stainton and Zeller and his earlier work shows the effect. In his later working years, he realized the fallacies of this system and consigned many of his earlier genera to the synonymy, continuing his work together with Durrant, on sounder lines.

To Herrich-Schäffer and his followers the characters of the venation were merely a means of classification. They found that groups of species, which had been associated in genera on other characters, agreed in venation and that this character was more dependable than most of those which had hitherto been used. There was, as yet, no science of phylogeny and no continuity in the arrangement of the genera.

It was not until Darwin's theory of evolution had been advanced, that the time was ripe for the realization of the full importance of wing venation as indicative of phylogenetic relationship and many years passed without the application of this principle.

It remained for Edward Meyrick first to apply Darwin's theories to the study of Microlepidoptera, and, with the aid of modern morphological studies, to grasp the possibilities of the wing venation as a means of recognizing natural relationship and lines of development. His ingenious rearrangement of the Microlepidoptera along natural evolutionary lines revolutionized the study of this group and has resulted in a sound appreciation of their mutual relationship and an undoubtedly nearly natural grouping of these insects.

Similar masterful studies of the lepidopterous wing venation with similar good results were made independently in Germany by Arnold Spuler and in America by Comstock. To them is due, among other things, the important discovery of the fundamental significance of the clavus, or as it is better known in this country by Comstock's somewhat later name, the jugum, a small projection from the base of the fore-wing which serves to hold the two wings together in the primitive groups of Lepidoptera, the Micropterygidae and the Hepialidae. (Busck, 1914a:46-48.)

The primitive suborders Zeugloptera (Micropterigidae) and Dacnonypha (Eriocraniidae, Mnesarchaeidae, Neopseustidae, Agathiphagidae) are not represented in the Hawaiian fauna. The third suborder, the Monotrysia, is represented by endemic species only by the supposedly widely distributed genus *Opostega*, and the interesting groups Hepialoidea and Incurvarioidae are not native to Hawaii (but an American representative of the Incurvarioidae may have recently become accidentally established). Excepting the *Opostega* representatives of the Monotrysia, all of the endemic Hawaiian Microlepidoptera belong to the suborder Ditrysia, and the Hawaiian lepidopterous fauna does not contain a truly primitive section. *Opostega* probably colonized Hawaii in rather recent geological time—possibly not until late Pliocene or even Pleistocene time. Nothing in the Hawaiian lepidopterous fauna appears to indicate an age older than Tertiary. All of the present Hawaiian moth fauna could be late Tertiary (Pliocene-Pleistocene) in origin, although some of the genera may be derived from ancestral forms which may date back as far as to the Miocene. I am rather surprised, however, that none of the Hawaiian genera necessarily appear to have sprung from groups as old as the Miocene. The present derived fauna is obviously a geologically young one, and, although I consider it largely Pliocene in origin, almost any part of it might possibly have sprung from Pleistocene ancestral immigrants which arrived by accident from the surrounding land areas. The high Boreal content is significant.

## ANALYSIS AND DERIVATION OF THE HAWAIIAN MICROLEPIDOPTERA

The microlepidopterous faunas of the world are so poorly known, and there are so many erroneous generic and family assignments, that most attempts to reach conclusions regarding distributions, relationships, and derivations of faunas are doomed to failure before they are begun. Much that has been written concerning the zoogeography of the Microlepidoptera is misleading, false, or utter rubbish; with the classification in such chaos the situation cannot be otherwise. It is not unreasonable to say that much, if not most, of the published work on the Microlepidoptera requires redoing. I need only cite the fact that Meyrick alone described over 14,000 species of Microlepidoptera, and almost all of them must eventually be restudied, redescribed, and figured (witness the huge work recently published by the British Museum on parts of the Meyrick collection, following studies by J. F. Gates Clarke (Clarke, 1955, 1958, 1963, 1965a, 1969a, b, 1970), in an attempt to make some of the Meyrick work understandable).

When I wrote my preliminary summary of the Lepidoptera in the section on analyses of the biota for the introductory volume of *Insects of Hawaii* (1948: 76–77), I said: “This review has revealed to me that chaos exists in the classification of the Lepidoptera. The Hawaiian group is in great confusion and is most difficult to work with in its present state. There are many erroneous generic and family assignments. Often none of several authors who have worked upon a particular group agree upon the position or relationships of the included insects. There appear to be numbers of misidentifications. Some of the published material is useless for the purpose of this paper because of errors and omissions.” I can now say that those seemingly strong statements were, in reality, mild. Had I known that the situation was as bad as it was, I would not have presented my analysis of the Hawaiian Lepidoptera. As it stands, that 1948 analysis is mostly erroneous, and it should not have been published. I refer my readers to the revised analyses in Volumes 7 and 8, and this volume, and call their attentions to the revised nomenclature introduced in these volumes. Unhappily, it is too soon to give an adequate review of the relationships and derivations of the microlepidopterous fauna of the Hawaiian Islands, because our knowledge of the surrounding areas is too incomplete to enable such a survey to be made. Our ignorance remains formidable. More chaos exists in the taxonomy of the Lepidoptera of the world than in any other order of insects.

Perhaps the most striking feature revealed by the tabulation of the endemic Hawaiian Microlepidoptera is the fact that, without the aid of man, representatives of only eight families succeeded in crossing the open ocean and permanently establishing themselves in Hawaii during the several million years which the islands have been available for colonization. A noteworthy characteristic of the fauna is the absence of the primitive groups of Lepidoptera. There are no representatives of the Eriocraniidae, Micropterygidae, or Hepialidae—the primitive Jugatae of some authors. Another unusual feature is the absence of many families so well-known on the continents. The large subfamily Oecophorinae, which is strongly developed in America, Australia,

FIGURE 3  
TABULAR ANALYSIS OF THE HAWAIIAN MICROLEPIDOPTERA

FAMILY	TOTAL GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	TOTAL SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Opostegidae	1	0	1	6	6	0
Incurvariidae	1	0	1	1	0	1
Tineidae	19	0	19	25	0	25
Tortricidae	18	8	10	84	74	10
Gracillariidae	3	1	2	32	30	2
Bucculatricidae	1	0	1	1	0	1
Lyonetiidae	1	0	1	13	12	1?
Yponomeutidae	3	0	3	14	12	2
Schreckensteiniidae	1	0	1	1	0	1
Pterophoridae	5	0	5	7	0	7
Carposinidae	1	0	1	49	49	0
Alucitidae	1	0	1	1	0	1
Scythrididae	1	1	0	5	5	0
Agonoxenidae	1	0	1	1	0	1
Cynodiidae	1	0	1	1	0	1
Gelechiidae						
Oecophorinae	1	0	1	1	0	1
Ethmiinae	1	0	1	1	0	1
Xyloryctinae	1	1	0	40	40	0
Blastobasinae	1	0	1	1	0	1
Chrysopeleiinae	1	0	1	1	0	1
Momphinae	2	1	1	8	6	2?
Cosmopteriginae	4	1	3	356	350	6
Gelechiinae	11	1	9	32	21	11
Totals	80	14	65	681	605	76

Number of genera containing endemic species: 22.

Number of genera containing adventive species: 60.

Number of genera containing only endemic species: 19.

Number of genera containing only adventive species: 57.

Number of genera containing both endemic and adventive species: 3.

(Continued at bottom of page 39.)

and Asia, is not represented. The Tortricidae have succeeded in colonizing the islands more often than any other family, and, with few exceptions, most of the other families appear to be represented by the descendants of single ancestral invasions. It appears that the entire endemic microlepidopterous fauna of the Hawaiian Islands, consisting of probably more than a thousand species, may have arisen from only about 22 ancestral immigrants who, by chance, were successful in crossing the ocean and establishing themselves permanently on the islands. How difficult it is for small moths to cross wide expanses of ocean and to succeed in colonization even over periods of several million years. It is possible that not more than one species in 250,000 years or more has been successful in reaching and establishing itself in Hawaii by the natural agencies of overseas transport. It is probable that many more species reached these islands but were unable to circumvent the overwhelming difficulties of colonization and survival.

Although the endemic Hawaiian lepidopterous fauna is relatively poor in family representation, it is rich in species. In this volume are listed 681 Microlepidoptera; these, added to the 168 Macrolepidoptera in Volume 7 and the 226 Pyraloidea of Volume 8, plus additions to those volumes, make a total of about 1,100 Lepidoptera now recorded from Hawaii. I believe that the actual number of species of Hawaiian Lepidoptera exceeds 1,500; many remain to be described. We may compare this number with the somewhat more than 600 species known in Ireland (Beirne, 1941*a*), with approximately 650 genera and 2,200 species recorded in the British Isles, with approximately 10,000 species known from America north of Mexico, and with the more than 11,000 species in Australia.

Unfortunately, we shall never be able to ascertain the number of species which existed recently in Hawaii before man's drastic alteration of the land and his introduction of mammals, insect diseases, predators, and parasites. A large number of species have been exterminated since man came to the islands. Many of the species collected before 1900 only by Dr. Perkins have not been seen since. The attacks of parasites purposely or accidentally imported by man have decimated the Hawaiian Lepidoptera and reduced many species to rarity, if not to extermination. We know little about imported insect diseases

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Percentage of endemism in native group: genera: 63 percent; species: 100 percent.

Percentage of present-day fauna endemic: more than 90.

Percentage of present-day fauna adventive: less than 10.

Average number of species per genus in endemic group: more than 27.

Average number of species per genus in adventive group: 1.26.

For simplification, I have included subspecies as species in the totals.

The figures in this and similar summaries in this work may be explained as follows:

1. "Percentage of endemism in native group: genera" is the percentage obtained by dividing the number of endemic genera by the total number of genera containing native species (in this instance, 63 percent of the genera which contain endemic species are themselves endemic).

2. "Percentage of endemism in native group: species" is the percentage obtained by dividing the number of endemic species by the total number of endemic plus indigenous species.

3. "Percentage of present-day fauna native" is the total number of endemic plus indigenous species divided by the total number of species recorded from the Islands (endemic + indigenous + adventive).

4. "Percentage of present-day fauna adventive" is, similarly, the total number of species divided into the total number of adventive species.

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FIGURE 4  
TABULAR SUMMARY OF THE ENDEMIC HAWAIIAN  
MICROLEPIDOPTERA

FAMILY	GENUS	NUMBER OF SPECIES	ANCESTRAL SOURCE		POSSIBLE NUMBER OF ANCESTRAL COLONIZATIONS	
			PACIFIC	BOREAL		
Opostegidae	<i>Opostega</i>	6		X	1	
	<i>Spheterista</i> *	17		X	1	
	<i>Pararrhaptica</i> *	19	X?		1	
	<i>Paraphasis</i> *	1	X?		1	
	<i>Panaphelix</i> *	2		X?	1	
	<i>Mantua</i> *	1		X?	1	
Tortricidae	<i>Bradleyella</i> *	5		X?	1	
	<i>Eccoptocera</i> *	11	X?		1	
	<i>Macraesthetica</i> *	1		X?	1	
	<i>Cydia</i>	14		X	1	
	<i>Crociosema</i>	3	X		1	
Gracillariidae	<i>Philodoria</i> *	30		X	1	
Lyonetiidae	<i>Bedellia</i>	12		X	1	
Yponomeutidae	<i>Prays</i>	7		X	1	
	<i>Plutella</i>	1		X	1	
	<i>Acrolepia</i>	4		X	1	
Carposinidae	<i>Carposina</i>	49		X	1	
Scythrididae	<i>Mapsidius</i> *	5		X	1	
Gelechiidae						
Xyloryctinae	<i>Thyrocopa</i> *	40	X		1	
Momphinae	<i>Batrachedrodes</i> *	6		X	1	
Cosmopteriginae	<i>Hypsmocoma</i> *	350		X?	1	
Gelechiinae	<i>Merimnetria</i> *	21		X*	1	
Totals	8	22	605	5?	17?	22

\* Endemic genus.

	HAWAIIAN ENDEMIC	NEW ZEALAND	AUSTRALIA	BRITISH ISLES	AMERICA N. OF MEXICO
Opostegidae	6 +	0	20	4	6
Tortricidae	74 +	140	809	325	950
Gracillariidae	30 +	16	222	83	240
Lyonetiidae	13 +	29	68	28	75
Yponomeutidae	5 +	36	158	63	115
Carposinidae	50 +	20	58	0	15
Scythrididae	5 +	4	14	10	35
Gelechiidae					
Oecophorinae	0	200	2,445	81	120
Xyloryctinae	40 +	2	418	0	0
Momphinae Plus Cosmopteriginae	356 +	15	394	30	125
Gelechiinae	18 +	41	483	151	600

Figure 5—A comparison of the approximate numbers of known species in the families of Microlepidoptera containing endemic species in Hawaii with the numbers of species in the same families in New Zealand, Australia, the British Isles, and America north of Mexico. Each of the endemic species numbers for Hawaii is too low, because undescribed species are known in all of the families. There may be more than 500 species of endemic Hawaiian Cosmopteriginae, and the true numbers of species in some of the groups is probably at least double the figures given here. Although there are no endemic Oecophorinae in Hawaii, I have inserted this well-known group in the table for comparative purposes. It is of interest that such enormous numbers of species should occur in Australia and elsewhere, yet the family never found its way into the endemic Hawaiian fauna. The species numbers for New Zealand are from Dugdale, 1970; those for Australia from Common, 1970; those for the British Isles are modified from Heslop, 1947; and those for America north of Mexico are approximations.

and their effects upon the endemic fauna, but I believe that this factor, too, has been of considerable importance in the reduction of many species. The extensive biological control programs of Hawaiian agricultural agencies, through which foreign parasites are purposely introduced, have by themselves brought wholesale destruction to the fauna, and the accidental introductions of other parasites and such voracious predators as the ant *Pheidole megacephala* (Fabricius) have raised havoc with this delicately balanced endemic fauna. There are now vast areas of hundreds of square miles of the Hawaiian Islands in which most of the native moths have been exterminated. The slaughter continues even in remote fastnesses in the high mountain rain forests where one may more frequently rear parasites from the immature stages of Lepidoptera than obtain the moths themselves. Parasitism not infrequently exceeds 90 percent. Such a condition is disheartening to a naturalist, and it compounds the difficult tasks of the student and monographer. Now we can only speculate about the nature of the fauna at its peak of development when man first arrived in Hawaii. Those of us working today, and in posterity, owe an enormous debt of gratitude to the farsighted English naturalists and to their



wonderful scientific institutions—The British Association for the Advancement of Science, The Royal Society and the British Museum (Natural History)—which organized and directed the Hawaiian faunal surveys carried out by the indefatigable Dr. R. C. L. Perkins before the fauna was so extensively decimated by the activities of man and the predators, parasites and diseases accidentally or purposely introduced by him. It would now be impossible, of course, successfully to repeat the Perkins' surveys, because so many of the animals he collected are extinct. Although the processes of extinction have been proceeding at a rapid pace since Perkins' work, Hawaiian institutions have long been shortsighted and have generally ignored what has been happening before their very eyes. They have made no concerted, major, continuing effort to collect and to preserve adequate representatives of the rapidly dwindling terrestrial insect fauna. Most of the natural history work done in the Hawaiian mountains during this century was done by keenly interested, devoted volunteer workers and was not financed by Hawaiian institutions. Most of the work which has been done in systematic and forest entomology and insect ecology and ethology has fallen to men like O. H. Swezey and F. X. Williams, who carried out their extensive work in the fields and forests over many years almost entirely in their own time and at their own expense. During my many years in Hawaii, I was allowed, for example, a total of less than \$100.00 of institutional funds for field work on the endemic Hawaiian fauna.

A notable exception to this neglect has been the work on *Drosophila* and other Diptera currently underway at the University of Hawaii. This work has been financed largely by the National Science Foundation, the National Institutes of Health, and several other non-Hawaiian institutions. The current Hawaiian Drosophilidae project has resulted in some of the most remarkable and significant discoveries and conclusions attained in the history of Hawaiian biological research. It has succeeded because it has been adequately staffed and financed. The word *Drosophila* has acted as a magic wand to attract finance and expert workers in several scientific disciplines.

Since the foregoing paragraphs were written, and after this text was submitted to the publisher, my close friends Dr. and Mrs. Klaus Sattler were sent to Hawaii by the British Museum to collect Lepidoptera. They made the finest collection since the Perkins' surveys. Working beyond the ordinary call of duty, they collected more than 14,000 select specimens in the all-too-brief time they had in the islands. Their material was returned to London in superb condition and in marked contrast to all previously made collections of Hawaiian Lepidoptera. At this writing, their material is still being processed in London. It is regrettable that this excellent new collection was not available for study during the preparation of this text. The Sattler's collection is extremely rich and contains the first specimens of many species that have been collected since their original discovery by Perkins so long ago. They obtained so many fine new species that it is obvious that a surprisingly large number of unknown species exists in the Hawaiian forests. This fact reenforces the need for intensive and extensive field work without delay to obtain and to preserve for posterity adequate samples of the remarkable and greatly endangered Hawaiian biota. (The Sattlers continued their remarkably successful field survey in 1976, and further work is planned.)

FIGURE 6

TABULAR SUMMARY OF THE ADVENTIVE  
MICROLEPIDOPTERA OF HAWAII

FAMILY GROUP	GENUS	NUMBER OF SPECIES	SOURCE			
			PALAEOTROPICAL INCLUDING PACIFIC	PALAEARCTIC	NEARCTIC	NEOTROPICAL
Incurvariidae	<i>Tegeticula</i>	1			X	
Tineidae	<i>Cryptithyroides</i>	1	X			
	<i>Niditinea</i>	1		X		
	<i>Tinea</i>	1		X		
	<i>Tineola</i>	1		X		
	<i>Praeaccedes</i>	1				X?
	<i>Phereoeca</i>	1	X			
	<i>Trichophaga</i>	1	X			
	<i>Monopis</i>	3	X(3)			
	<i>Choropleca</i>	2				X(2)
	<i>Nemapogon</i>	1		X		
	<i>Neodecadarchis</i>	1	X			
	<i>Lepidobregma</i>	1	X			
	<i>Pantheus</i>	1	X			
	<i>Decadarchis</i>	2	X(2)			
	<i>Erechthias</i>	1	X			
	<i>Mecomodica</i>	1	X			
	<i>Setomorpha</i>	1				X
	<i>Lindera</i>	1				X
	<i>Opogona</i>	3	X(3)			

(Continued on page 44.)

Tortricidae	<i>Croecia</i> <sup>1</sup>	1				X
	<i>Epiphyas</i>	1	X			
	<i>Amorbia</i>	1			X	
	<i>Bactra</i> <sup>1, 2</sup>	2	X(2)			
	<i>Cryptophlebia</i>	2	X(2)			
	<i>Strepsicrates</i> <sup>1</sup>	1			X	
	<i>Epinotia</i> <sup>1</sup>	1				X
	<i>Episimus</i> <sup>1</sup>	1				X
Gracillariidae	<i>Cremastobombycia</i> <sup>1</sup>	1				X
	<i>Caloptilia</i>	1		X?		
Bucculatricidae	<i>Bucculatrix</i>	1			X	
Lyonetiidae	<i>Bedellia</i>	1	X			
Yponomeutidae	<i>Plutella</i>	1		X		
	<i>Acrolepia</i>	1		X		
Schreckensteiniidae	<i>Schreckensteinia</i> <sup>1</sup>	1			X	
Pterophoridae	<i>Megalorhipida</i>	1	X			
	<i>Lioptilodes</i>	1			X	
	<i>Lantanophaga</i> <sup>1</sup>	1				X
	<i>Anstenoptila</i>	1			X	
	<i>Stenoptilodes</i>	3	X(3)			
Alucitidae	<i>Alucita</i>	1	X?			
Agonoxenidae	<i>Agonoxena</i>	1	X			
Cynodiidae	<i>Swezeyula</i>	1		X		
Gelechiidae						
Oecophorinae	<i>Endrosis</i>	1				X?
Ethmiinae	<i>Ethmia</i>	1	X			
Blastobasinae	<i>Blastobasis</i>	1	X			
Chrysopeleiinae	<i>Ithome</i>	1				X
Momphinae	<i>Chedra</i>	2			X(2)?	
Cosmopteriginae	<i>Trissodoris</i>	1	X			
	<i>Anatrachyntis</i>	3	X(3)			
	<i>Asymphorodes</i>	2	X(2)			

(Continued on page 45.)

Gelechiinae	<i>Oecia</i>	1				X?
	<i>Dichomeris</i>	1	X			
	<i>Trichotaphe</i> <sup>1</sup>	1				X
	<i>Crasimorpha</i> <sup>1</sup>	1				X
	<i>Phthorimaea</i>	1				X
	<i>Keiferia</i>	1				X
	<i>Sitotroga</i>	1	X			
	<i>Pectinophora</i>	2	X(2)			
	<i>Autosticha</i>	1	X			
	<i>Stoeberhinus</i>	1	X			
Totals	60	76	42?	8	9?	17?

<sup>1</sup>Purposely introduced.

<sup>2</sup>Only one of the *Bactra* was purposely introduced.

The numbers in parentheses following the "X" marks indicate the numbers of species from each source area if more than one.

Nearly all or all of the 76 species which I consider to be adventive probably gained entrance to Hawaii through the agencies of man. It seems likely that several were introduced by the Polynesians in materials carried with them in their sailing canoes, and others no doubt were carried in European and American sailing ships during the time of exploration and early settlement. These 76 species are included in 60 genera (only 23 genera contain the many more than 600 endemic species). Twenty-five of the foreign species are pests or are of some detrimental economic importance, and some of the other 51 species are potential pests or do cause occasional damage. Ten of the foreign species have been introduced purposely to aid in the biological control of weed pests. About 26 of the foreign species have come into Hawaii from America, and 50 have come from the Pacific and Old World (although some of the latter may have been introduced via America). Excluding the purposely introduced species, about 20 percent of the foreign species have become established in Hawaii since 1920—this in spite of rigid quarantine regulations.

It is significant that the average number of species per genus in the foreign (adventive) group is only 1.26, but in the native group the average number is more than 26 species per genus (actually considerably more, because large numbers of new endemic species await description).

All members of the Incurvariidae, Tineidae, Bucculatrigidae, Schreckensteiniidae, Pterophoridae, Alucitidae, Agonoxenidae, Cynodiidae, Oecophorinae, Ethmiinae, Blastobasinae, and Chrysopeleiinae found in Hawaii are foreign species. The endemic Hawaiian Microlepidoptera belong only to the families Opostegidae, Tortricidae, Gracillariidae, Lyonetiidae, Yponomeutidae, Carposinidae, Scythrididae, and Gelechiidae (including the Xyloryctinae, Momphinae, Cosmopteriginae, and Gelechiinae).

## A CONDENSED HISTORY OF THE STUDY OF THE HAWAIIAN MICROLEPIDOPTERA

Hawaii was discovered by Captain James Cook in 1778. Evidently no Hawaiian Microlepidoptera were collected on the Cook expeditions, and only one species of Microlepidoptera was described from various other expeditions to Hawaii over the next hundred years. The first moths collected in Hawaii appear to be a few taken by the Beechey expedition to the Pacific and Bering Straits from 1825 to 1828. The first species of Microlepidoptera to be described from Hawaii was what is now known as the immigrant *Anatrachyntis incertulella* (Cosmopteriginae), which was collected by the Beechey expedition and described by the English entomologist Francis Walker in 1864.

The Reverend Thomas Blackburn, the able English amateur entomologist, collected in Hawaii from 1876 to 1882. He sent parts of his collections to England for study, and A. G. Butler described the first endemic Hawaiian Microlepidoptera from Blackburn's collections. Dr. David Sharp was so stimulated by the unusual insect fauna discovered by Blackburn that he sowed the seeds that led to the fruition of the great Perkins' expeditions, beginning in 1892, which were organized and largely financed by the Royal Society and the British Association for the Advancement of Science with some financial assistance from Bishop Museum and the British Museum (Natural History). In 1877, Butler listed three species of Microlepidoptera from Blackburn's collections. One of these, which we now know to be the widespread immigrant *Autosticha pelodes* (Meyrick), was incorrectly determined as *Depressaria convictella* Walker. The other two species in Butler's first list were not specifically named. They were possibly species of *Hyposmocoma*, although they were incorrectly referred to the genera *Argyresthia* and *Laverna*. In 1879, Butler described *Hyposmocoma lignivora* (as a *Scardia*), and this is the first endemic Hawaiian species of Microlepidoptera to be described. In 1881, Butler listed 27 Hawaiian Microlepidoptera from Blackburn's collections, 23 of which he described as new.

In 1892, Dr. R. C. L. Perkins began his historical Hawaiian field surveys, and his incomparable collections of Microlepidoptera were monographed, with the able assistance of J. H. Durrant, by Lord Walsingham, who reported upon 58 genera and 444 species and lesser forms in *Fauna Hawaiiensis* in 1907. Walsingham (1907b: 742-743) said:

Mr. Perkins devoted a great deal of time to the *Macrolepidoptera*, and it was only when he failed to find species not previously met with that he gave special attention to the smaller forms. . . . Before Mr. Perkins so laboriously and persistently dragged these Hawaiian *Tineina* from their obscurity 35 species only, as now admitted, had been described; 1 by Walker, 29 by Butler, and 5 by Meyrick, the two latter authors working out Blackburn's collections. Mr. Meyrick also collected a few species in Oahu himself, in 1883, which by his courtesy are included in the present paper. I have also to thank him especially for having lent me all his material, including types of his own species and genera, and such exponents of Butler's species as Blackburn had numbered and retained for his own use.

In his "Introduction" (Volume 1, part 4) of the monumental *Fauna Hawaiiensis*, Dr. Perkins said (1913: xxxv-xxxvi):

As to the insects far more time was given to a special search for Coleoptera than any other Order. After the beetles the Microlepidoptera probably occupied the most time. Many of these were collected in very wet and sometimes windy localities and as they could not be carried alive in so rough a country without damaging themselves, I found it necessary to kill and pin them, as soon as they were caught. Liquid ammonia was always used in killing, except for stray specimens picked up, when I was specially in search of other insects or of birds. It was often necessary to carry an umbrella in order to obtain shelter from the wind and rain, when pinning the specimens in the field . . . and now and then I spent a day strictly in catching the larger Lepidoptera. . . . Light is very attractive to Lepidoptera, both large and small, and especially in wet localities, no doubt for the reason that in these, dark cloudy nights are most frequent. Clear cold nights are almost useless, and worse still if there is a strong wind. Even the smallest moths will sometimes come freely during very heavy rain, and a black windless night with torrential downpours, which cease at intervals, are the very best, during those intervals. Even the butterflies, *Pyrameis lamneamea* and *P. atalanta* sometimes are not infrequent visitors under such conditions. Flowers are attractive to many moths both by day and night, especially the Ohia (*Metrosiderus*) [sic] from which at night some kinds may be shaken to the ground, either unable or unwilling to fly.

In 1904, Dr. Otto H. Swezey began his nearly half-century of study of the Hawaiian Microlepidoptera, and, after the appearance of Walsingham's classical report in 1907, most of the work on Hawaiian Microlepidoptera was done by Swezey and by Edward Meyrick who described many of the new species discovered by Swezey. Meyrick also described a number of species collected by Perkins which were not included in the Walsingham 1907 monograph or were collected after Walsingham had completed his study. Meyrick's last contribution on the Hawaiian fauna was in 1935. Dr. Swezey continued to study Hawaiian moths until he retired from Hawaii in 1952. His numerous observations form a continual and invaluable record in the *Proceedings of the Hawaiian Entomological Society* from Volume 1 in 1906 to Volume 15 in 1953. His last publication was issued in 1954. Dr. Swezey was most interested in the hostplant relationships and the biologies of the moths, and it was on this phase of the work that most of his effort was concentrated. Although he spent much time collecting in the fields and forests on hundreds of field trips, exploring widely, he never made any broad survey collections of Microlepidoptera, nor did he use a light trap to collect in the forests. He was not much interested in making revisional studies himself or in describing new species; he preferred to leave that work to others who he considered more experienced and competent. Thus, since the Perkins' surveys between 1892 and 1901, no special efforts have been made to assemble extensive survey collections of Hawaiian Microlepidoptera. (Since this was written Klaus and Edith Sattler have made a notable new collection. See the comments on p. 42.)

In this text are listed 81 genera and 681 species and lesser forms. When this total is compared with the 58 genera and 444 species and lesser forms recorded in 1907 by Walsingham, it becomes evident that the large increase of known species recorded over the past 60 years—without special emphasis being placed on general collecting—reflects the urgent need for continued faunal surveys.

A more detailed history of the study of Hawaiian Lepidoptera, with portraits of Perkins, Swezey, Meyrick, and Walsingham, is given in my Volume 7 of *Insects of Hawaii* (1958:23–28).

## INSTITUTIONS WHERE THE TYPES OF HAWAIIAN LEPIDOPTERA ARE STORED

Most fortunately, the endemic species of Hawaiian Microlepidoptera have been described heretofore by only five authors: Butler, Walsingham, Meyrick, Swezey, and Busck. The Butler and Walsingham types are in the British Museum (Natural History). Some of Meyrick's Hawaiian types are also in the British Museum (where is housed his great collection), and some are now in the Bernice P. Bishop Museum in Honolulu (they were formerly housed in the Hawaiian Sugar Planters' Association Experiment Station). Dr. Swezey's types also have been transferred from the Experiment Station to the Bishop Museum, and his general collection is now at the Hawaiian State Department of Agriculture. August Busck described only three species of endemic Hawaiian moths, and his types are in the United States National Museum in Washington. The types of the few species described by me are in the British Museum and the Bishop Museum.

Lord Walsingham cited and labeled types for all of his *Fauna Hawaiiensis* species, and he published the collection number for each of them. He also labeled his paratypes. He did not use the terms "holotype" and "allotype," and he labeled his material "type ♂" or "type ♀". When he had both sexes, he usually cited the male first, but on occasion he selected the female. He almost invariably illustrated (in color) the type he cited first, and, by consulting his figure legends, one can easily determine which specimen he figured. Moreover, the specimens figured bear notations that they have been figured, and the types are further designated in the legends to the plates. I have accepted as the holotypes those specimens cited first and illustrated by Walsingham, and, when both sexes are represented, I treat the type specimens of the opposite sex cited as the allotypes and so cite and designate them in this text. Walsingham had a clear and modern concept of types, both for genera and for species, and his citations are definite and unambiguous.

## NOTES ON COLLECTING AND MOUNTING MICROLEPIDOPTERA

Moths are abundant in Hawaii, and many species can be attracted to lights in the lowlands and in the highlands. Detailed mountain surveys using both incandescent and "black" light remain to be made. A surprisingly large number of species can be captured in Hawaii during daylight hours. Many moths may be collected by beating dead limbs, branches, foliage, and bunches of dead grass as well as the dry, hanging fronds of bananas, palms, *Pandanus*, and ferns. In the rain forests, the masses of aerial roots and the blossoms of *Metrosideros* and other plants often harbor many moths. Other moths frequent the bark of almost every tree, and these species are often so beautifully camouflaged that one must pass his hand or some object over the tree trunks, or the epiphytic growths thereon, to make the moths move before they can be detected. Other moths can be disturbed into flight, often in swarms, if one simply walks through low herbage.

Technical study of Microlepidoptera is difficult and exacting. It is made even more difficult and often frustrating, exasperating, or impossible because of poorly prepared specimens. Much of the material with which I have had to work has been unsatisfactory, and not a little of it has been in deplorable condition. Various lots of reared material, which should have been in excellent condition, were so damaged by inexpert hands as to be next to useless. One should *not* glue Microlepidoptera to cards. One should *not* place dead Microlepidoptera loose in gelatin capsules, vials, or pill boxes, or wrap them in cotton wool. One should *not* allow Microlepidoptera to be exposed to the bleaching rays of the sun, thereby causing them to become faded and discolored (this is especially true of the tropical sun). One should *not* ship specimens without protecting them by proper methods of packing. If the specimens one rears or captures are considered to be of any real value—if there is any reason at all to collect them—then they are worthy of being treated with care; every attempt should be made to get them into the collection or into the hands of specialists in a condition as nearly perfect as possible.

If one cannot properly spread the specimens reared or captured, then it is better only to pin them carefully and to make no attempt to spread them. In any event, specimens should always be pinned as soon as possible after being killed. They should never be allowed to dry before being pinned, because they may then be almost impossible to spread in correct form. After carefully thrusting the pin vertically through the middle of the thorax, a puff or more of breath will usually force the wings open and make the task of final setting easier (and blowing on the specimen will assist in removing loose scales and debris). Such specimens, pinned and with the wings blown open, may be placed in a container for shipment to the specialist who can usually relax and spread the moths with reasonable chance of obtaining acceptable material. To avoid abrading the scales and thus damaging the moths, do not handle them with the fingers. Never allow moths to shake about with other specimens in a general collecting bottle. It is best to capture each moth individually in a separate container. Rarely can perfect specimens be obtained from light traps if masses of many kinds of insects become packed together in the killing jar. There may be times, however, when a number of specimens may have to be collected in the same killing bottle. When that is required, a piece of loosely crumpled tissue paper should be placed in the bottle to assist in keeping the specimens separated during their death struggles, and only moths should be killed in the same bottle. A large beetle placed in a bottle containing moths easily may ruin most of them. A "strong" killing jar which will ensure that the specimens are killed quickly will aid in preventing them from becoming battered and abraded. Pinning small moths squarely through the middles of the thoraces is often the most difficult part of the mounting process. Unless one's eyes are well adapted for very good close vision, a large lens mounted on a stand (which will allow the free use of both hands), or the low power of a dissecting microscope, should be used to assist with the pinning process. If the pin is placed too close to the base of a pair of wings, it may be difficult to spread the specimen. If the pin is inserted through the thorax at an angle, instead of vertically, it may be difficult correctly to attach the specimen to the pith of the final mount.



Various acceptable methods are used for the capture and preparation of Microlepidoptera. A superior technique which can be recommended is the one used by Klaus Sattler and his associates in the Microlepidoptera Section of the British Museum (Natural History), and it results in the production of beautifully prepared specimens. Among the advantages of this system are: It is simple (one need not be an expert in preparing delicate moths; a student can master the procedures with a minimum of instruction). It is convenient and is adaptable to use for a day's collecting near home or for a major expedition to tropical jungles. It is a safe system. It is rapid and saves much time in the field. No bulky equipment is required (spreading boards and relaxing chambers need not be taken into the field or on expeditions). It is cheap. Large numbers of moths (and Neuroptera, Trichoptera and other groups of insects which normally are prepared for the collection with their wings spread) may be stored with complete protection in a comparatively small area, and their shipment back to the museum in small, light-weight containers is accomplished easily. The specimens may be left indefinitely in the trays in which they have been placed in the field, and they remain easily visible for examination at any time. The method is as follows:

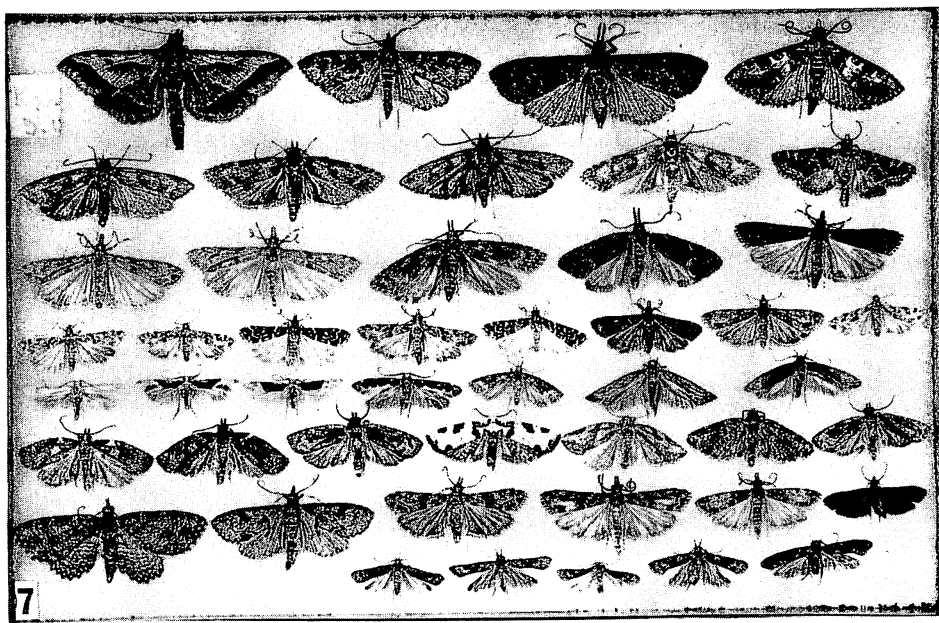


Figure 7—An example of a British Museum field collection box showing specimens as they were received from a collecting trip to Hawaii. The shallow, clear plastic box has a fitted lid and is lined with an expanded polyethylene plastic pinning sheet. The specimens were pinned into the box immediately after being killed in ethyl acetate. It will be noted that most of the specimens require a minimum of attention to prepare them for the permanent collection and that most of the specimens can be named in their present condition. Thousands of specimens prepared in a similar manner can be stored safely in a small space. From such boxes a specialist can sort out the specimens he wishes to examine as they are required without the necessity of disturbing or preparing the entire collection before study can begin. This system is highly recommended. (Courtesy of Klaus and Edith Sattler, the collectors. The specimens were taken at Kahuamaa Flat, Kokee State Park, Kauai, 9 September 1973. Natural size.)

1. Specimens are caught in individual glass vials (or in glass-bottomed pill boxes) large enough to allow the moths to rest across the bottoms of the vials without rubbing their wings on the sides of the vials. (Do not use plastic containers. These may develop charges of static electricity which may cause the wings of the moths to adhere to the plastic, and the moths may then be damaged.) Only one moth is placed in each vial or pill box. (A stiff card slipped between the mouth of the vial and the surface upon which the moth rests will facilitate its capture and enable the cork to be inserted with little danger that the moth may escape.) The vials containing the living moths are kept in a cool, dark place until the animals are to be killed and pinned.

2. To prepare a killing tube, use a section of a large-sized glass tube (open at both ends). At one end insert a cork. At the other end insert a disc of some porous paper such as blotting paper, and behind this disc place a plug of cotton

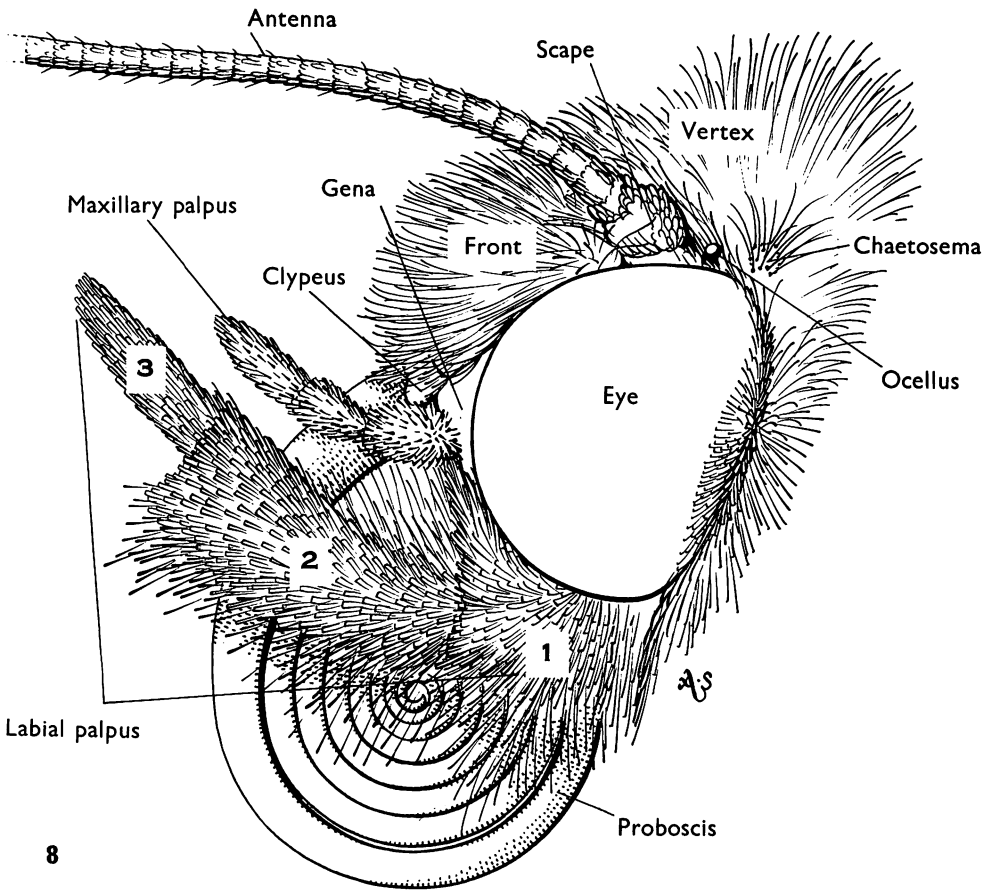


Figure 8—Lateral aspect of the head of a moth to show various parts used in classification. The three segments of the labial palpus are numbered 1, 2, and 3. For discussion of the chaetosema (plural: chaetosemata) see Jordan, 1923, and Eltringham, 1925 and 1929.

wool. Pour onto the cotton wool a modest amount of ethyl acetate (acetic ether), and close the end of the tube with another cork. If too much of the chemical is introduced, unwanted moisture will form in the section of the tube which is to contain the moths. If the tube does become wetted in this section, the specimens may easily be spoiled. Several such killing tubes should be available, and only one moth at a time should be killed in each tube.

If facilities for freezing are available, I have found that killing by freezing is an excellent and simple method which avoids the use of chemicals. It leaves the specimens relaxed, and it makes possible extended delay between capture, pinning and spreading. The moths must, however, be kept from drying while frozen or they will have to be relaxed.

3. Transfer the moth from the individual catching and holding vial into the killing tube by inserting the end of the catching vial into the open end of the killing tube. Do not attempt to touch the moth. The moth will often fly or crawl into the killing tube if one places his hand around the holding tube to darken it so that the brighter light in the killing tube will attract the moth. If the moth does not readily enter the killing tube, it can be shaken out of the catching vial and into the killing tube by tapping the vial or shaking it abruptly. The choice of a correct size of holding vial to match the diameter of the killing tube will facilitate transfer of the moths with little risk of any escaping.

4. Allow the moth to remain in the killing tube for only a few minutes.

5. Turn the dead or anesthetized moth out onto a cloth or a handkerchief and pierce the middle of the thorax with an appropriate-sized pin. The cloth will serve to hold the specimen safely in position for pinning. Use forceps to assist in getting the specimen into correct position for insertion of the pin. Damage may result to the specimen if it is handled with the fingers.

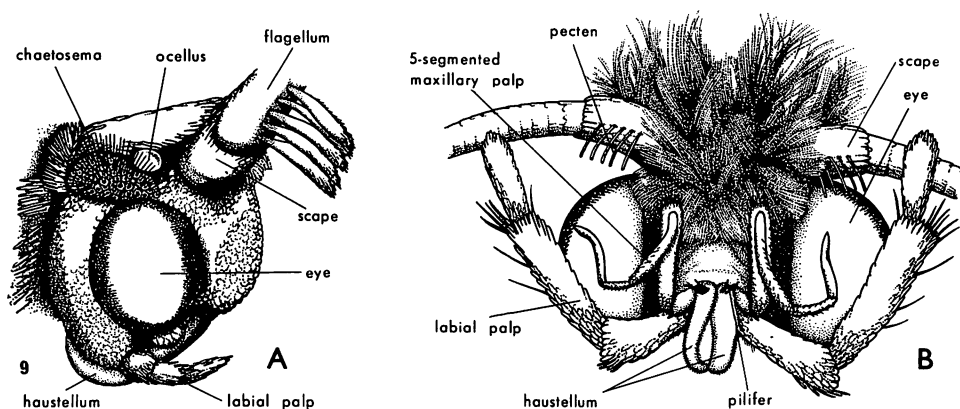


Figure 9—Details of the heads of a male *Pollanisus* (Zygaenidae), right lateral aspect (A) and *Monopis* (Tineidae), ventro-frontal aspect (B). (After Common, 1970, with permission.) The maxillary palpi are greatly reduced on A, but they are fully developed on B. Note the stiff, erect bristles on the penultimate (second) segments of the labial palpi on B which are characteristic of the Tineidae in Hawaii, as is the "rough" hairy vestiture. I have used "proboscis" in this work instead of the less common "haustellum" which is generally unfamiliar to the nonspecialist. The chaetosemata are unusually large on the species illustrated in A.

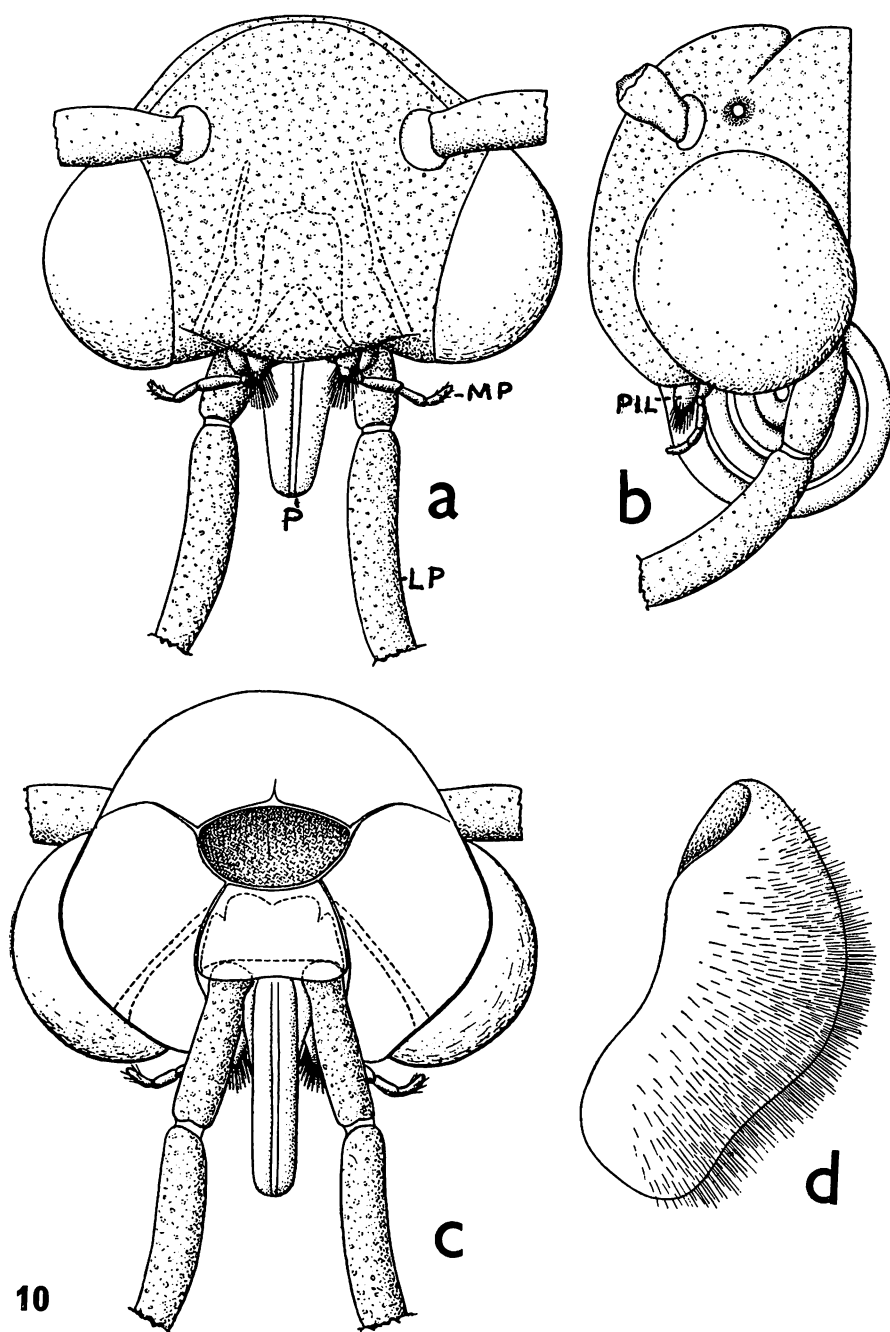


Figure 10—Details of the descaled head of an adult of *Acrolepia assectella* (Zeller), Yponomeutidae. *a, b, c*, frontal, lateral, and caudal aspects; *d*, vestigial mandible; *LP*, labial palpus; *MP*, maxillary palpus; *P*, proboscis; *PIL*, pilifer. (Modified from Frediani, 1954.) Compare figure 11 of *Phthorimaea*.

6. Hold the pin with forceps and blow on the wings from beneath and behind to cause them to open, as required.

7. If the specimens are not going to be spread and set immediately for the collection, as during a field trip, the specimens may be pinned onto an expanded polyethylene composition plastic pinning sheet. Press the pin into the pinning sheet until the thorax and abdomen of the moth touch the surface of the plastic. Now insert the ends of curved forceps, or a pin, beneath the wings and lift and push them forward as required to spread the wings as neatly as possible

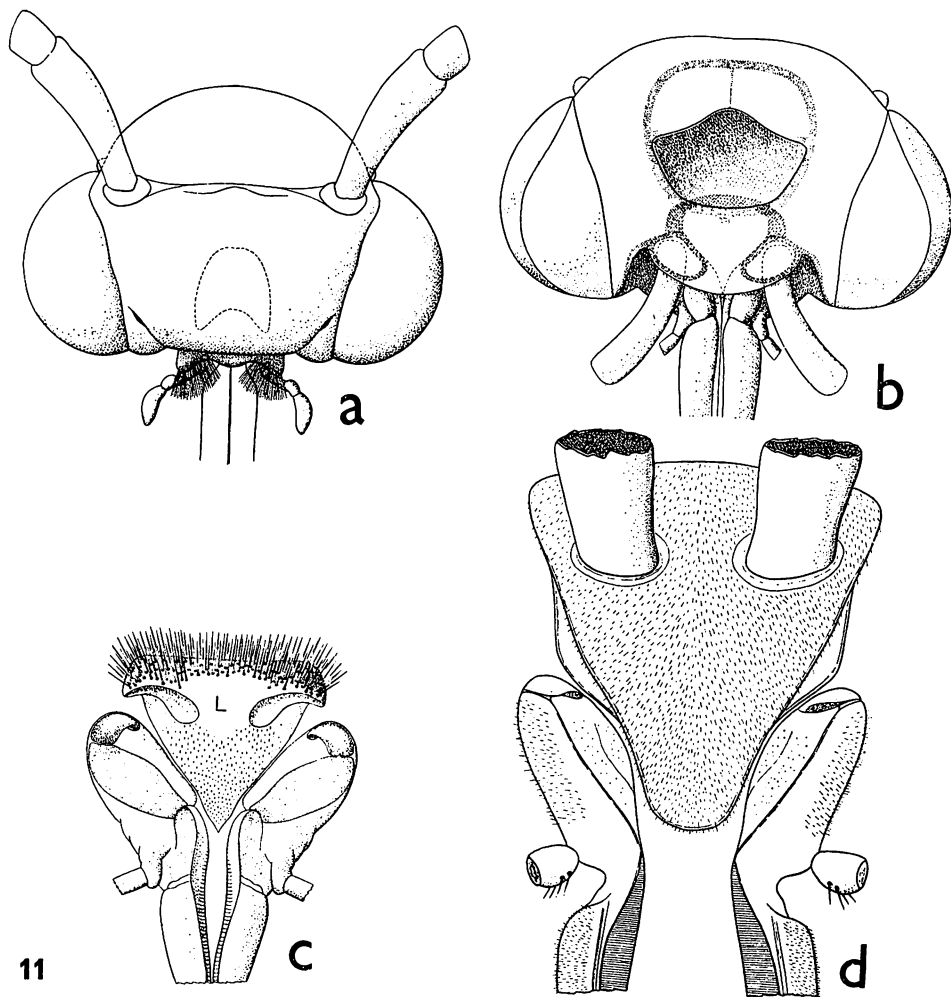


Figure 11—Details of the heads of adults of *Phthorimaea* and *Acrolepia*. *a* and *b*, frontal (labial palpi not shown) and caudal aspects of the head of *Phthorimaea operculella* (Zeller), Gelechiidae. *c*, ventral view of the labium and base of proboscis (galea and maxillae) of the same. *d*, the same parts of *Acrolepia assectella* (Zeller), Yponomeutidae. The bases of the maxillary palpi are shown. The bases of the labial palpi are shown on *d*, but only the places of insertion of the labial palpi are shown on *c*. (*a*, *b*, *c*, after Bartoloni, 1951; *d*, after Frediani, 1954.)

to set the specimen properly (a pin bent in a "L" shape may be found useful for this purpose). If the wings will not stay in an approved position, rub the plastic beneath the wings with the curved part of a curved-end forceps. The rubbing will establish a charge of static electricity on the plastic (if the air is not too humid), thereby attracting the wings to the plastic where they will adhere. One cannot always get the wings into the position one would like to have them, especially if cyanide is used to kill them, but one should try one's best. Pins may be used to hold the wings and antennae in position until dry. When dry, the specimens may be used for preliminary study, or they may be

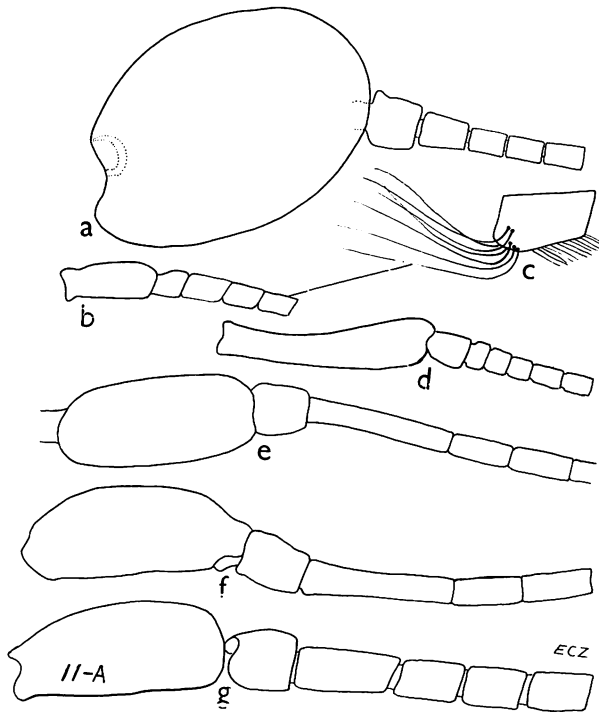


Figure 11-A—Sketches of some basal segments of the denuded left antennae of various Microlepidoptera. *a* shows a true eye-cap formed by the greatly expanded basal segment; the vestiture on the basal segment extends only slightly beyond its edges. In contrast, *e*, *f*, and *g* have false eye-caps formed by greatly enlarged pectens composed of masses of long squamae and setae. These setae extend beyond the ventral edges of the basal segments for distances from one and one-half times to two times the breadths of the segments and make the segments appear much broader than they are. *a*, *Opostega filiforma* Swezey, female. Distad from segment four each segment has a single whorl of squamae whereas the other species illustrated have two rows of squamae. This is the specimen from Mt. Olympus, Oahu, from which I made the genitalia and wing illustrations. *b*, *Carposina cervinella* (Walsingham), male; from the specimen from which slide BM 15850 was made. *c*, an enlarged sketch of a segment of *b* showing the persistent setae which remain after the squamae are denuded. *d*, *Hypsmocoma (Euperissus) latiflua* (Meyrick), male; Oahu; the basal segment has a pecten composed of two or three long bristles; this is the specimen from which slide Z-70-15 was made. *e*, *Bucculatrix thurberiella* Busck, female; Nanakuli, Oahu. *f*, *Bedellia orchilella* Walsingham, female; Pupukea, Oahu. *g*, *Swezeyula loniceræ* Zimmerman and Bradley, male paratype; Honolulu. *e*, *f*, and *g* each has the basal segment swollen to accommodate their enlarged pectens, and, when not denuded, they resemble false eye-caps. *a*, *c*, *d*, *e*, *f*, and *g* are drawn to the same scale; *b* is drawn to a smaller scale.

stored to await final preparation for the collection. If one takes care at this early stage of preparation, it is frequently possible to obtain fully satisfactory specimens which may not need to be relaxed and reset when placed on the final mounts for the permanent collection.

It is usually advisable to place, for perhaps an hour, a ball of cotton wool containing a few drops of ethyl acetate in a corner of the closed container in which the pinned moths are placed to ensure that the moths are killed. If they have been only anesthetized, they may, of course, become damaged or their appendages may become disarranged if they move after the anesthesia has passed. (Consideration should be given to the use of nicotine sulfate applied to the pins as used by Ian Common as outlined below.)

8. If one is going to collect a large number of specimens on a field trip or expedition where it will not be possible to return to the laboratory each day or to set the specimens in the field as they are caught, then one should prepare

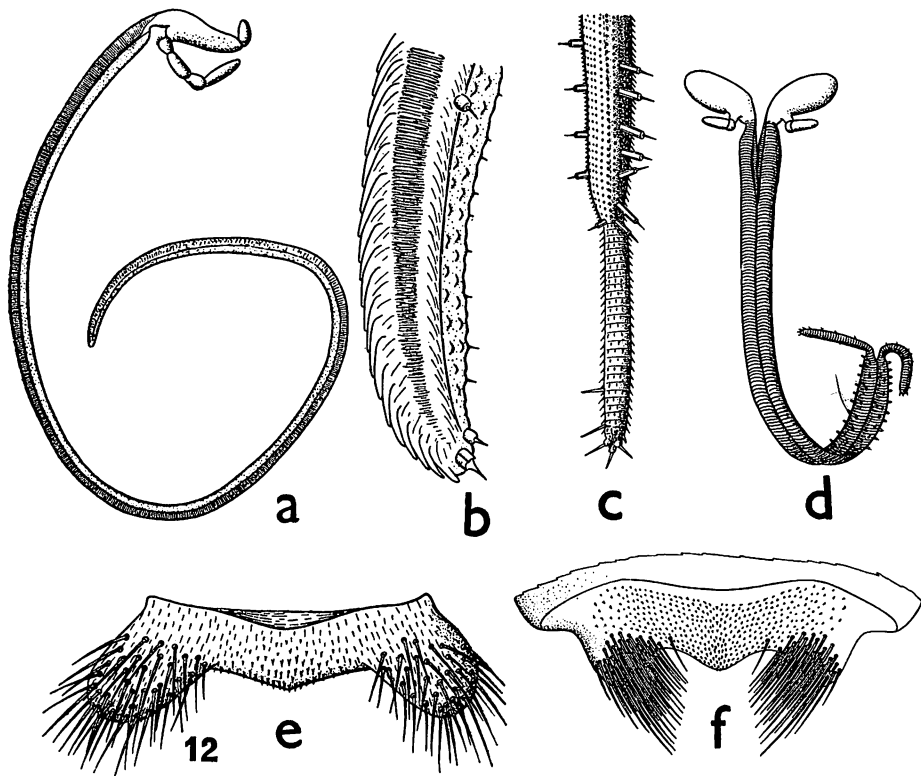


Figure 12—Some details of the mouthparts of the adult of *Acrolepia assectella* (Zeller), Yponomeutidae (*a, b, e*) and *Phthorimaea operculella* (Zeller), Gelechiidae (*c, d, f*). *a* to *d*, proboscis of each species with the distal parts enlarged at *b* and *c*. *e, f*, the labrum of each species. (Rearranged from Bartoloni, 1951, and Frediani, 1954.) These features are not often examined by lepidopterists but deserve detailed attention.

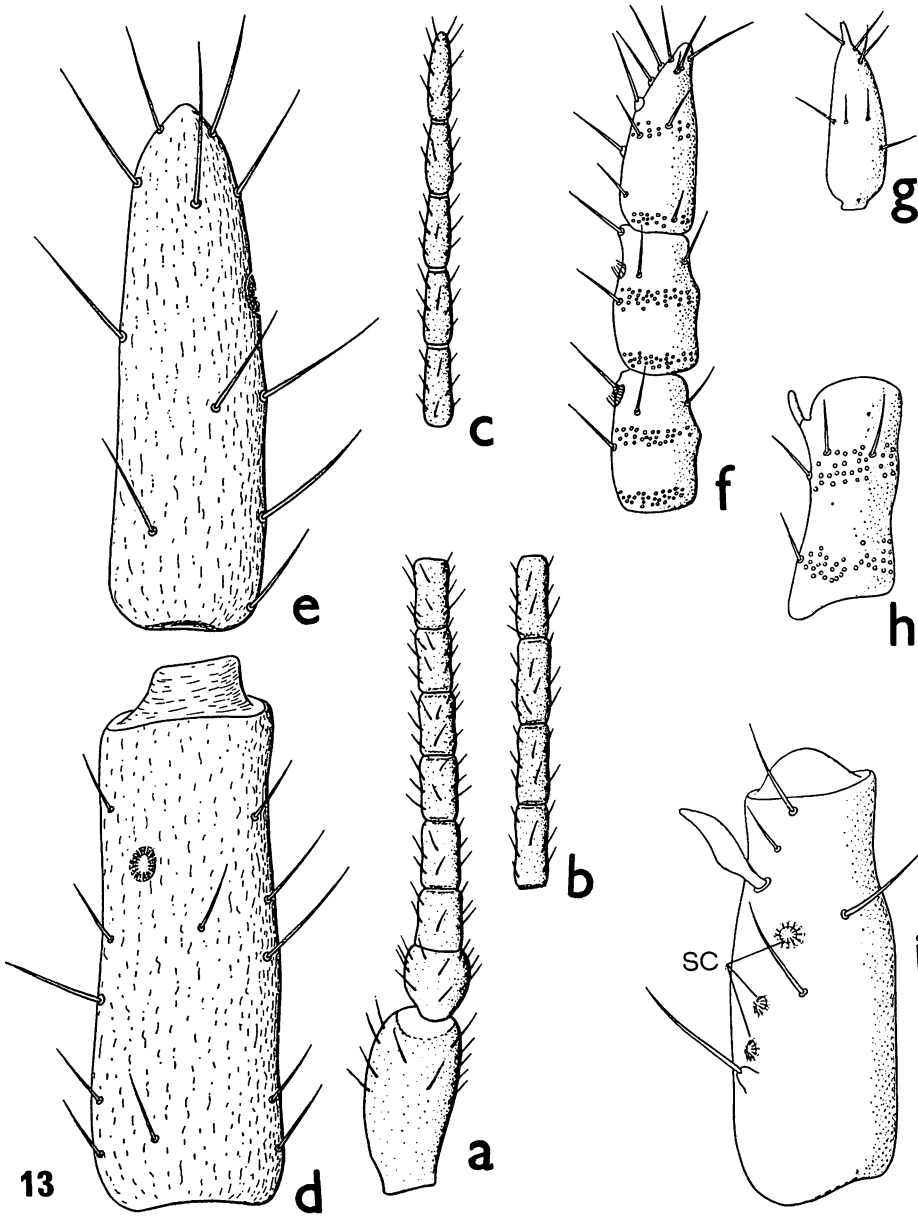


Figure 13—Some details of the descaled antennae of *Acrolepia assectella* (Zeller), Yponomeutidae (a–e) and *Phthorimaea operculella* (Zeller), Gelechiidae (f–i). (Rearranged from Bartoloni, 1951, and Frediani, 1954.) a, proximal segments; b, segments 16–19; c, distal segments; d, segment 20 enlarged; e, distal segments; f, three distal segments of a female; g, the distal segment of a male; h, segment 10 of a female; i, segment 39 of a female (SC=circular sensoria). The antennae of Lepidoptera contain many features which are generally not used by taxonomists, but they are worthy of detailed investigation.



in advance an appropriate number of shallow pinning boxes lined with expanded polyethylene plastic pinning material. The boxes may be of clear plastic, shallow cigar boxes, or paper boxes. A convenient size for Microlepidoptera is about  $8 \times 12$  cm., such as that illustrated in Figure 7. If the box has a plastic lid, it may be found necessary that it be treated with an anti-static fluid to prevent the building up of static electricity on the lid, which, if it occurs, may attract the moths' wings and spoil their arrangement. If one has no antistatic fluid, wiping the plastic lid with a damp cloth will serve the purpose temporarily. This problem can be avoided if the specimens are dried before lids are placed on the trays. The trays are appropriately labeled, and the specimens carefully, completely, and quickly dried (to avoid molding or decomposition which will ruin specimens). When the specimens are dry the trays may be sealed with tape to make them vermin-proof. They may then be placed in storage until needed. If one is collecting in the tropics where drying often is difficult, and a drying oven is not available, the trays, at least partly open, may be placed in a container in which a drying agent is used to extract the moisture. I have used a crystalline material (cobalt sulfate in a silica gel?) which changes color when it has absorbed moisture and which can be dried out for reuse by heating it in an oven or over a fire.

Using the above method, one can pack thousands of moths in a small area and keep them safely stored until required. They should be removed as quickly as possible from areas of high tropical humidity where they might easily and quickly become damaged by mold or decomposition. One can superficially study the material in the trays at any time, and it is easy to remove any desired specimens when one wishes to study them or to relax, spread, set and label them permanently without disturbing the other specimens in the trays. Specimens prepared in this manner are easily relaxed, their final mounting

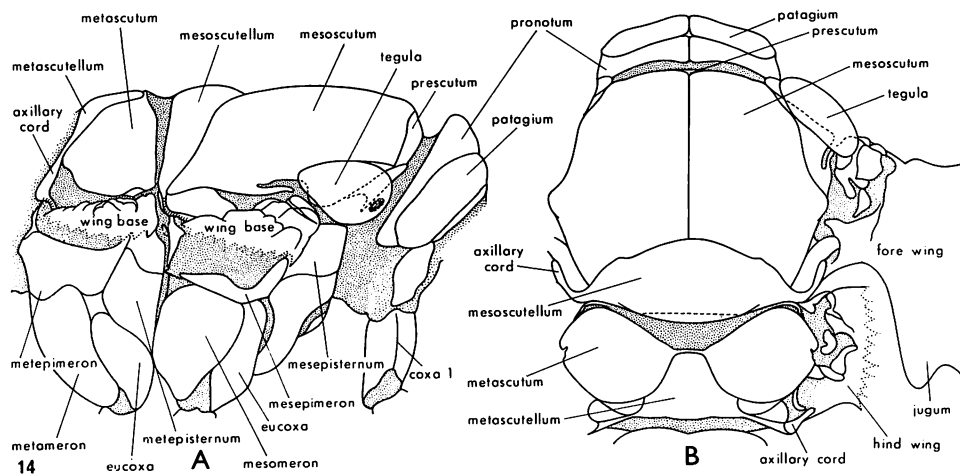


Figure 14—Details of the thorax of *Oncopera* (Hepialidae) in lateral and dorsal aspects. (After Common, 1970, with permission.)

is accomplished without difficulty, and perfect specimens are obtained. Some modification of the technique may be found necessary when one collects in the tropics where moths may be attracted to one's light in vast numbers.

Dr. Perkins used an early version of the Sattler technique, and that is why so many of his specimens remain in excellent condition to this day. Dr. Perkins killed the specimens he caught in ammonia fumes, and, after blowing the wings open, he pinned them to cork sheets for transport to England. His work often was done while he lay on a bed of branches and fern fronds under a crude canvas shelter, often under appalling weather conditions, in the mountain rain forest (see also the quotation from Dr. Perkins in my discussion above on the history of the study of Hawaiian Microlepidoptera).

A considerably different technique from that outlined above is used by Ian Common, the eminent Australian lepidopterist, who also prepares specimens to perfection. Common uses cyanide as a killing agent, whereas it is rejected by the Sattler school.

An interesting innovation by Common is the use of the insecticide nicotine sulfate (commonly known by the trade name "Black-leaf 40") for some of his work, as described below.

Glass-bottomed pill boxes (not now easily obtained) or glass vials are used to capture specimens from rearing cages, nets, etc. The specimens are transferred to cyanide killing bottles (a sharp tap on the inverted, carefully opened pill box or vial will usually cause the moth to drop quickly down into the killing bottle). The moth is left in the cyanide fumes only until it is rendered unconscious but is not killed. It is then tipped out onto a cloth-covered pinning block (cloth-covered plastic foam may be used), and it is pinned immediately. Before inserting the pin, its point is dipped into a vial packed with cotton wool which has been saturated with nicotine sulfate. (Do not allow more than a coating of nicotine sulfate to adhere to the pin or discoloration of the moth's thorax may occur.) The moth dies quickly. It should then be left for 10 or 15 minutes for complete relaxation, and it may be easily spread.

When collecting large numbers of moths in the field or at light at night when it is not practicable or possible to use the foregoing technique, other procedures may be followed.

When collecting in the field during the day, specimens are captured individually in glass-bottomed pill boxes or glass vials, and the specimens are brought to home base or laboratory alive. The specimens from each locality are placed in separate cyanide killing bottles (not too many to a given bottle) and left in the killing bottles for about 8 to 15 hours (this delay before pinning is important to allow rigor mortis to pass). To prevent the specimens from drying in the killing bottles, each bottle has some cellulose wadding rammed down tightly on the plaster covering the cyanide, and a few drops of water, as required, are added to the wadding before each use. The specimens are tipped out of the bottle (only a few at a time) onto pinning blocks and carefully pinned into the foam (use a lens on a stand or a microscope if required to ensure that the pins are inserted vertically in the middles of the thoraces). Transfer the pinning blocks containing the pinned specimens to an airtight relaxing chamber to await spreading.

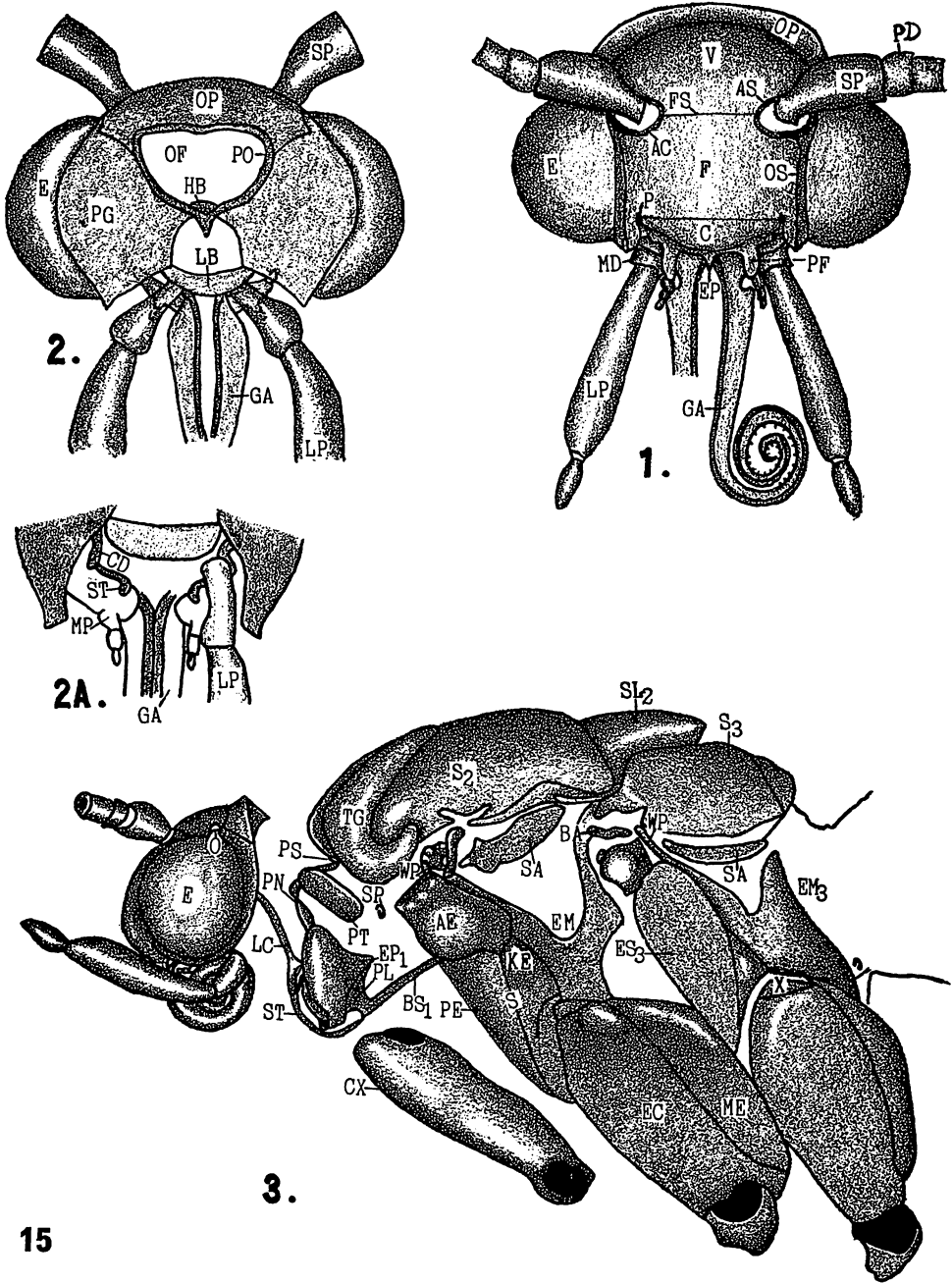


Figure 15—See legend on page 61.

When collecting at lights at night, the moths are caught individually in glass-bottomed pill boxes or vials and transferred immediately to cyanide killing bottles (which are always kept in a vertical position and the moths not allowed to be shaken about). Add only enough specimens to no more than lightly cover the bottom of each killing bottle. Leave the moths in the killing bottles overnight and pin them on foam pinning blocks to await spreading, as described in the preceding paragraph, or spread them immediately.

Another method of preparing specimens is that used by Ronald W. Hodges in America, and, having seen examples of his beautifully prepared material, I can say that his method is also excellent. Dr. Hodges has generously contributed the following outline of his procedures (which I have slightly edited and modified):

To obtain material suitable for proper and detailed study, careful attention to detail is necessary during the collecting process and subsequent handling and spreading of the specimens. Once these correct techniques are acquired, however, the processes can be as rapid as any other methods of collection and preparation that I have seen, and the results are superior.

First, I collect from a light sheet using, if possible, a combination of a 15-watt black light and an incandescent light. Black lights of higher wattage tend to prevent the moths from coming to, and alighting on, the sheet, and the collector thus may see little of what is attracted.

Specimens are collected directly from the lighted sheet into cyanide jars. For this purpose I use quarter-turn, screw-top jars and work with a killing jar in each hand. After a small number of specimens (about one to five) has been captured, the jar containing them is put on the ground until the moths have stopped moving; the moths are then transferred to storage jars which have a layer of packed cotton batting on the bottom. The moths are segregated by size as they are collected and then put into the appropriate storage jar. I normally have three such storage jars: one for small, one for medium-sized, and one for large Microlepidoptera. This process of collecting and storage is continued throughout an evening. Two points of detail that should be adhered to very carefully are: (1) the moths should never be allowed to slide about the bottom of a jar; as soon as a few moths have been collected, set the killing jar down until the moths have stopped moving, and then transfer them immediately into the storage jars; and (2) never collect a large moth in a jar containing much smaller moths. In order to maintain an unbroken process of collecting, I have four to six cyanide jars in continuous use.

Different specimens come to the front and back, top and bottom, of the illuminated light sheet. One must examine all parts of the sheet and pay strictest attention to the various sized "spots" present. I have found that the use of a hand or a head flashlight tends to make many of the gelechioids difficult to catch, although such lights are useful to enable one better to see the specimens. I try to capture the specimens without using such an aid. Thus, I collect "shapes" on the light sheet instead of selected specimens.

I usually leave the specimens in the storage jars overnight. At this point it is necessary to see that the specimens do not become dry. If only a small number of specimens has been collected, I take a piece of absorbent paper, wet it, place it across the top of the jar, and screw the cap down. The following morning I empty the contents of each jar onto a piece of paper and sort the specimens I intend to spread (they are now segregated by size and often by species), and I place them in a relaxing box. For relaxing I use a glass refrigerator container which has a layer of wet, absorbent paper placed on the bottom. Naphthalene crystals are placed over this. Above the naphthalene, and separated from the wet layer by two crosspieces of wood or plastic, I place a piece of heavy paper on which the specimens are laid for relaxing.

Figure 15—External anatomy of *Choristoneura fumiferana* (Clemens), Tortricidae.

1. Frontal view of head: *AC*, antennal sclerite; *AS*, antennal suture; *C*, clypeus; *E*, eye; *EP*, epipharynx; *F*, frons; *FS*, frontal suture; *GA*, galea; *LP*, labial palpus; *MD*, mandible rudiment; *OP*, occiput; *OS*, ocular suture; *P*, frontal pit; *PD*, pedicel; *V*, vertex.

2. Caudal view of separated head: *E*, eye; *GA*, galea; *HB*, hypostomal bridge; *LB*, labium; *LP*, labial palpus; *OF*, occipital foramen; *OP*, occiput; *PG*, postgena; *PO*, postoccipital sclerite; *SP*, scape.

2A. Caudal view of mouthparts: *CD*, cardo; *GA*, galea; *LP*, labial palpus; *MP*, maxillary palpus; *ST*, stipes.

3. Lateral view of head and thorax: *AE*, anepisternum; *BA*, basalar pad; *BS*<sub>1</sub>, prothoracic basisternum; *CX*, prothoracic coxa; *E*, eye; *EC*, mesothoracic eucoxa; *EM*, mesothoracic epimeron; *EM*<sub>3</sub>, metathoracic epimeron; *EP*<sub>1</sub>, episternum; *ES*<sub>3</sub>, metathoracic episternum; *KE*, kataposternum; *LC*, lateral cervical sclerites; *ME*, meron; *O*, ocellus; *PE*, pre-episternum; *PL*, pleuron; *PN*, pronotum; *PS*, prescutum; *PT*, patagium; *S*, pre-episternal suture; *S*<sub>2</sub>, mesoscutum; *S*<sub>3</sub>, metascutum; *SA*, subalare; *SL*<sub>2</sub>, mesothoracic scutellum; *SP*, spiracle; *ST*, sternum; *TG*, tegula; *WP*, wing process; *X*, metathoracic epicoxal piece. (After Freeman, 1947.)

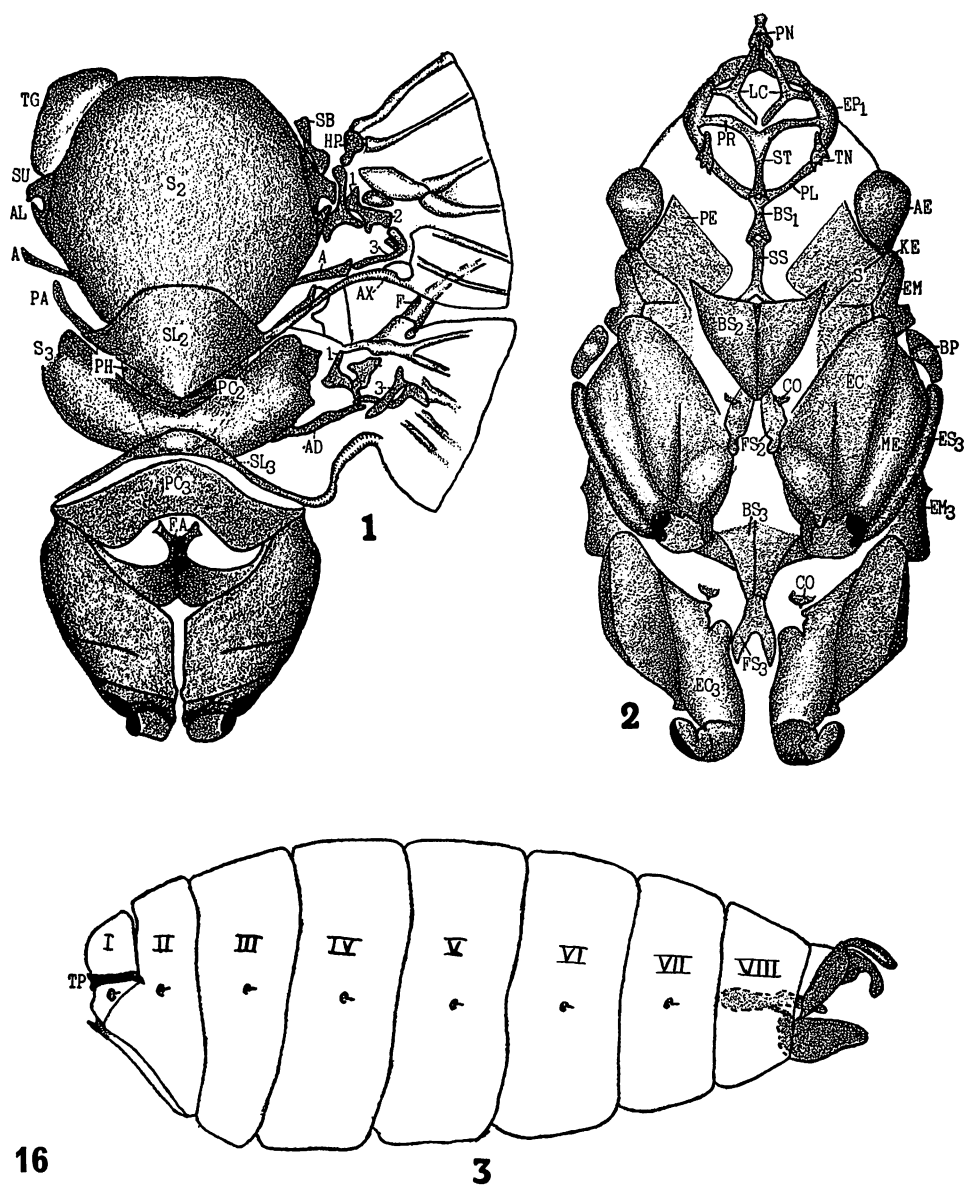


Figure 16—External anatomy of *Choristoneura fumiferana* (Clemens) (Tortricidae).

1. Dorsal view of thorax:  $A$ , mesothoracic adanale;  $AD$ , metathoracic adanale;  $AL$ , adnotale;  $AX$ , axillary cord;  $F$ , frenulum;  $FA$ , furcal arms;  $HP$ , humeral plate;  $PA$ , postadanale;  $PC_2$ , mesothoracic postscutellum;  $S_2$ , mesoscutum;  $SB$ , subtegula;  $SL_2$ , mesothoracic scutellum;  $SL_3$ , metathoracic scutellum;  $SU$ , surlare;  $TG$ , tegula;  $I$ ,  $2$ ,  $3$ , first, second, and third axillary sclerites.

2. Ventral view of thorax:  $AE$ , anepisternum;  $BP$ , basalare pad;  $BS_1$ , prothoracic basisternum;  $BS_2$ , mesothoracic basisternum;  $BS_3$ , metathoracic basisternum;  $CO$ , condyle;  $EC$ , mesothoracic eucoxa;  $EC_3$ , metathoracic eucoxa;  $EM$ , mesothoracic epimeron;  $EM_3$ , metathoracic epimeron;  $EP_1$ , prothoracic episternum;  $ES_3$ , metathoracic episternum;  $FS_3$ , mesothoracic furcasternum;  $FS_3$ , metathoracic furcasternum;  $KE$ , katepisternum;  $LC$ , lateral cervical sclerites;  $ME$ , meron;  $PE$ , pre-episternum;  $PL$ , pleuron;  $PN$ , pronotum;  $PR$ , precoxale;  $S$ , pre-episternal suture;  $SS$ , spinasternum;  $ST$ , sternum;  $TN$ , trochantin.

3. Lateral view of abdomen:  $TP$ , tergo-pleural groove. (After Freeman, 1947.)

At this stage most of the moths usually are not ready to be spread. Rigor mortis must pass and the specimens become relaxed before they are suitable for spreading. For the smaller moths this is a short period of time, and often by about 10 or 11 A.M. on the day after they have been collected, they can be spread satisfactorily. By the afternoon of that day, or the following day (two days after collection), most of the moderate-sized Lepidoptera can be spread. [This delay for relaxing is an important detail which should not be ignored if one uses cyanide as a killing agent.] The small moths, particularly the gracillariids and cosmopterigids (any with wide fringes on the wings), must be spread relatively soon after they have been placed in the relaxing jar to prevent their long fringes from matting.

Insofar as the spreading is concerned, perhaps the most critical step is the initial pinning of the specimen. I pick up a specimen by the legs with forceps and carefully place it with the legs down between my thumb and forefinger, nestling the specimen in the crevice but taking great care not to apply pressure on the specimen. Then with the right hand I pin the specimen. The pin must pass squarely into the mesothorax. If the insect is improperly pinned, it is nearly impossible to draw its wings forward to a correct position. After pinning the specimen, I put it on a regular spreading board (upper surface of the board with grooves from  $\frac{1}{32}$  to  $\frac{1}{4}$  inch wide). I draw the wings forward with spreading needles to a point where the fringe acts as the tornal angle. If the hindwing should come above the level of the forewing, I insert the tip of a pin under the posterior margin of the forewing at the base and then draw the hindwing forward. I then take another pin and draw the point under the wings to straighten the fringes. Usually, I spread about 20 specimens in this manner and then paper the wings down with tracing paper, remove the spreading needles, and proceed to the next set of specimens.

A word of caution: be very careful to ensure that none of the scales are removed or the appendages broken. More characters can be observed and studied on a "good" specimen than on a "poor" one.

It is an advantage, and usually something that is neglected, if a specimen or two of each moth species can be mounted unspread in its natural position. The way the wings are held when the moths are at rest, and the color pattern formed by the closed wings, are often of diagnostic importance as are the way the antennae, legs and body are held.

Consult the colored plates accompanying this work for examples of well-prepared specimens.

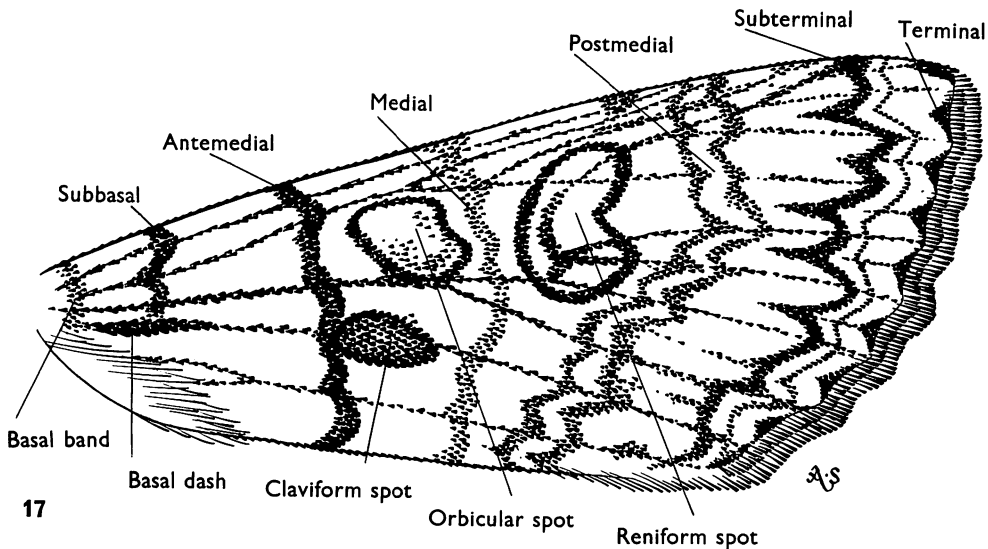


Figure 17—Forewing of a moth to illustrate some of the markings used in classification.

“SPREADING” or “SETTING” SPECIMENS: Perfectly prepared specimens are a delight to the eyes and a joy to the worker. Poorly prepared material is like a plague.

To prepare moths for the collection and study, they must be “spread” or “set”. Spreading boards for Microlepidoptera which are to be mounted on micropins may be made from strips of soft balsa wood, or similar material, in a variety of ways. One method is to prepare a strip of soft balsa wood about

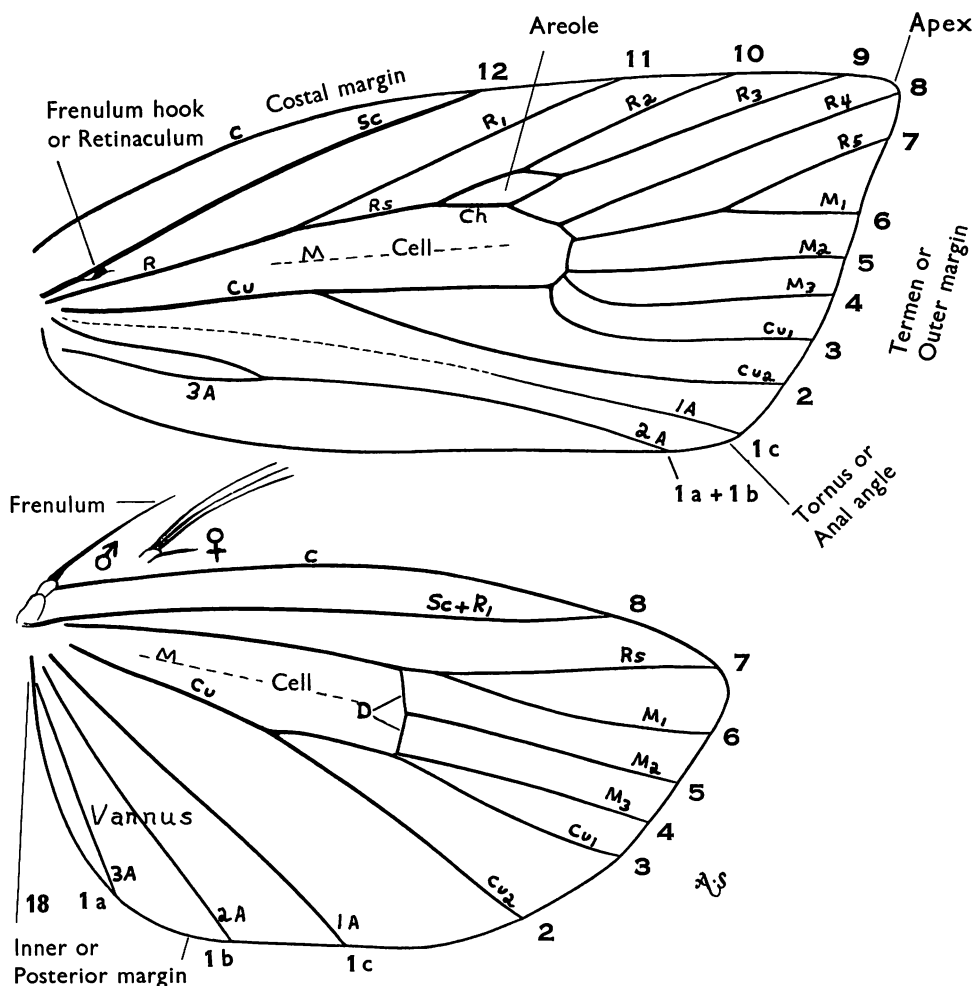


Figure 18—Fore- and hindwing of a moth to show complete venation. The two common schemes of vein nomenclature are indicated. The sexes of most of the higher moths can be distinguished because the males bear a single frenulum while the females of most species have more than one bristle (usually three, sometimes two) in the frenulum. A, anal; Areole=accessory cell; C, costa; Ch, chorda; Cu, cubitus; D, discocellulars; M, medius; R, radius; Rs, radial sector; Sc, subcosta.

20 to 30 mm wide and perhaps 20 mm thick, and of convenient length, and glue paper to one of the wide surfaces. A groove, U- or V-shaped, is cut down the middle of its papered length to make a slot into which the moths' bodies are pinned. To accommodate the bodies of various sized moths, grooves from two to five mm wide should be cut in a supply of assorted strips.

The moths, which have been mounted on micropins (and their wings opened from the body by a puff of breath if required) are carefully and straightly pinned into the slots in the spreading boards so that their bodies fit into the grooves and their wing bases are very close to the papered surface of the board (make certain that the pins are vertical). A pin placed gently beneath the wings may then be used to lift the wings partly into position as required. A rectangle

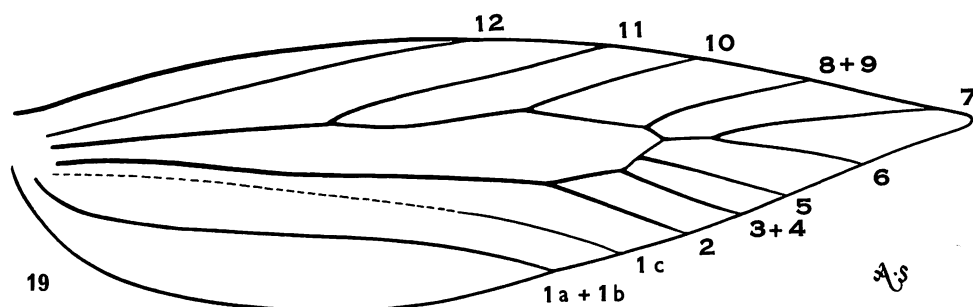


Figure 19—Forewing of a small moth to illustrate reduced venation.

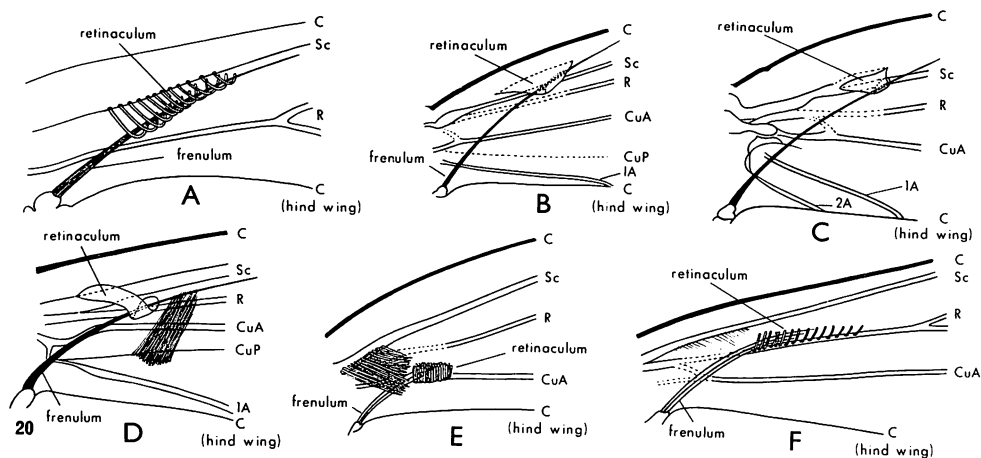


Figure 20—Ventral aspects of parts of the bases of the left wings to show the frenulum and various kinds of retinacula. A, male *Nepticula*, Nepticulidae; B, male *Narycia*, Psychidae; C, male *Barea*, Oecophorinae (compare E); D, male *Uresiphita*, Pyralidae; E, female *Barea*, Oecophorinae (compare C); F, female *Phthorimaea*, Gelechiinae. (After Common, 1970, with permission.)



of transparent paper (such as the waxed paper used for wrapping sandwiches and other food, smooth side down, or tracing paper) is then placed over the wings of one side of the moth, and the paper is pinned down at its top end (head end of the moth). The free end of the transparent paper toward the operator is then held down with a fingertip or fingernail. The point of a fine pin or setting needle is then caught on one of the strong veins near the base of the front edge of the forewing, and the wing is pulled forward until it is at right angles to the body. A pin is then put through the paper near to and behind the apex of the forewing. The tension on the paper is then relaxed slightly, as required, and the hindwing is moved forward to its proper place close behind the forewing. The paper is then pulled tight and several pins are placed through it around the wings as required to hold them firmly in position. The wings on the opposite side of the moth are then similarly spread. The abdomens may be held in position with crossed pins, and the antennae are set in attractive positions close to the forewings and pinned in place. Great care must be taken during the entire procedure to ensure that the scales are not abraded and that one does not tear the wing membrane with the pins used to spread the wings.

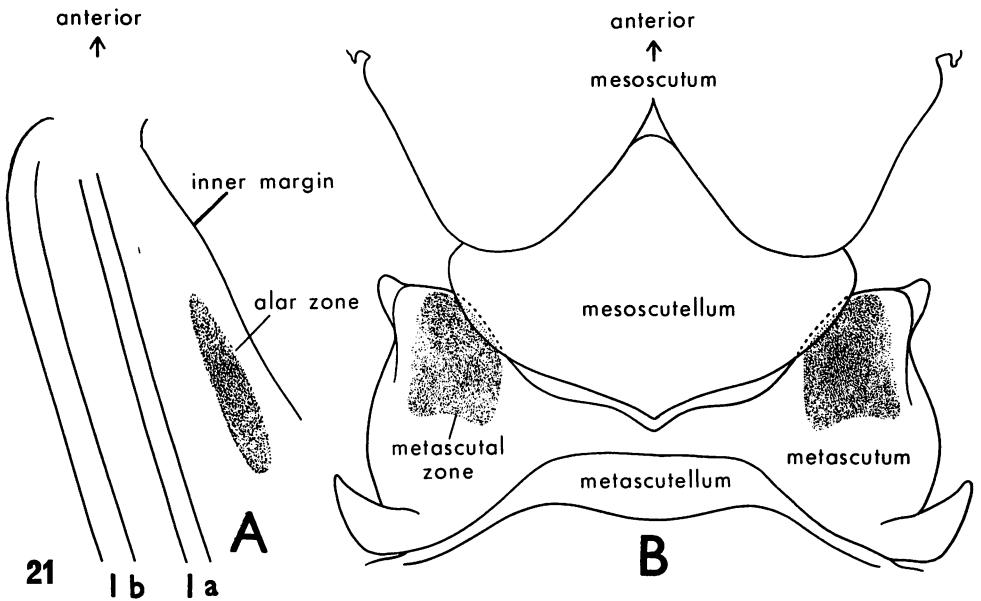
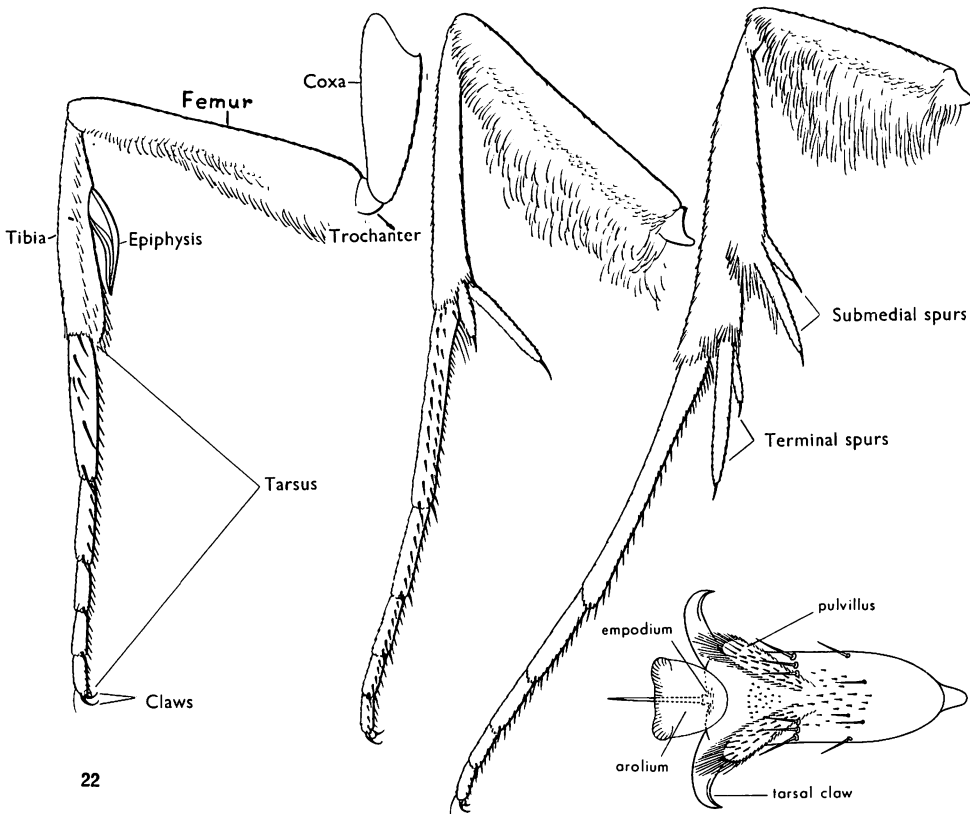


Figure 21—Wing-locking mechanism of a moth. The areas marked “alar zone” and “metascutal zone” are armed with microscopical hooklike processes. When the wings are folded the hooks on the wings engage those on the metascutum and thus fasten the wings to the thorax. These areas may appear as velvety zones under low magnification. Compare figures 754–756. This principle is now simulated by man for use as a quick fastening and release mechanism for fabric items. At *A* is a sketch of part of the inner basal area of the forewing showing the “alar zone” of microscopical spines (which are on the ventral surface). At *B* is shown part of the thorax with the corresponding metascutal zones. The species is *Xyleutes durvillei* (Herrich-Schäffer), an Australian cossid. When this species “unlocks” its wings, a distinct sound is produced. (Modified from Common, 1969:121, whose paper contains much instructive detail.)

When the moths are spread they must be left undisturbed for at least a week to dry. If the air is not very dry, then a longer drying period may be required to ensure that the moths retain their perfectly spread positions. A drying oven is an advantage and will hasten the drying process, but the oven temperature should not be very high—about 35°C is satisfactory.

Care must be used when removing the pins and the paper strips after the specimens have dried, because the dried moths are easily damaged. When removed from the spreading boards, the moths are then pinned into pith strips that have been mounted at an appropriate height on standard length insect pins. They are then ready to be labeled and placed in the collection.

**REARING SPECIMENS:** The rearing of endemic Hawaiian moths is most often a discouraging enterprise. One must usually carry the immature specimens captured in the forests to the hotter, drier, and very different surroundings of institutional laboratories in the coastal lowlands. These different conditions place abnormal stress upon the organisms, which may be narrowly



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Figure 22—The fore, mid, and hind legs of a moth with a sketch of a terminal tarsal segment in ventral aspect inserted at lower right. (The latter figure is after Common, 1970, and is used by permission; the other figures are by Arthur Smith.)

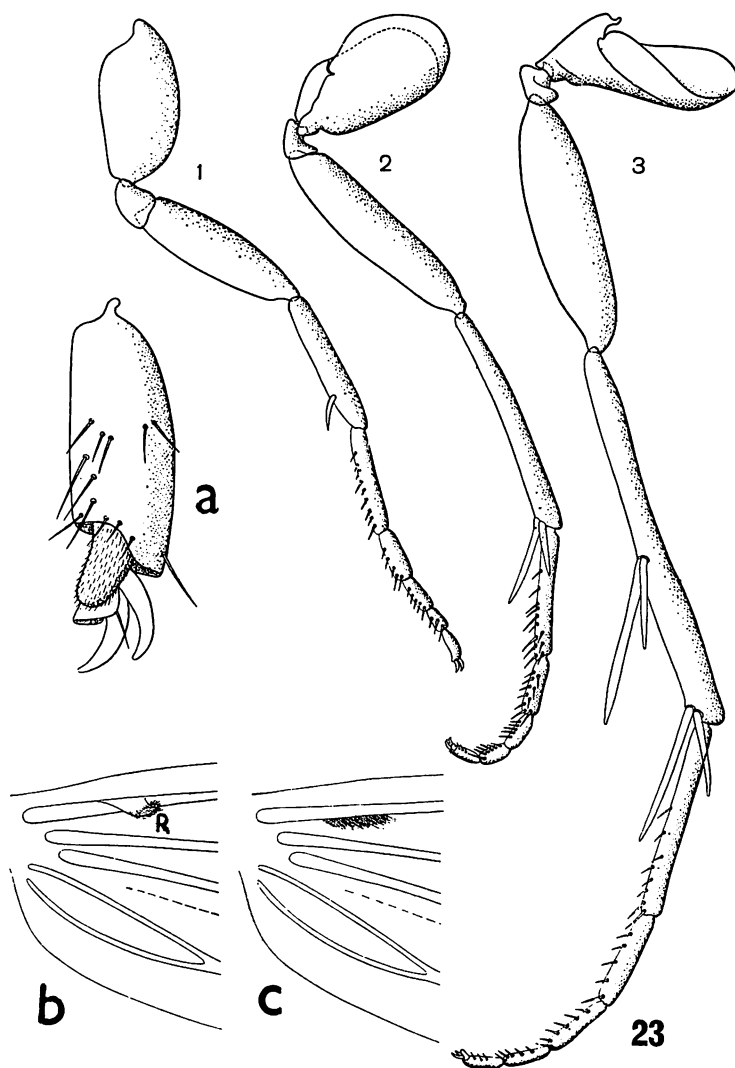


Figure 23—Details of *Phthorimaea operculella* (Zeller), Gelechiidae, and *Acrolepia assectella* (Zeller), Yponomeutidae. 1, 2, 3, fore, mid, and hind legs, descaled, and a, distal part of the metatarsus of *Phthorimaea operculella*. (After Bartoloni, 1951.) Compare figure 24. b, diagram of the underside of the base of the forewing of a male *Acrolepia assectella* to show the retinaculum (*R*) or hook into which the frenulum of the hindwing locks. c, the same of a female of the same species to show hairs and setae but without retinaculum. (After Frediani, 1954.)

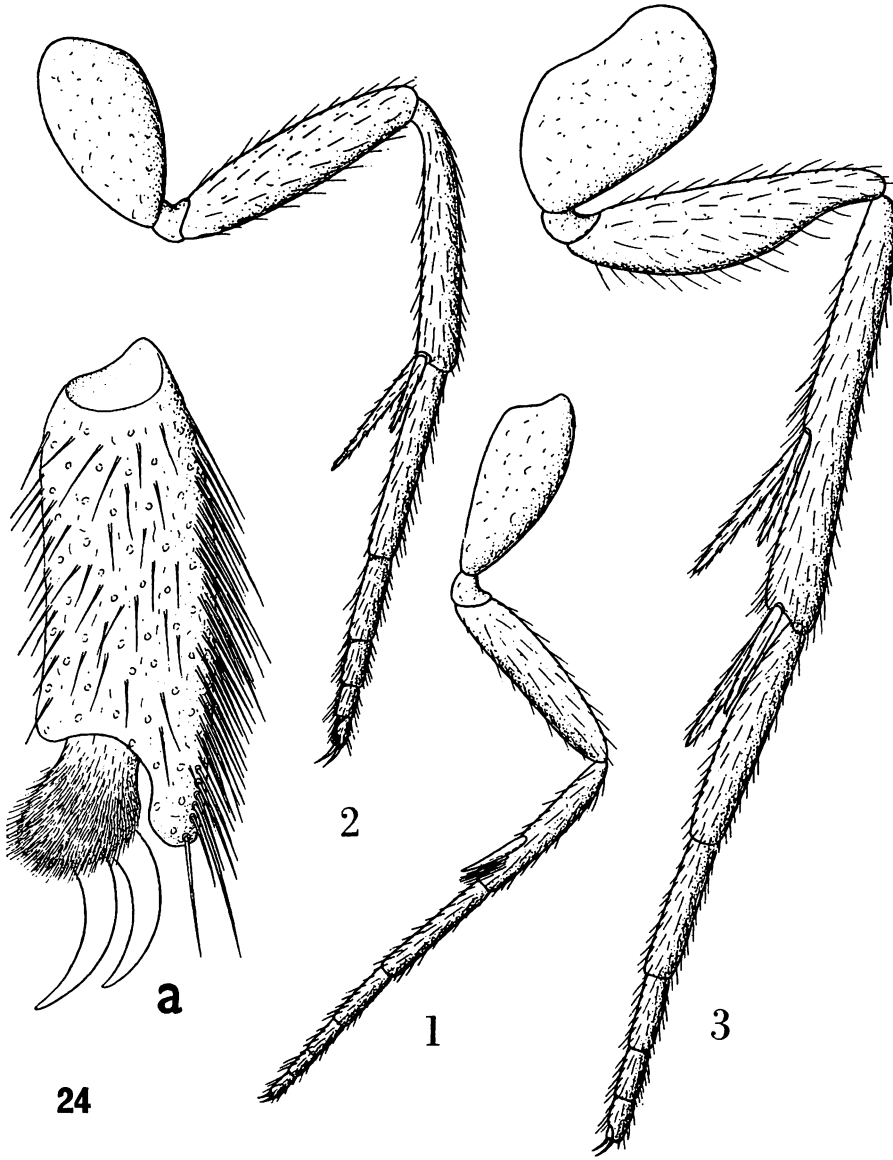


Figure 24—Details of the legs of *Acrolepia assectella* (Zeller), Yponomeutidae. 1, 2, 3, fore, mid, and hind legs, descaled. a, distal part of mesotarsus. Compare figure 23. (After Frediani, 1954.)

adapted to restricted ecological niches. All too often efforts made to rear Hawaiian moths from immature stages end in failure. Frequently only crippled moths develop from specimens reared to the adult stage. The life cycle may often be carried to the pupal stage, but no adults emerge. Larvae frequently die from unexplained causes or are overwhelmed by molds or diseases. But it is the introduced foreign parasites that usually cause greatest distress. Many foreign parasites of lepidopterous eggs, larvae, and pupae have been accidentally or purposely introduced to Hawaii (and more are continually being introduced), and they have decimated the endemic Hawaiian Lepidoptera. A large percentage of these parasites attack many species of moths (see p. 98).

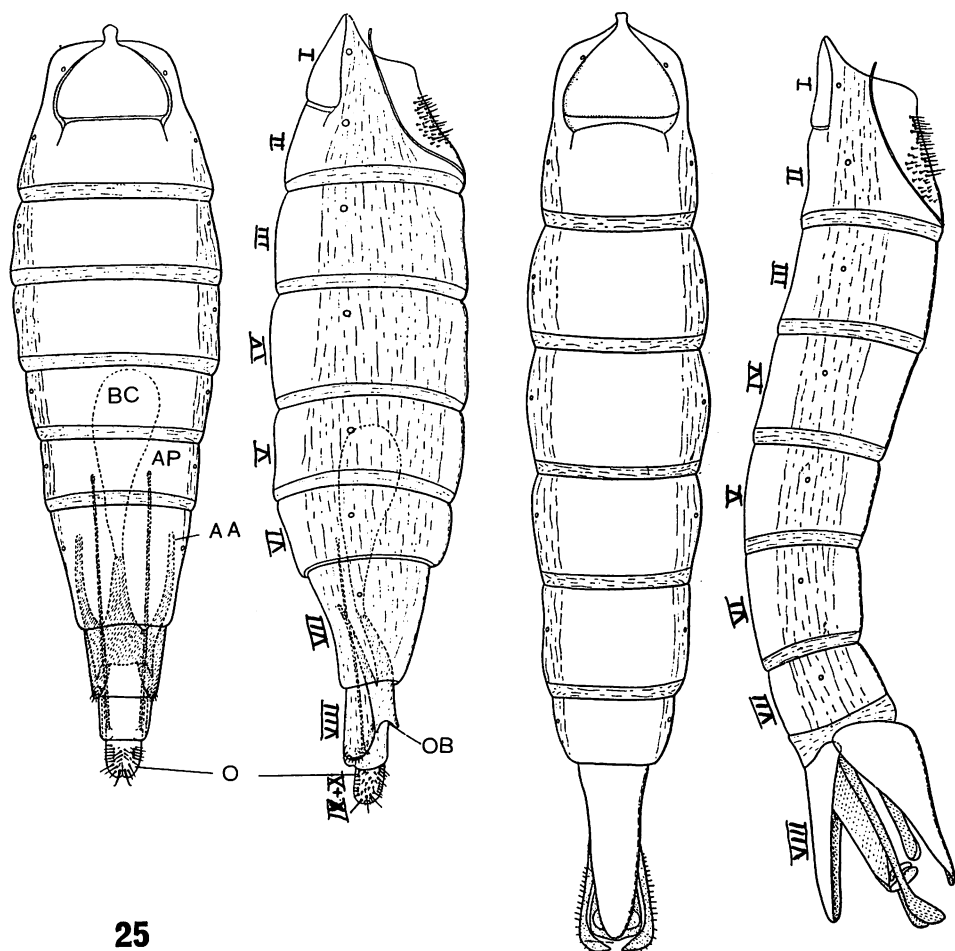
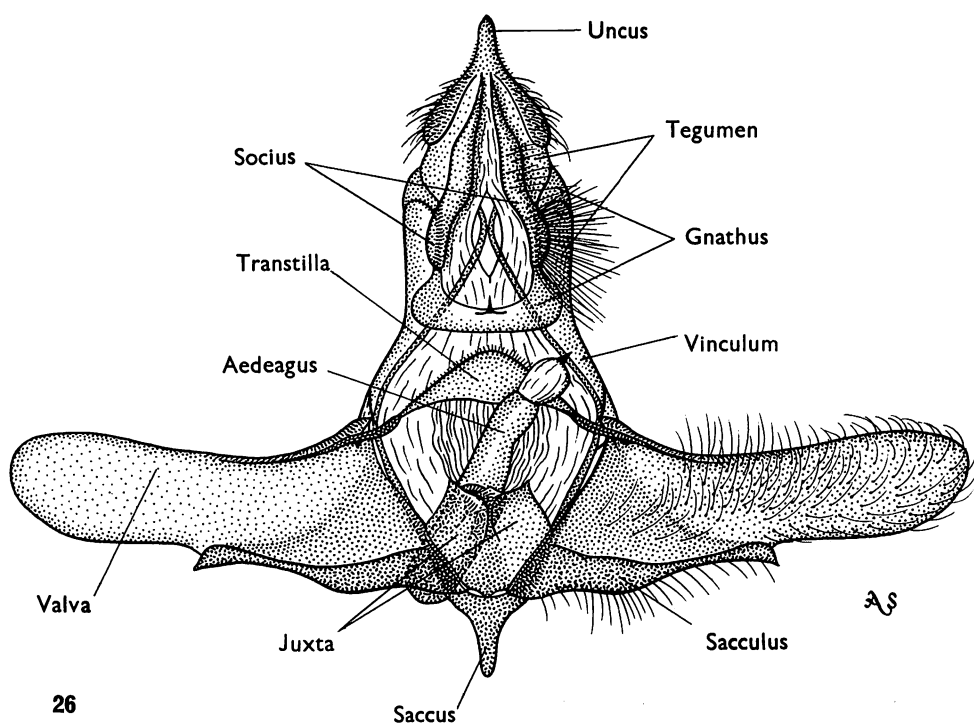


Figure 25—Dorsal and lateral aspects of the abdomen of a female (left) and a male (right) of *Phthorimaea operculella* (Zeller), Gelechiidae. *AA*, anterior apophyses; *AP*, posterior apophyses; *BC*, bursa copulatrix; *O*, ovipositor; *OB*, ostium bursae. (Modified from Bartoloni, 1951.)

Thus, many endemic moths are now rare, and others have been exterminated. Not being host-specific, many of these foreign parasites have been able to maintain high populations in spite of the reduction in the numbers of this or that delicately adjusted, highly vulnerable endemic moth. It is not unusual to find 90 percent or even higher rates of parasitism in the immature stages of endemic moths. This is most discouraging, and it makes our task of studying the extraordinary endemic fauna doubly difficult and frustrating.

If one rears specimens so that larvae and pupae are associated correctly with the adults, one should always try to preserve some larvae and whole pupae.



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Figure 26—Male genitalia of a hypothetical moth, spread open. (Modified from Torre-Bueno, 1937.) It will be noted that I have used *gnathus* instead of *gnathos*. When Chapman originally proposed the term *gnathus* (1911:287), he said "I would call it 'gnathus' (*γναθος*), anglicized 'gnath' in allusion to its so often resembling a lower jaw. . . ." Chapman, as the inventor, had the right to name the organ *gnathus*. Inasmuch as I began to use Chapman's original spelling when I first began my Hawaiian work and have used that spelling in Volumes 7 and 8 of this series, I have continued to use the spelling in this volume. I do not know who first proposed the change to the pure Greek *gnathos* (feminine), but it appears to me easier and better to use the original spelling *gnathus* in agreement with such other parts of the male genitalia as *uncus*, *socius*, *anellus*, *saccus*, *sacculus*, and *aedeagus*. There are, of course, many generic names incorporating *gnathos*, and these are latinized to take the form of such names as *Syngnathus*.

Some workers persist in wrongly using the term *harpe* for *valva*. The term *harpe* (plural: *harpes*) was used originally for structures on the ental face of the valva, and it should not be used for the valva. See figures 27 and 28 for *harpes*.

The term *aedeagus* was originally proposed by Foudras in 1859 (1860:144); I have always followed his spelling.

If one cannot do that, one should at least preserve the cast larval and pupal skins of the specimens. Satisfactory specimens can often be prepared from seemingly impossibly crumpled cast larval skins. The cast larval skins are best preserved in fluid, but pupae and pupal skins may be preserved dry. Always take great care to associate correctly the cast skins with the exact specimens emerging from them; otherwise one may wrongly associate a female pupal skin with a male moth or even place the cast skins of the immature stages of one species with moths of another species which might have been bred from the same host material. Larvae should be killed in near-boiling water, and then they may be preserved in 70 percent alcohol to which a small amount of glycerin has been added. If the larvae cannot conveniently be killed in hot water, they may be killed and preserved in a solution of 80 percent alcohol containing 10 percent glacial acetic acid (usually it is best not to leave them more than a few weeks in this fluid). The specimens should be stored in the dark.

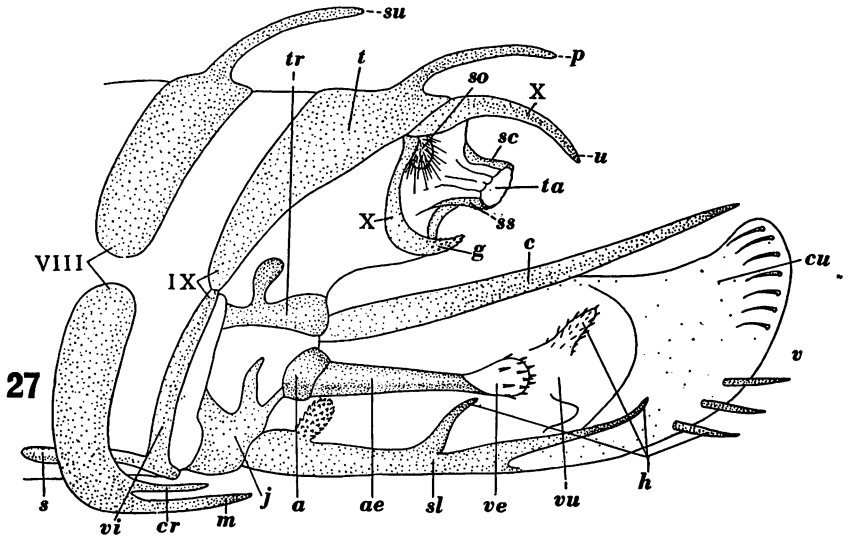


Figure 27—Diagram of the genitalia of a hypothetical lepidopteron, viewed from the left side and with the left valva removed. VIII, IX, X refer to parts of the abdominal somites; *a*, anellus; *ae*, aedeagus; *c*, costa; *cr*, ceratum; *cu*, cucullus; *g*, gnathus; *h*, harpe; *j*, juxta; *m*, mappa; *p*, pseuduncus; *s*, saccus; *sc*, scaphium; *sl*, sacculus; *so*, socius; *ss*, subscaphium; *su*, superuncus; *t*, tegumen; *ta*, anal tube (tuba analis); *tr*, transtilla; *u*, uncus; *v*, valva; *ve*, vesica ("internal sac"), the spinelike processes are cornuti; *vi*, vinculum; *vu*, valvula. (After Diakonoff, 1954:70; see his paper for a discussion and history of the nomenclature.)

## NOTES ON THE PREPARATION OF DISSECTIONS OF MICROLEPIDOPTERA FOR MICROSCOPICAL STUDY

It is essential that carefully prepared dissections be made if one wishes properly to study Microlepidoptera. Accurate identifications are frequently impossible to make without dissections. Good preparations require care, patience, steady hands, practice, and time. The wing venation usually cannot be examined properly without slide mounts, and it is almost always essential that genitalia be prepared and mounted on slides or stored in glycerin in microvials. Because many of the older workers failed to make wing and genitalia preparations, we now find that they slipped frequently into serious error. Simplified techniques for making microscope slide mounts have become widely adopted and generally accepted today, and I will outline methods that are used with success by a number of workers.

The earliest study of Lepidoptera genitalia in America appears to be that of Scudder and Burgess in 1870, but their work attracted little attention at that time. Good photographs of Lepidoptera genitalia were published as early as 1888 by Max Standfuss. Most unfortunately, the importance of the proper study of genitalia was not realized, or accepted, by many workers. Thus, Meyrick, who described about 20,000 species of Lepidoptera, ignored the genitalia. His published works are saturated with errors as a consequence. Even today, new species are being described without illustrations of the genitalia, and this contributes to the difficulties of our work. *No new species should be described without adequate illustrations!*

If one wishes to examine wing venation in a rough way, and sometimes this method may be adequate, one may find that wetting the wings *in situ* with alcohol, benzene, xylene, or similar fluid will allow him to see certain venational features. (CAUTION: benzene and xylene are poisons and should be used with care.) It is usually best, when using this method, to examine the venation from the ventral side of the wing, and various features often may be ascertained if the wings are rotated in a strong light while being viewed. In many instances, however, this method is inadequate, because it may not reveal with sufficient clarity features of diagnostic importance. Many authors have interpreted erroneously the wing venations of many species by reliance upon this superficial method of wing examination.

To make microscope slide mounts of wings, the following steps may be followed:

1. Wet the wings of the right side with 70–80 percent alcohol applied with a camel's hair brush. Wetting the wings will prevent their being blown away by breath or by air currents after they have been cut free from the body.
2. Cut or break the wings off as close to the thorax as possible. A small chip of razor blade (broken off the edge of a blade by using pliers) cemented to the end of a drawn-out glass tube makes an excellent small scalpel useful for this and other operations. A dissecting needle may also be used.
3. Place the wings in alcohol to wet completely.



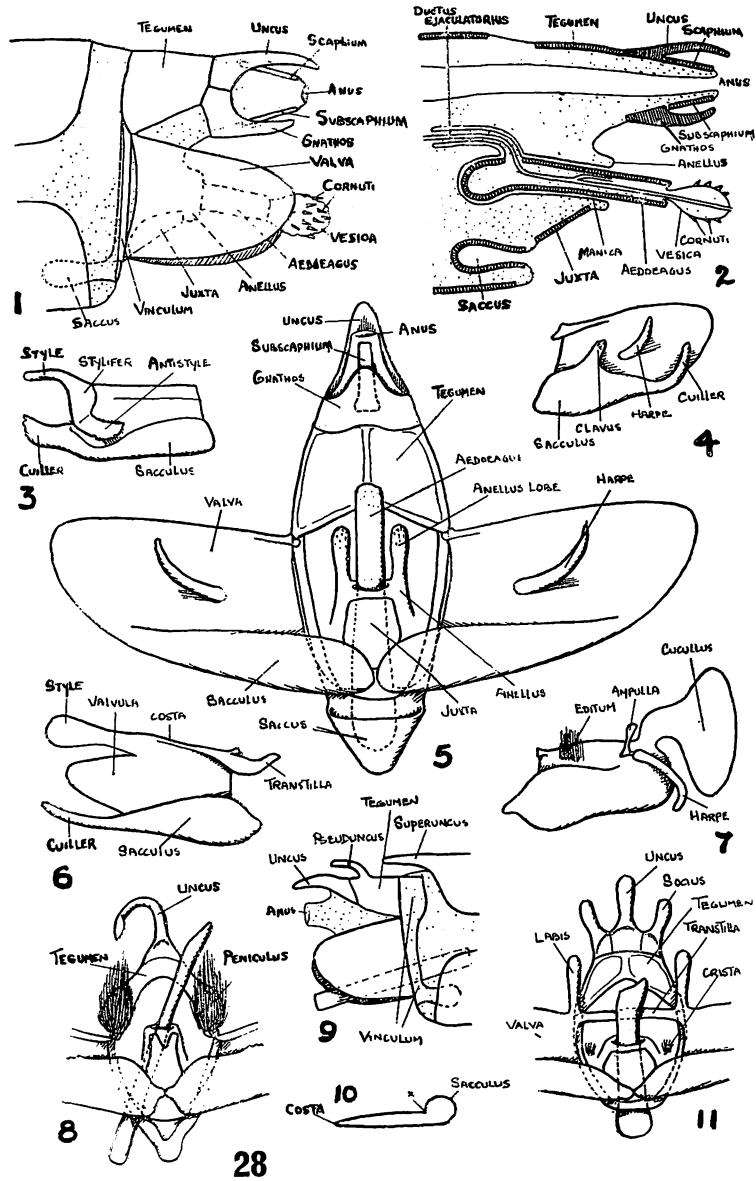


Figure 28—Diagrams of details of the male genitalia of Lepidoptera. 1, apex of abdomen in lateral aspect; 2, longitudinal section through the same; 3, 4, 5, 6, 7, views of the inner surfaces of the valvae of various forms to show details; 5, ventro-caudal aspect of the genitalia with the valvae spread open; 8, 11, ventrocaudal views of parts of two different genitalia spread open to show various structures; 9, lateral aspect of the apex of the abdomen of another form; 10, cross section near the base of a valva. (After Beirne, 1942.) (Continued at bottom of page 75.)

4. Transfer the wings to pure laundry bleach (5 percent sodium hypochlorite solution, "Eau de Labarraque", known as "Chlorox", etc., in America) to clear. Watch carefully under the microscope, because the bleaching process is rapid and the wings may be damaged if allowed to remain in the chemical too long. Keep the wings under the surface of the bleach by pressing them down with a dissecting needle or fine forceps, as required. As soon as the wings are bleached to the desired degree (usually at the time when numerous bubbles begin to form on the wings in only a few minutes), transfer to water. Very carefully wash and clean away dirt, scales, and hairs with a small, trimmed camel's hair brush and/or curved dissecting needles. A gentle tapping or pumping motion with the dissecting needle may be adequate. Use short, gentle movements to avoid tearing the wings, which are very fragile at this stage. Clean especially carefully around the wing cells and edges of the wings to make possible the examination of the origins and points of termination of the veins. (CAUTION: *great care must be taken in this operation or the delicate wings will be damaged.*)

5. Transfer to 70 percent alcohol and continue cleaning. Change the alcohol as required for effective cleaning.

6. Transfer to 95 percent or absolute alcohol and complete cleaning.

7. Carefully clean a glass microscope slide and a cover slip. I have found that a rubber ear-syringe is helpful to complete the cleaning, because, by puffing air on the slide and coverslip, one may blow away dust which is almost impossible to remove with a cloth. Of course, the slide must be thoroughly cleaned first, because the air blast is useful only in removing flecks of loose dust on dry slides.

Beirne (1942:38) gave the following comparative details of morphological structures of the terminalia and their equivalents in the Lepidoptera:

STRUCTURE	EQUIVALENT IN LEPIDOPTERA
Segment 8	Segment 8 (+ coremata)
Tergum	Tergum (+ superuncus, etc.)
Sternum	Sternum
Segment 9	Segment 9
Tergum	Tegumen (+ pseuduncus, etc.)
Sternum	Juxta
Gonopods	Valvae (+ transtilla, etc.)
Parameres	Anellus lobes
Phallus	Phallus
Phallobase	Anellus
Endotheca	Manica
Aedeagus	Aedeagus
Endophallus	Vesica (+ cornuti)
Intersegmental membrane between segments 8 and 9	Vinculum (+ saccus)
Segment 10	Segment 10
Tergum	Uncus
Sternum	Gnathus
Segment 11	Anal tube
Tergum	Scaphium
Sternum	Subscaphium
Pygopods	Socii

8. Transfer the wings to the *clean* microscope slide. This process may often prove awkward, but, to simplify the process, follow these directions: (a) wet the right end of the slide with 95 percent or absolute alcohol for about 25 mm.; (b) slip the right end of the slide down into the dish of clean alcohol containing the wings; (c) with the assistance of a fine brush or a needle, float the wings (dorsal side up and with base to the left) onto the wet end of the slide and arrange in proper position (add a few drops of alcohol to the slide to assist floating the wings to position, as required); (d) working rapidly, wipe off surplus alcohol around the wings and remove any fibers or dirt that may be noticed (but do not allow the wings to dry or curl and thus pull away from the slide); (e) cover the wet wings with a *clean* coverslip which has previously been prepared; (f) attach the coverslip to the slide with an ordinary microscope slide label which has a large, appropriate-sized, circular hole cut in the middle (cover the label and coverslip with a piece of paper and rub gently around the edges of the coverslip to glue carefully the label to the slide to seal down the

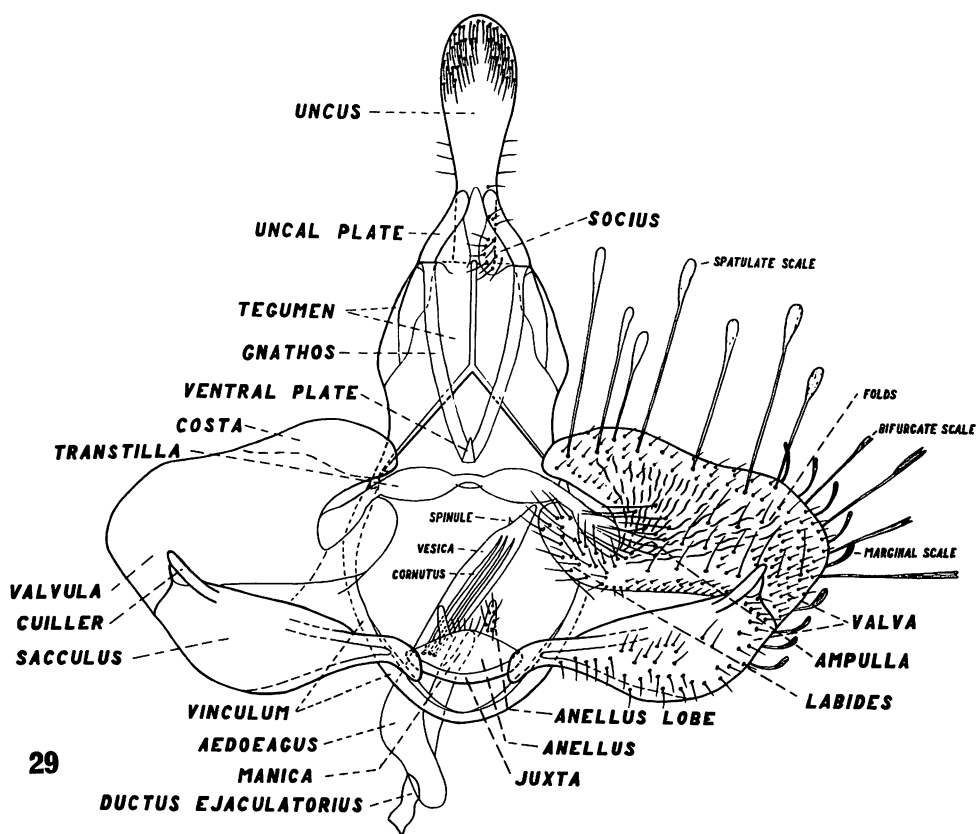


Figure 29—Male genitalia of a hypothetical species of torcid to show various structures. For "aedoeagus", read aedeagus. For "gnathos", read gnathus. (Source of drawing unknown.)

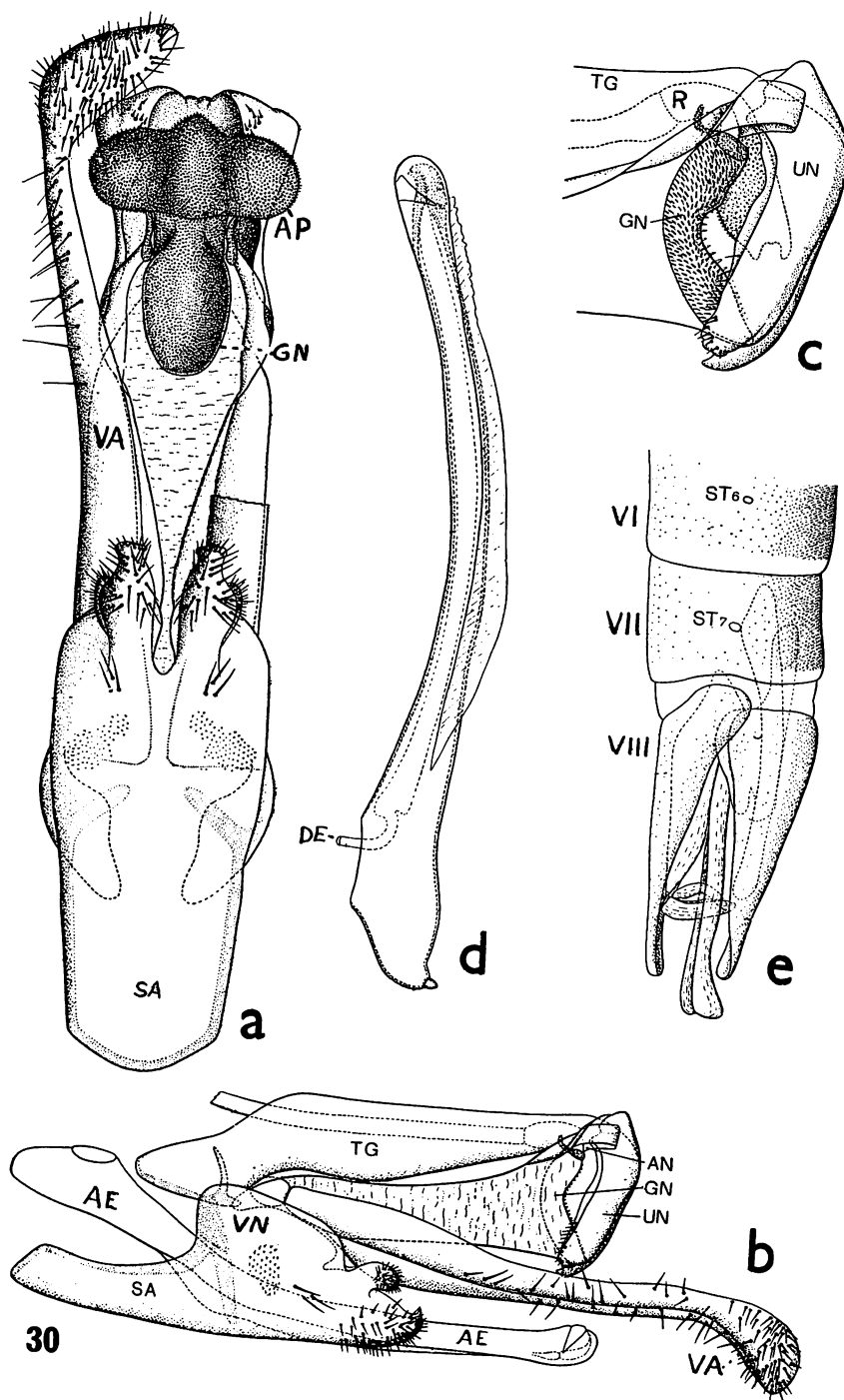


Figure 30—Male genitalia of *Phthorimaea operculella* (Zeller), Gelechiidae (rearranged from Bartoloni, 1951). *a*, ventral aspect with right valva removed and anal papillae expanded; *b*, left lateral aspect; *c*, left lateral aspect of apex of tegumen and appendages; *d*, aedeagus; *e*, right lateral aspect of caudal end of abdomen. *AE*, aedeagus; *AN*, anus; *AP*, anal papilla; *DE*, ductus ejaculatorius; *GN*, gnathus; *R*, rectum; *SA*, saccus; *ST*, spiracle; *TG*, tegumen; *UN*, uncus; *VA*, valva; *VN*, vinculum.

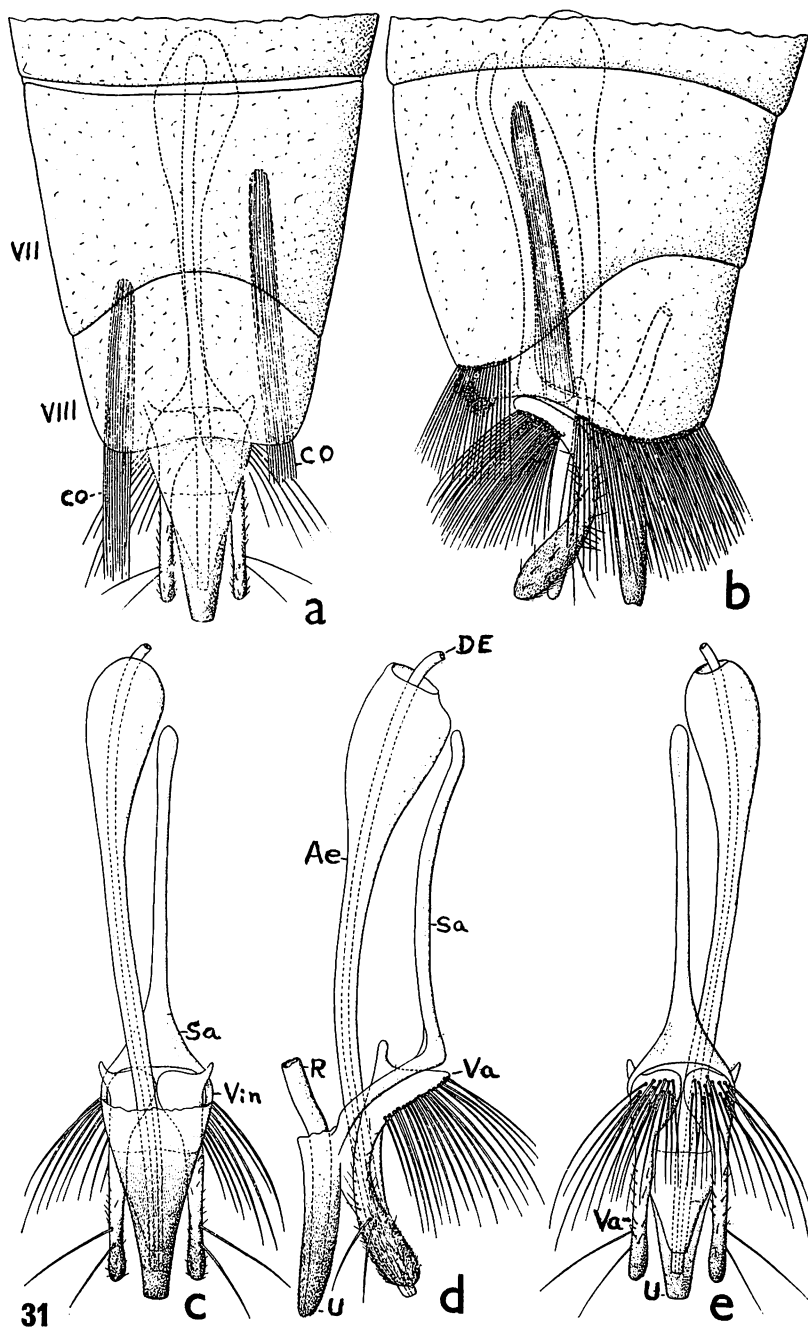


Figure 31—Details of the male abdomen and genitalia of *Acrolepia assectella* (Zeller), Yponomeutidae (rearranged from Frediani, 1954). *a* and *b*, dorsal and lateral aspects of the caudal end of the abdomen; the left corema is shown partly extruded; *c*, *d*, and *e*, dorsal, right lateral, and ventral aspects of the male genitalia. *Ae*, aedeagus; *Co*, corema (plural: coremata; scent-dispersing hair-brushes); *DE*, ductus ejaculatorius; *R*, rectum; *Sa*, saccus; *U*, uncus; *Va*, valva; *Vin*, vinculum; *VII*, *VIII*, seventh and eighth abdominal somites.

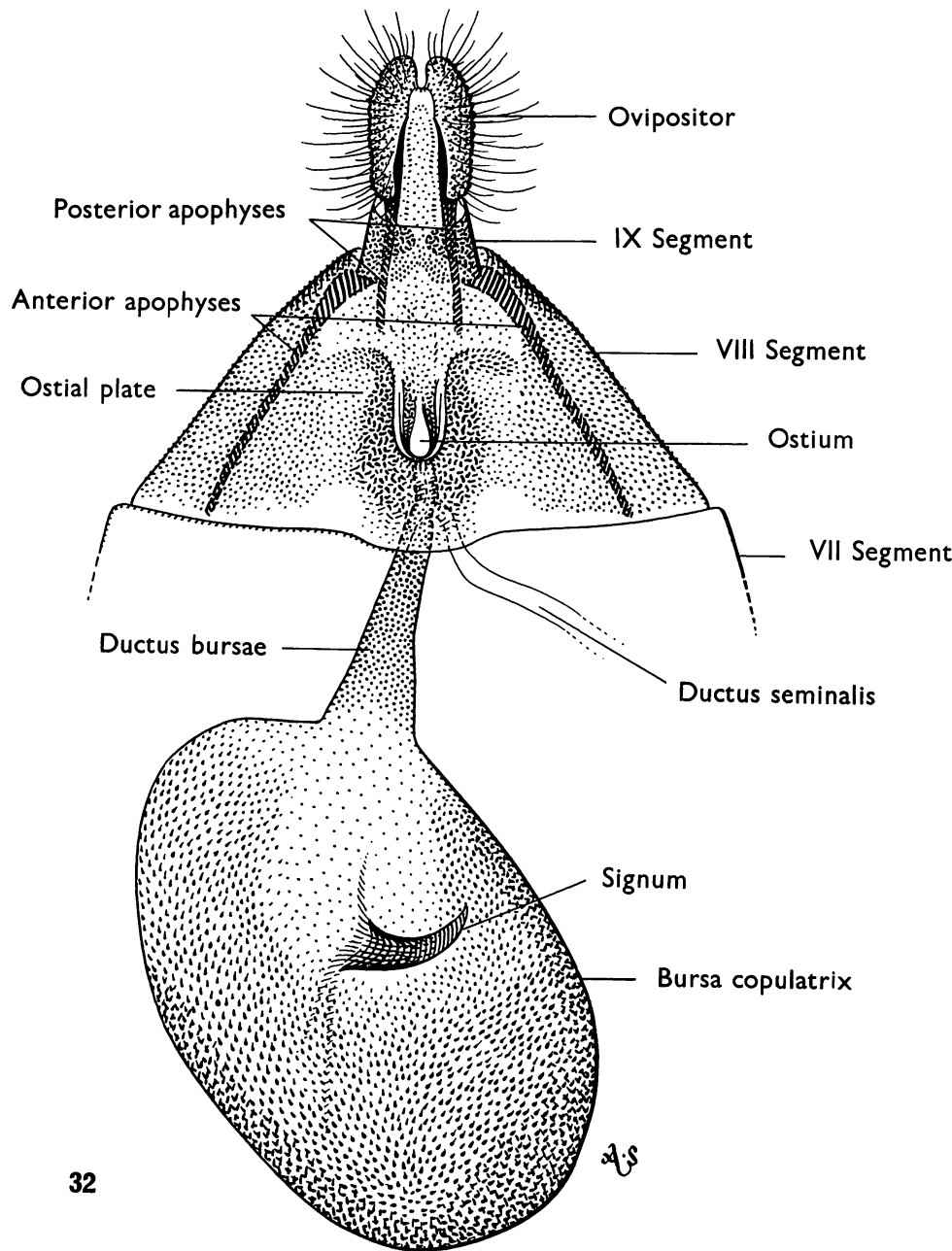


Figure 32—Diagram of the female genitalia of a hypothetical moth.

coverslip); at this stage the wings will still be moist with alcohol; (g) allow the preparation to dry for examination (the veins often are not easily traced before the slide is completely dry); (h) label the slide. The prepared slide may be placed in a projection apparatus and the venation easily and accurately drawn.

As early as 1876, Dimmock (p. 228) referred to the use of sodium hypochlorite to bleach the wings of Lepidoptera.

For those who have steady hands and great patience, wing slide preparations of superior quality may also be made without using bleaching fluid. The wings are placed in alcohol and the scales removed with a dissecting needle with a slightly curved end and a small brush. Some Europeans use small, stiff, specialized feathers obtained from the wings of snipes as excellent descaling tools. I have seen superb slides made by this process, and, when well done,

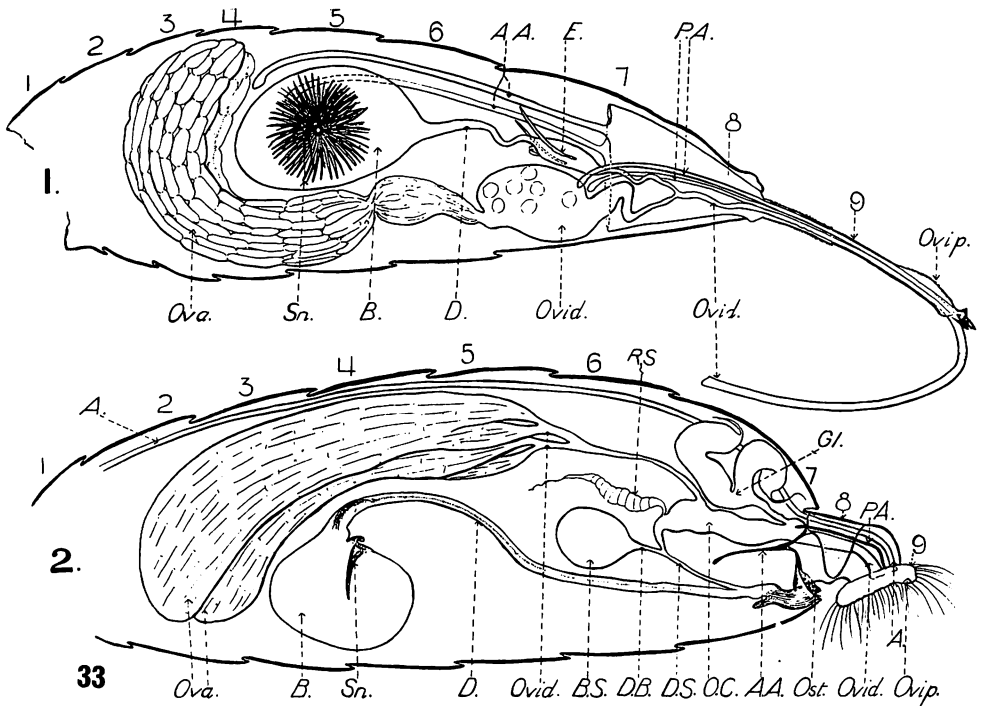


Figure 33—Schematic longitudinal sections through the female abdomens of (1) a moth with one sex opening (*Tegeticula alba* Zeller, yucca moth) and (2) a moth with two sex openings [*Archips rosanus* (Linnaeus)]. These are examples of the Monotrysia and the Ditrysia, major divisions of the Lepidoptera (after Busck, 1931). 1 to 9, the abdominal segments; A, alimentary canal; A. A., anterior apophyses; B, bursa copulatrix; B. S., bulla seminalis; D, ductus bursae; D. B., ductus bullae; D. S., ductus seminalis; E, enlarged part of ductus bursae; Gl., gland; O. C., common oviduct; Ost., ostium; Ova., ovaries; Ovid., oviducts; Ovip., ovipositor; P. A., posterior apophyses; R. S., receptaculum seminalis (spermatheca); Sn., signum.

certain minute characters may be revealed which may not be visible on ordinary preparations. It does, however, take more time and care than does the bleaching method.

[Since the foregoing outline for the preparation of wings for study was written, several years ago, I have become an associate of Ian Common in

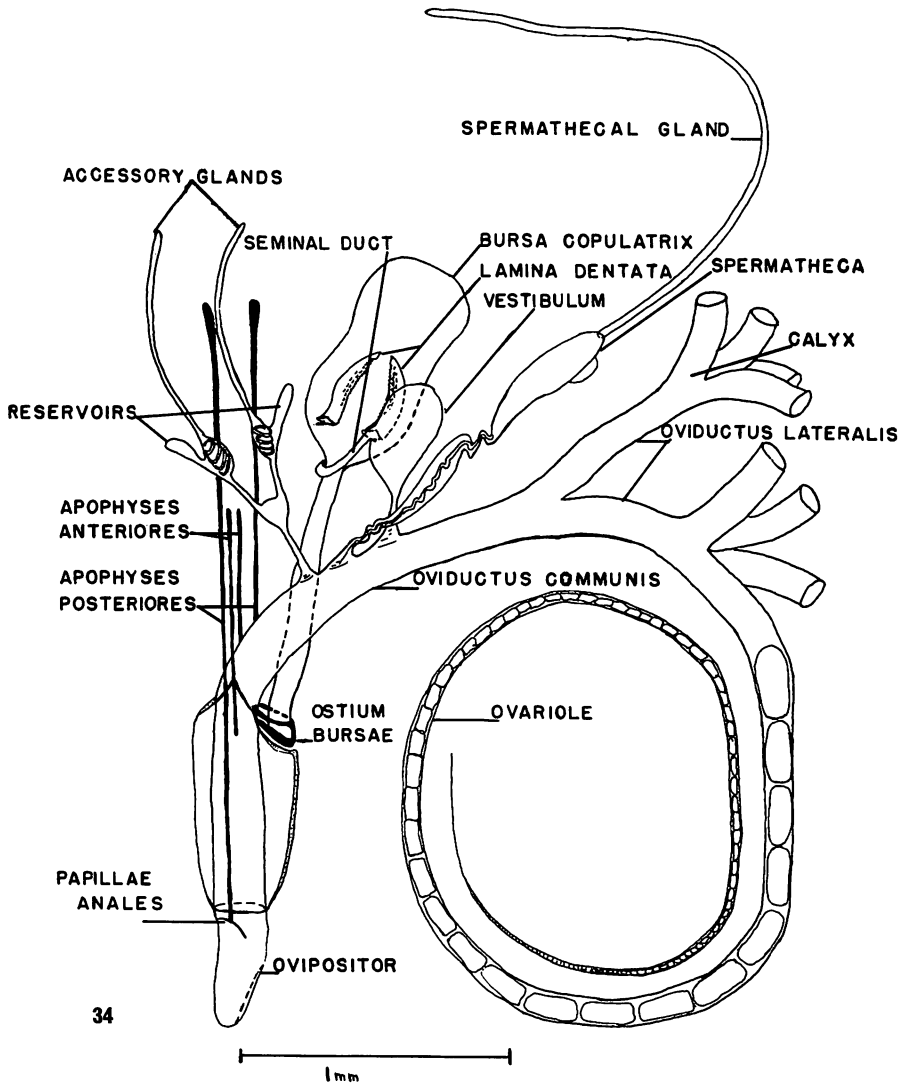


Figure 34—Female genitalia of *Pectinophora gossypiella* (Saunders), Gelechiidae, the pink bollworm. For "lamina dentata", read signa. (Drawing kindly loaned by S. G. Wellso.)



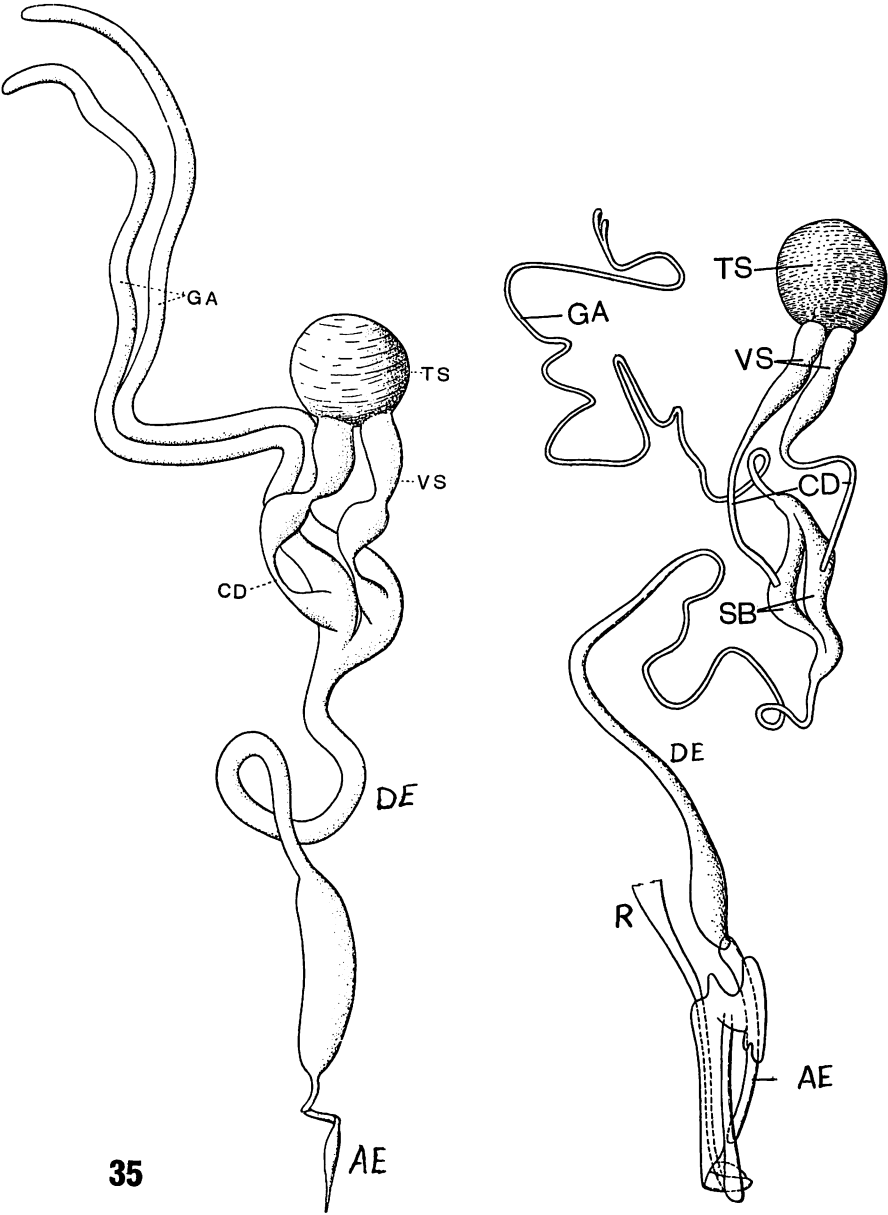


Figure 35—Male genitalia of *Acrolepia assectella* (Zeller), Yponomeutidae, left (modified from Frediani, 1954) and *Phthorimaea operculella* (Zeller), Gelechiidae, right (modified from Bartoloni, 1951). AE, aedeagus; CD, vasa differentia; DE, ductus ejaculatorius; GA, accessory glands; R, rectum; SB, reservoirs; TS, testis; VS, seminal vesicals.

Australia and have observed the excellent wing preparations made by him. Dr. Common stains the bleached wings and mounts them in Euparal. The product is of superior quality, folds are easily distinguished from veins, and the veins are revealed in better detail than in most unstained, dry-mounted preparations. I now recommend this technique, as follows:

1. Remove the wings as noted in "2" above. Cut off the hindwings first by cutting downward.

2. Place the wings in about 70 percent alcohol to wet completely.

3. Transfer the wings to the sodium hypochlorite solution and watch carefully until they are completely bleached. (See "4" in the foregoing discussion.)

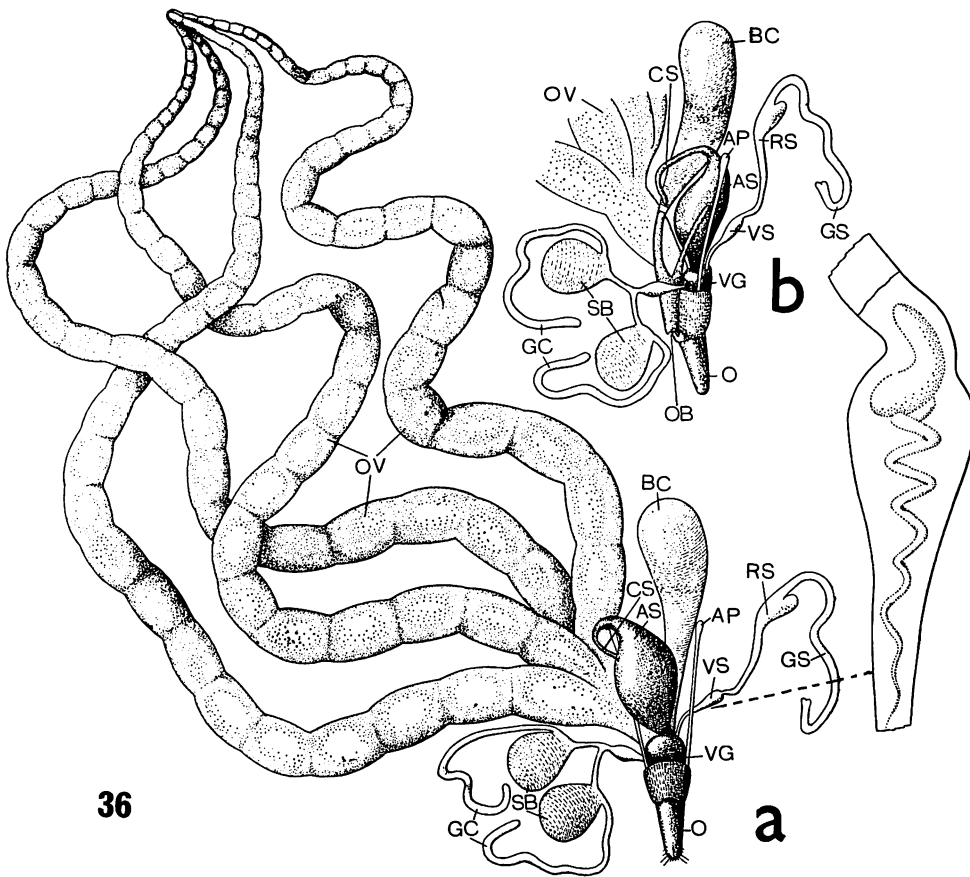


Figure 36—Female genitalia of *Phthorimaea operculella* (Zeller), Gelechiidae (modified from Bartoloni, 1951); only one ovary, with its four ovarioles, is shown. *a*, dorsal aspect; *b*, lateral aspect. *AP*, anterior apophyses; *AS*, bulla seminalis; *BC*, bursa copulatrix; *CS*, seminal canal; *GC*, colleterial glands; *GS*, spermathecal gland; *O*, ovipositor; *OB*, ostium bursae; *OV*, ovarioles; *RS*, spermatheca; *SB*, accessory gland reservoirs; *VG*, vagina; *VS*, seminal vesical. The colleterial glands produce a substance used to glue the eggs to the hostplant.

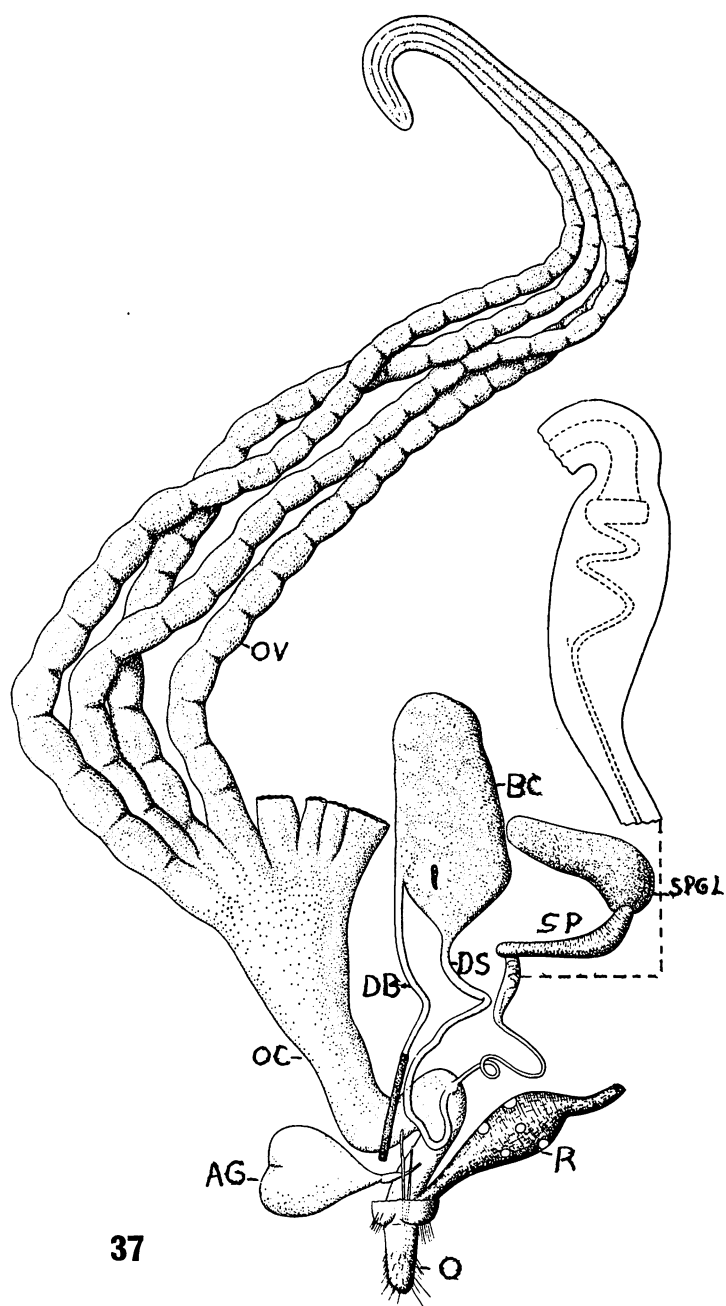


Figure 37—Female genitalia of *Acrolepia assectella* (Zeller), Yponomeutidae (modified from Frediani, 1954). AG, accessory gland; BC, bursa copulatrix; DB, ductus bursae (shown here detached from ostium bursae); DS, ductus seminalis; O, ovipositor; OC, oviductus communis; OV, ovariole; R, rectum; SP, spermatheca; SPGL, spermathecal gland.

4. Transfer the bleached wings to distilled water. Wash thoroughly in four changes of distilled water and leave the wings in the water for a few minutes between each change of water. It is of critical importance that all traces of the bleach be removed at this stage.

5. Transfer the wings to a stain prepared according to the following formula: 10 gm chloral hydrate, 5 ml acetic acid, 1 gm acid fuchsin, 100 ml of 50 percent ethyl alcohol. Stain for about 24 hours.

6. Remove the wings from the stain and dip momentarily into about 95

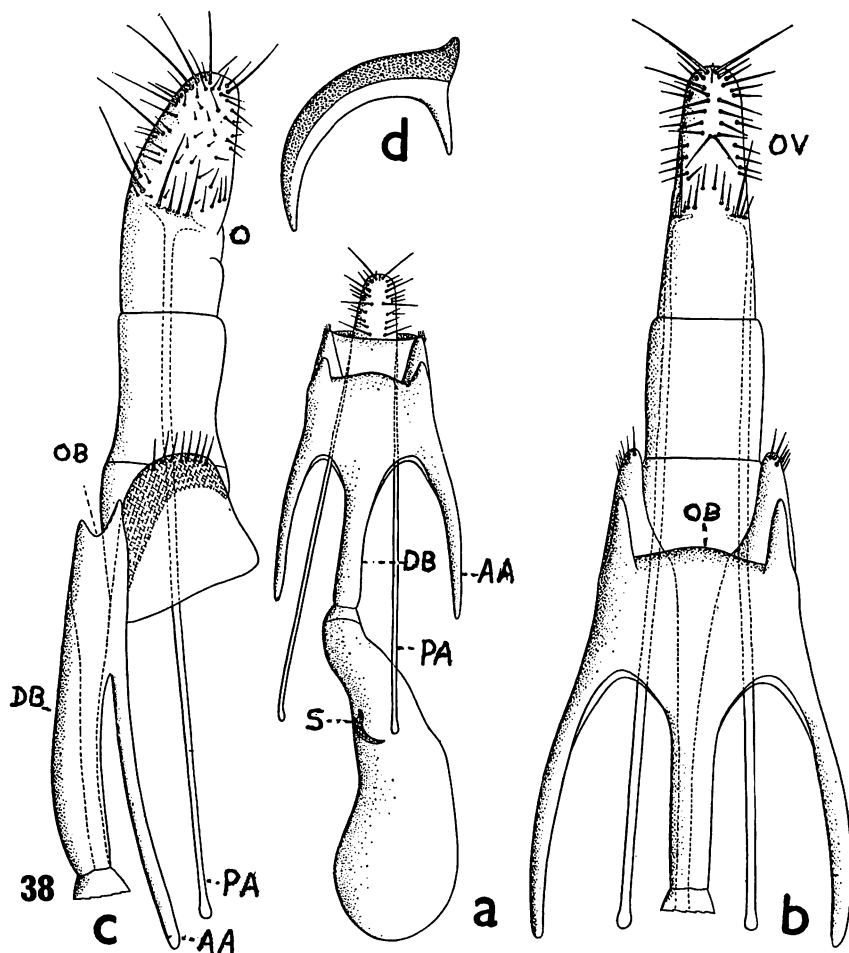


Figure 38—Details of the female genitalia of *Phthorimaea operculella* (Zeller), Gelechiidae (modified from Bartoloni, 1951). *a*, ventral view with ovipositor retracted; *b*, the same, with ovipositor extended; *c*, right aspect; *d*, signum; *AA*, anterior apophyses; *DB*, ductus bursae; *O*, ovipositor; *OB*, ostium bursae; *PA*, posterior apophyses; *S*, signum. Compare figure 39 of *Acrolepia*; note difference in attachment of the anterior apophyses and the fusion with ductus bursae.

percent alcohol (two changes) to rinse off excess stain, and then transfer rapidly to absolute alcohol. (NOTE: the stain is removed rapidly in alcohol of less than absolute purity, and passage through the 95 percent alcohol should be as rapid as possible.)

7. Transfer the wings to a glass slide by the use of a camel's hair brush placed longitudinally beneath the wings in fluid and lifting them to the slide where, by the use of a rolling motion of the brush, they are spread flat. Watch carefully as the alcohol evaporates and apply the Euparal when the alcohol has receded from the slide to the margins of the wings. Arrange the wings in correct positions on the slide and apply the coverslip.

Perhaps the most important advantage of using Ian Common's technique is that it is not necessary to descale the wings. Because no abrasion is required, there is no danger of damaging the delicate wing membrane. The laborious,

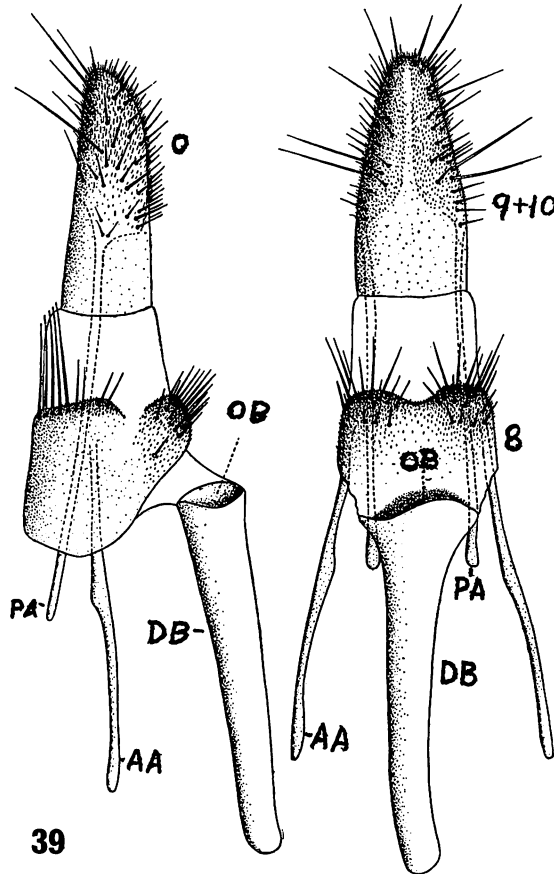


Figure 39—Distal parts of the female genitalia of *Acrolepia assectella* (Zeller), Yponomeutidae, in lateral and ventral aspects (after Frediani, 1954). AA, anterior apophyses; DB, ductus bursae (heavily sclerotized in this species); O, ovipositor; OB, ostium bursae; PA, posterior apophyses; 8, 9, 10, eighth to tenth somites. Compare figure 38 of *Phthorimaea* and note the different structure.

time-consuming, patience-trying process necessary to prepare dry mounts as outlined above is a major disadvantage of that system, and it is often extremely difficult to avoid damaging the wings no matter how careful, experienced, and patient one is. Strangely, the scales and hairs mostly seem to disappear from view in the bleached, stained, Euparal-mounted preparations, and even faint veins stand out clearly.]

To prepare the genitalia, the following procedures may be followed:

### **HOT POTASH TREATMENT OF GENITALIA**

1. Wet the abdomen with alcohol (a wet abdomen will usually stick to the surface upon which it falls and is less liable to be lost if accidentally dropped). Break the abdomen off the thorax. This can usually be done easily by gently lifting the abdomen upward, causing it to break away at the base. If the abdomen fails to break away easily and there is danger that part of the thorax may break away with it, weaken the base of the abdomen by cutting or piercing the base with a small scalpel or a dissecting needle; experience will be your teacher.

2. Transfer the abdomen to 70–80 percent alcohol to wet completely. This step will enable the specimen to sink immediately under the surface of the potash and will hasten the penetration of the potash.

3. Place the abdomen in a heat-tolerant glass tube to which has been added a 10 percent solution of KOH or NaOH to a depth of two or three centimeters. Place the tube in a beaker of water. Heat the water at most to a gentle boil and allow digestion to proceed for five to ten minutes, depending upon the size of the specimen.

**WARNING:** It is dangerous and undesirable to heat or to boil the caustic potash directly over a flame or heat, and such a practice may ruin the specimen. The potash should never be heated to a temperature above that of boiling water. If heat is used to hasten digestion, the tube containing the specimen in the potash should always be placed in water. Do not cork the tube. When heat is applied to a corked tube, the tube will either burst or the cork will be violently expelled, together with the caustic compound and the specimen, and the worker may be injured. The open end of the tube may be closed with a loose plug of cotton wool, if desired.

Should a convenient source of heat, such as a stove, gas or electric fire, not be available, an electric light placed very close to the dish or tube containing the specimen will heat the potash to a safe and satisfactory temperature for rapid digestion.

4. Place some glacial acetic acid in a watch glass or cavity slide and remove the specimen from the potash to the acid. Now, with dissecting needles, gently clean away hairs and scales and the debris from within the abdomen. A fine camel's hair brush and a pair of very fine forceps may also be desirable for this operation. Change the fluid as required. It is best to clean the genitalia and abdomen as carefully as possible at this stage when they are less apt to be damaged; the tissues harden after they are placed in alcohol and are then

more easily damaged. If the specimen does not clean thoroughly and easily, return it to the hot potash and leave it for a few minutes, or simply shake it in the hot potash for a few seconds, which may be all that is required. Return it again to the acid and continue to clean. Repeat these processes until the specimen is completely clean. The use of acid will often produce a better preparation, because it may dissolve certain materials or enable them to be washed away more easily.

5. Transfer the specimen to water to remove the acid and clean further if required.

6. When the preliminary cleaning is done, and while the genitalia are still attached, transfer the abdomen from the water to a solution of the antiseptic known in America as "Mercurochrome" (dibromoxymercuri-fluorescein-sodium 2 percent aqueous solution; one may also obtain the stain in crystal form and make a stronger solution by adding crystals to a small amount of water), or to another appropriate stain, for staining. A small amount of Mercurochrome in a cavity slide or in a watch glass or other small receptacle is adequate. Leave the tissue in the stain for a few minutes, depending upon the character of the specimen and past experience in staining. This is a simple operation. The Mercurochrome stain is easily obtained, at least in America and England, and it has proved to be simple to use, completely satisfactory, and superior to some other stains.

7. Transfer the specimen from the stain to a tube containing water and shake vigorously. Place again in water on the cavity slide or watch glass and clean further as required. Now carefully dissect the genitalia from the abdomen by tearing the abdominal tissue cephalad of the attachment of the genitalia. If the aedeagus is to be removed from the male genitalia, pull it from the cephalic side. Be sure to cut the abdominal skin from the female genitalia cephalad of any sclerotizations near the ostium. Clean off any superfluous membranes and debris from the dissections.

8. Transfer the dissected parts to 70 to 80 percent alcohol (again on a cavity slide or watch glass) and spread the genitalia as desired; this is often best accomplished for the males at the shallow edge of the fluid. Turn the genitalia convex side up and spread with curved forceps or needles; then hold the genitalia down tightly for a few seconds to allow them to harden in correct position in the alcohol. Add fresh alcohol as required. (CAUTION: do not allow the specimens to become dry or they may be damaged or air bubbles may develop within various cavities.)

If one wishes to study and to draw various parts in different positions, the specimens may be transferred to glycerin. One may then store the parts in glycerin in the bottom of a microvial which may be placed on the pin beneath the moth. Only a very small drop of glycerin in the bottom of the tube is used; otherwise, the glycerin may creep up the tube and around the cork, and this may cause the pin to rust. The sides of the microvial must be kept free from glycerin and the cork must never come into contact with the glycerin.

If the specimen is to be mounted permanently on a microscope slide, continue as follows:

9. Transfer the parts from 80 to 95 percent alcohol (or absolute alcohol if available), quickly spread the genitalia, as required, and hold in position for a short time until the desired shape is retained; clean off any debris which may remain.

10. Transfer to Euparal solvent and then mount in Euparal (if the solvent is not available, it will usually prove satisfactory to pass from the 95–100 percent alcohol to Euparal.). Use great care to arrange the parts in such a way that they may be photographed or drawn with the best possible results. The abdominal pelt should always be mounted with the genitalia.

If the genitalia are cut into several parts which may easily become disoriented upon application of the cover slip, it may be advisable to arrange the parts on a layer of mountant which is then allowed to thicken for a short time. The parts will then be held in the desired position while a drop or two of fresh mountant is placed over the material and the cover slip is applied. It may be necessary to add a drop or more of thin mountant or some solvent at the edge of the cover slip to draw the mountant out to the edges of the cover slip.

11. Label the slide so that it can be traced by anyone back to the pinned specimen from which the genitalia were removed, and label the pin accordingly.

### **COLD POTASH TREATMENT OF GENITALIA**

Some workers prefer to use this simple, safe, and dependable method of preparation.

1 and 2. Repeat exactly steps 1 and 2 as given in the foregoing procedure for the hot potash treatment.

3. Remove the abdomen from the specimen, wet it with alcohol, and place it in a cold solution of 10 percent KOH or NaOH. The addition of some alcohol to the solution will assist the abdomen in sinking into the caustic, but an abdomen which has been well soaked in alcohol will usually sink unless it contains entrapped air. A small tube about 5 cm. long, closed with a cork which is not attacked by caustic, is usually used for this operation. Pin a label containing pertinent reference data to the cork. Soaking overnight or longer in the cold caustic has proved completely satisfactory for safe digestion. If one has several dissections to make, one may plan ahead and put several specimens to soak one day for preparation the next.

4. After digestion, transfer the abdomen to glacial acetic acid and proceed as in step 4 under the hot potash treatment. Some workers omit the acid treatment or they place only a little acid in water, but better preparations are made by use of the acid.

5. Proceed with the staining and mounting as outlined under the hot potash treatment.

The specimens may be mounted either in Euparal, Canada balsam, or other mountant. The simplest and quickest method, and one which has advantages, is to mount the dissections from the 95 percent or absolute alcohol directly into Euparal. The specimens can be removed from the slide by soaking in Euparal solvent or alcohol at any desired time in the future. I now use this Euparal method. It saves much time, has proven totally satisfactory, and it avoids the use of xylene.



To use the traditional Canada balsam mounting medium, proceed as follows:

6. Transfer the specimen from 95 percent alcohol to clove oil. Spread the genitalia and hold in the desired position for a few moments to harden, as required. Leave in the clove oil a few hours or overnight to clear.
7. Transfer to xylene for a few minutes to remove the clove oil.
8. Mount in balsam on a slide as for Euparal.

It is sometimes necessary to remake an old slide mounted in Canada balsam, and it may prove rather difficult to soften the balsam so that the cover slip may be removed. The usual procedure is to soak the slide in xylene for an extended period. A more rapid method is that suggested by Carlson (1935:365). He recommended the use of a mixture of 90 parts of xylene and 10 parts of n-butyl alcohol. This mixture attacks and dissolves the old balsam quickly so that the cover slip can usually be removed within a few hours after immersion in the solution.

When making slide preparations, always use separate amounts of reagents for each specimen to avoid the possibility that a part of one specimen may become mixed with parts of another specimen. It is best to move the various containers to the dissections rather than moving the dissections across the desk or table to the solutions, because it is easy to lose a dissection. Never allow the dissections to dry once they have been treated in potash, and great care must be taken with small parts such as aedeagi to transfer them quickly from one solution to another. I have found watch glasses and cavity slides more satisfactory for use in the various operations than large dissecting dishes containing large amounts of fluid in which it is difficult to handle the specimens. This is especially true of small specimens, and considerable difficulty may ensue when one attempts to spread particularly difficult-to-spread male genitalia. Such genitalia may be easily prepared in a shallow fluid layer but will be found difficult to handle in a large amount of fluid. The wings, abdominal pelt, and the genitalia may be mounted on the same slide. One usually mounts the abdominal pelt horizontally, with the genitalia placed toward the person, at the middle of the slide, and the wings are mounted on the right end of the slide. The name of the species, the data from the pin labels, and the museum slide number should be carefully written on the slide. Codes should not be used; they usually lead only to difficulty.

One should at all times take great care with cleanliness and should make neat, clean, well-oriented, photogenic slide mounts. Good slide preparation takes great patience, *time*, and experience. One can hardly expect to make perfect dissections and mounts without considerable experience.

The above-outlined techniques are suggestions, and there are other ways to achieve success. I have found these methods to be simple and satisfactory. They are used by several of my friends who produce slide mounts of superior quality. There are other methods in use today whose products are inferior preparations, and such methods should be avoided at all costs. One must remember that the material upon which one is working may be of extreme value; it may be unique; and one owes a responsibility to his colleagues, his

science, and to future generations who will study the material.

For additional details on slide making, see Clarke, 1941*b*:149; Busck, 1931*b*:199 and 1942:157; Tams, 1926:145; Bennett, 1929:220, 245; Eltringham, 1929:54; Hardwick, 1950:231; Diakonoff, 1954*c*:67; Klots, 1956:97; and Powell, 1964:12. Considerable improvement in technique has been made since some of these papers were published, however.

## MICROLEPIDOPTERA OF ECONOMIC IMPORTANCE IN HAWAII

### I. BENEFICIAL SPECIES

The following species were purposely introduced into Hawaii to aid in the biological control of various plant pests:

#### TORTRICIDAE

*Croesia zimmermani* Clarke was introduced from Mexico to attack *Rubus* species (introduced blackberry). The larvae feed upon the foliage.

*Bactra venosana* (Zeller) was introduced from the Philippines to assist in the control of the widely spread pest *Cyperus rotundus* (nut grass). The larvae bore in the stems.

*Strepsicrates smithiana* Walsingham was introduced from North America to aid in the control of *Myrica faya* (firebush). The larvae are leaf rollers.

*Epinotia lantana* (Busck) was introduced from Mexico to attack *Lantana Camara* (lantana), a serious pest shrub. The larvae feed in the flower heads, destroy the fruits, and bore in twigs.

*Episimus utilis* Zimmerman was introduced from Brazil to aid in the control of *Schinus terebinthifolius* (Christmas-berry). Its larvae feed on the leaves.

#### GRACILLARIIDAE

*Cremastobombycia lantanella* Busck was introduced from Mexico to aid in the control of *Lantana*. The larvae mine the leaves.

#### SCHRECKENSTEINIIDAE

*Schreckensteinia festaliella* Hübner was introduced from California to assist in the control of *Rubus* species (blackberries). The larvae are leaf skeletonizers.

#### PTEROPHORIDAE

*Lantanophaga pusillidactyla* (Walker) was introduced from Mexico to assist in the control of *Lantana*. Its larvae attack the flower clusters and reduce seed production.

#### GELECHIIDAE

*Trichotaphe aenigmatica* Clarke was introduced from Mexico to aid in the control of *Pluchea odorata* (sour bush). Its larvae are defoliators.

*Crasimorpha infusata* Hodges was introduced from Brazil to aid in the control of *Schinus terebinthifolius* (Christmas-berry). The larvae bore in stems and form galls.

## II. PEST SPECIES

In the following list only those species are included that damage plants or materials of direct use to man. Species are not listed here simply because they are common; neither are species listed which attack endemic plants of no primary economic use to man. Species which are potential pests but which have not yet been reported causing damage in Hawaii are omitted, as are species which cause only occasional damage.

### TINEIDAE

*Tinea pellionella* (Linnaeus) damages furs, feathers, woolens, and other animal matter.

*Tineola bisselliella* (Hummel) damages furs, feathers, woolens, etc.

*Nemapogon granellus* (Linnaeus) attacks dried fungi and may also be found in stored grain and cereal products.

*Neodecadarchis flavistriata* (Walsingham) occasionally damages buds of sugarcane and fruits of banana and pineapple.

### TORTRICIDAE

*Epiphyas postvittana* (Walker) larvae roll the leaves of many kinds of plants, and the damage done may be confused with that of *Amorbia*.

*Amorbia emigratella* Busck larvae roll the leaves and disfigure or injure many ornamental and crop plants.

*Cryptophlebia illepidia* (Butler) larvae damage or destroy the fruits and seeds of many plants. This is the worst pest of the nuts of *Macadamia* species in Hawaii.

*Cryptophlebia ombrodelta* (Lower) is a more recent accidental introduction with habits generally similar to *C. illepidia*.

Endemic species of *Cydia* sometimes attack the seed pods and twigs of endemic *Acacia* and *Sophora* in numbers sufficient to be considered of some economic importance.

### GRACILLARIIDAE

*Philodoria hauicola* (Swezey) is an endemic species which frequently calls attention to itself because its larvae mine the leaves of *Hibiscus tiliaceus* in such numbers that damage is caused to the plants used in gardens (as well as to wild plants).

*Philodoria hibiscella* (Swezey) is another endemic species whose extensive mines in the leaves of ornamental *Hibiscus* sometimes damage garden plants.

### BUCCULATRIGIDAE

*Bucculatrix thurberiella* Busck, the cotton leaf perforator, is an immigrant from North America, and its larvae disfigure cotton leaves.

## LYONETIIDAE

*Bedellia orchilella* Walsingham is a miner in the leaves of *Ipomoea batatas* (sweetpotato). Although it has not yet been reported elsewhere, it differs conspicuously from the endemic Hawaiian *Bedellia*, and is so closely related to foreign *Ipomoea* leaf miners that it is probably an immigrant species. It is allied to the widely distributed *Bedellia somnulentella* (Zeller).

## YPONOMEUTIDAE

*Plutella xylostella* (Linnaeus) is the widely known diamond-back moth. It damages cabbage and related plants.

*Acrolepia assectella* (Zeller) is the onion leaf miner whose larvae damage onions and related plants.

## AGONOXENIDAE

*Agonoxena argaula* Meyrick larvae skeletonize the leaves of palms, especially *Cocos nucifera* (coconut).

## CYCNODIIDAE

*Swezeyula lonicerae* Zimmerman and Bradley larvae mine the leaves of *Lonicera* species (honeysuckle).

## GELECHIIDAE

## ETHMIINAE

*Ethmia nigroapicella* (Saalmüller) larvae defoliate *Cordia subcordata* ("kou") to such a serious extent that the trees are no longer common in Hawaii.

## CHRYSOPELEIINAE

*Ithome concolorella* (Chambers) larvae destroy the flowers of *Prosopis chilensis* (mesquite), thereby reducing the honey flow from the most important honey source in Hawaii.

## COSMOPTERIGINAE

*Anatrachyntis rileyi* (Walsingham), the pink cornworm or pink bud moth, may damage stored seeds or grain. It has been reported to cause minor damage to pineapple fruits.

## GELECHIINAE

*Dichomeris acuminatus* (Staudinger) feeds on the foliage of *Medicago sativa* (alfalfa), *Cajanus flavus* (= *cajan*) (pigeon pea), and some other legumes.

*Phthorimaea operculella* (Zeller) is the potato tuber moth, and it damages various solanaceous plants.

*Keiferia lycopersicella* (Walsingham) is the tomato pinworm which may cause losses to tomato crops and may attack other solanaceous plants.

*Pectinophora gossypiella* (Saunders) is the pink bollworm, and it damages cotton and infests a number of malvaceous plants. It destroyed the cotton industry in Hawaii.

*Pectinophora scutigera* (Holdaway) has habits rather similar to the pink bollworm and may be confused with it.

*Sitotroga cerealella* (Olivier), the Angoumois grain moth, is a pest of grains.

### III. ALLERGIC REACTIONS CAUSED BY LEPIDOPTERA

It is not widely known that scales, hairs, and parts of dried bodies of moths and their larvae and pupae may cause asthma and other allergic reactions in sensitive persons. It has been reported that parts of moths may at times be more numerous than pollens in wind-borne dusts. Household infestations of clothes moths may cause discomfort or even serious illness to allergic persons. Interested readers are referred for more details and a bibliography to the work *Asthma From Insect Emanations* by Urbach and Gottlieb, as listed in the bibliography. See also my notes under the webbing clothes moth (*Tineola bisselliella*) in this volume.

Some caterpillars (but none in the endemic Hawaiian fauna) bear urticating hairs that can cause mild to severe dermal rashes. Some bear hollow spines that contain poisons which are released when the spines are broken off in tissues. Some bear barbed spines that can cause severe dermal conjunctivitis if rubbed into the eyes which they may penetrate deeply and from which they may have to be removed surgically. See Gilmer, 1925, and Frazier, 1969, for details of some poisonous spines.

Some persons have entomophobia and react with aversion to caterpillars or moths. Some rare individuals may become abnormally frightened by larger moths.

### PARASITES AND PREDATORS OF HAWAIIAN MICROLEPIDOPTERA

The following list of species of parasites and predators is preliminary and incomplete. We know nothing concerning the parasites and predators of most of the Hawaiian Lepidoptera. Most of what we do know has resulted from the researches of two devoted naturalists: R. C. L. Perkins and O. H. Swezey. Dr. Swezey was especially interested in the parasites of Lepidoptera, and he recorded faithfully his many observations.

Many species of foreign parasites have been introduced by various agricultural agencies in Hawaii—particularly by the Hawaiian Sugar Planters' Association Experiment Station and, especially in recent years, by the Hawaiian State Department of Agriculture—to control a comparatively few moths of economic importance. Other foreign parasites have been imported accidentally through the activities of man. Some of these foreign parasites have decimated the endemic lepidopterous fauna. It is now frequently

difficult to rear many endemic moths because of the high incidence of parasitism. Many of the introduced parasites attack many species of moths, and they have not confined their attacks to the few pest species which they were introduced to control. The ichneumonid *Pristomerus hawaiiensis* Perkins is listed here from 26 small moths, and it also attacks other moths in addition to Microlepidoptera. The ichneumonid wasp *Trathala flavo-orbitalis* (Cameron) has a host list of more than 30 species of Microlepidoptera and pyralids. If they were host-specific, the parasite populations would normally fluctuate according to the fluctuations in numbers of the host populations. Unfortunately many are not host-specific and so are able to maintain high populations even when they have greatly reduced the numbers of one or another host species. The attack by foreign parasites has brought many endemic moths to the brink of extinction. Many Hawaiian moths have not been captured since they were discovered as long as 75 years ago, and many species have been exterminated. The Hawaiian lepidopterous fauna is now very different from what it was before men came to the Islands, and no living person and no future generation can ever see the glorious fauna even as it was when Dr. Perkins made his unparalleled surveys near the close of the last century. This privilege has been lost forever. How meager would be our knowledge of the Hawaiian biota were it not for the far-sightedness of the English scientists and institutions which conceived, financed, and executed the Perkins' surveys. Dr. Perkins rescued and preserved for posterity an enormous fund of information and a remarkable sample of the biota. Fortunately, too, another dedicated naturalist, Dr. Otto Swezey, followed Perkins and continued and expanded the study of the Hawaiian Lepidoptera. In his half century in Hawaii, Dr. Swezey witnessed an enormous change in the biota. In 1954:134, he wrote:

Collecting in the mountain forests of late years, I have seldom found the ragged feeding on wild banana leaves which formerly was so prevalent and indicated the presence of *Omiodes* [*Hedylepta*]. This appears to be due to the work of immigrant parasites such as *Zaleptopygus* [*Trathala*] *flavo-orbitalis* (Cameron) . . . and *Casinaria infesta* (Cresson) . . . , both of which I have reared from *Omiodes* [*Hedylepta*] caterpillars, and which first appeared in the lowland areas in 1910 and 1921, respectively. At first these parasites attacked *Hymenia recurvalis* (Fabricius), the amaranth webworm [a foreign immigrant], then gradually spread to the native pyraustid caterpillars in the mountain forests, with the result that many species of native moths are now so scarce as to be almost extinct.

Many other parasites have placed similar pressures on other endemic moths, but, next to the activities of man, the greatest single known tragedy to have befallen the Hawaiian insect fauna was the early introduction of the widespread big-headed ant, *Pheidole megacephala* (Fabricius). Few are the endemic insects which can withstand its rapacity for long. That ant is responsible for the destruction of the endemic insect faunas over vast areas of Hawaii. It had decimated the lowland faunas before the first general entomological collecting was done, and the Rev. Thomas Blackburn, who began collecting in Hawaii in 1876, said (1885:202):

It is by no means an unusual thing to pass a morning collecting on the mountains (at any rate on those under 3000 feet high), and to return home with perhaps two or three specimens secured, and having seen literally nothing else except the few most abundant insects. I have frequently spent an hour or more sweeping flower-covered herbage, or beating branches of trees over an inverted white umbrella, without seeing the sign of a beetle of any kind. My experience in this matter agrees with that of previous explorers in the islands of the Pacific Ocean, many of whom allude to the extreme paucity of insect life there.

I concur with Dr. Perkins, when he remarked upon Blackburn's comment (1913:xxxix), that "I am quite sure that this must be due to his having neglected to get beyond the range of the small ant *Pheidole megacephala*, before beginning to collect." Perkins (1913:xli-xlii) had the following to say regarding *Pheidole megacephala*:

As with the birds, destruction of forest has, doubtless, caused the disappearance of many local insects, but even of greater importance has been the introduction of foreign carnivorous [and parasitic] species, especially of the dominant ant, *Pheidole megacephala*. There is no record of the time when this destructive creature was imported, but even during the last twenty years it has occupied some considerable areas previously free from it. It may be said that no native Hawaiian Coleopterous insect can resist this predator, and it is practically useless to attempt to collect where it is well established. Just on the limits of its range one may occasionally meet with a few active beetles, e.g. species of *Plagithmysus*, often with these ants attached to their legs or bodies, but sooner or later they are quite exterminated from such localities. It is quite certain that native beetles and many other insects are absent from the localities occupied by *Pheidole*, solely on account of its presence. In several instances, as the ant has been observed to occupy a new area, this area having been collected over before it was present and yielding many native beetles, the latter have entirely disappeared. In a few low-lying localities, even close to the coast, there are some places, which from excessive dryness and other causes, the *Pheidole* is unable to occupy, at any rate permanently, and yet unfavourable, as these are, for insects of any kind, here only will native Coleoptera be found. On one occasion I came across an instructive instance of the effect of these ants on the native fauna. A more or less open piece of forest at an elevation of 1500 ft. above sea-level, with a large variety of trees scattered in it, appeared at first sight an excellent spot for collecting native insects. A number of native Hymenoptera were seen flying round the foliage, hardy insects which the ants cannot exterminate, though they are often seen attached to them by the mandibles. Every tree trunk was invaded by *Pheidole*, and beating the boughs dislodged them in thousands. Not a single beetle nor any native insect was obtained from these trees. One solitary tree, however, for some reason was quite free from ants. It was a large *Bobea*, with hanging masses of 'Maile' (*Alyxia*) dependent from the boughs. From the dead stems of this were shaken hundreds, if not thousands, of one species of *Proterhinus*, others also being present, as well as the large weevils, *Rhyncogonus*, and other kinds of beetles. I visited this spot on many occasions for the sake of a rare species of wasp, but never obtained a beetle except from this one tree, and a year later it too was occupied by *Pheidole* and barren of native insects. Fortunately *Pheidole* is not universal in its distribution. It can in some localities just attain 4000 ft. in the mountains, under certain climatic conditions. Below twelve or thirteen hundred feet it often occupies most of the islands, excepting some extremely arid localities. Though not so utterly destructive to [some] other insects as to the beetles, yet many of them are destroyed by it, and generally speaking, collecting is very poor, where it abounds. Most of the native species taken in such places are vagrant, like Lepidoptera, and have bred in some adjoining area, either free from this ant, or where it is comparatively sparse. Miles of attractive forest in some parts of the islands are almost devoid of native insects, through its destructiveness. A very few endemic insects seem able to breed in its haunts, even where it is quite abundant, but many of the foreign or imported insects flourish in spite of it.

Perkins said further (1913:ci-cii):

*Pheidole megacephala* is the most abundant of all the . . . ants. In many parts it occupies not only the whole open country, but also the forests to a height of about 2000 ft. in the mountains. In open country it sometimes becomes established as high as 4000 ft., and may be numerous at three thousand. Usually, where forests are dense, it ceases to range above about 1200 to 1500 ft. of elevation, while in its range, no matter how fine or how dense the forest may be, the endemic fauna, save for a few forms, that can resist, or are tolerated by the ants, is entirely exterminated. This native fauna, especially of beetles, appears as if by magic, the moment the limit of the range of *Pheidole* is reached. In some places on the coast there are localities so dry and hot that *Pheidole* cannot occupy permanently, and here a remnant of a lowland endemic fauna persists, unsuitable as are the conditions for insects in general. Of the native insects that are attacked by *Pheidole*, the Aculeate Hymenoptera are the least injured. Even in the case of large Crabronids and wasps of the genus *Odynerus* it is common enough to find specimens with one or more workers of *Pheidole*, or with the great head of the soldier-form attached to their legs or antennae, and we have noticed instances where these strong insects have been entirely overcome by their assailants.

And on page cxxv Perkins continues:

*Proterhinus* is ubiquitous throughout Hawaiian forests, where any native Coleopterous fauna remains, and ranges above these to a height of 9000 ft. or more on the higher mountains, affecting the shrubs that grow

at high elevations. They entirely cease to exist in the lower forests, where these are well occupied by the ant *Pheidole megacephala*, which rapidly exterminates them. Doubtless, there has once been a considerable number of species, inhabiting areas at lower elevations, which are now extinct.

As another example of the attack by this ant, there appeared in *Proc. Hawaiian Ent. Soc.* 3(3):142–143, 1916, the following note:

Professor Illingworth reported that [*Hedylepta* (*Omiodes*) *blackburni* (Butler)] . . . began depositing eggs on his coconut trees in Palolo Valley, March 16, 1915, and continued to the present (May 6, 1915), but none of the caterpillars had been able to resist the attacks of the ants . . . long enough to pupate. A few of the larvae reached almost full size, but they had to finally succumb. The ants were first observed, actually at work, destroying a young colony, on April 14th last. They first cut away the under-part of the web, that protects the caterpillars, and then pulled them out. In a number of cases they were seen eating the egg-masses, and several times they were found attacking the almost full-grown larvae.

It should be emphasized that there are no endemic ants in the Hawaiian fauna. Hence, no adaptations to enable the endemic insect fauna to live with ants were evolved.

We should not overlook the fact that more than 100 years of rapid and drastic environmental change occurred between Captain Cook's discovery of Hawaii in 1778 and Perkins' explorations which began in 1892, and that the lowlands were occupied and greatly altered (especially by fire) by the Polynesian people for 1,000 or more years before their discovery by Captain Cook. The bulk of the lowland flora and fauna was gone before Perkins or any biologist, saw it. There is no doubt that a rich and remarkable lowland flora existed before its destruction by man, but we know little about the now almost totally extinct lowland fauna.

Detrimental environmental changes have not ceased; they continue unabated, some at an accelerated pace. The purposeful and accidental introduction of more and still more foreign parasites and predators will further alter the composition of the remaining endemic fauna. Some endemic species, although no doubt their numbers diminished, may be able to adjust themselves to the foreign parasites, but other more delicately constituted endemics will perish before the onslaught. Most unfortunately, no institution has ever officially recognized what is disappearing, and none ever has supported adequately a continued program of concentrated study of the rapidly changing endemic Hawaiian insect fauna. Most of the fund of knowledge of the endemic fauna assembled since the providential Perkins' surveys has been accumulated by zealous naturalists in their "spare time" without the support of Hawaiian institutions and, not infrequently, in spite of them.

Below I have listed records of parasites and predators which have come to my attention during the writing of this text. Surely, there is further information which I have failed to notice, and still more data must rest unrecorded in institutional files and in collections. I can say nothing about diseases of Hawaiian Microlepidoptera, because we know almost nothing about them. It is possible that foreign diseases are an important factor in reducing the numbers of endemic moths.

The parasites are listed first, and after them are listed the few recorded predators. It is of interest that there is only one species of parasitic Diptera recorded in Hawaii as a parasite of Microlepidoptera. A number of species of parasitic Diptera are known to attack Hawaiian Macrolepidoptera and Pyraloidea (see Volumes 8 and 9).



It appears that the only endemic hymenopterous parasites known to attack Hawaiian Microlepidoptera belong to the families Eupelmidae (*Eupelmus* and *Lepideupelmus*) and Bethylidae (*Scleroderma* and *Sierola*). Of these, *Sierola*, the largest known genus of Hawaiian Hymenoptera (there are more than 180 species recorded, and many new species remain to be described), has more species listed as parasites of Hawaiian Microlepidoptera than any other genus (see under Bethylidae, below). It appears, therefore, that the endemic Hawaiian Microlepidoptera were under relatively light pressure from parasites before man so drastically disturbed the fauna. Now enormous pressure has been placed on the delicately adapted endemic moths by the many foreign parasites that have been purposely or accidentally introduced.

In the following list, the names of the parasites are printed in **bold face** type, and the names of their host moths are printed in *italic* type beneath the names of the parasites.

## PARASITES HYMENOPTERA ICHNEUMONOIDEA

### Braconidae

#### **Agathis hawaiiicola** (Ashmead)

*Neodecadarchis flavistriata* (Walsingham), Tineidae

*Lepidobregma minuscula* (Walsingham), Tineidae

*Decadarchis simulans* (Butler), Tineidae

*Thyrocopa sapindiella* Swezey, Xyloryctinae

*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae

*Hypsmocoma* species, Cosmopteriginae

*Pectinophora gossypiella* (Saunders), Gelechiinae

*Stoeberhinus testaceus* Butler, Gelechiinae

*Autosticha pelodes* (Meyrick), Gelechiinae

#### **Agathis** species near **cincta** Cresson

*Ithome concolorella* Chambers

#### **Apanteles agonoxenae** Fullaway

*Agonoxena argaula* Meyrick, Agonoxenidae

#### **Apanteles bedelliae** (Viereck)

*Philodoria hauicola* (Swezey), Gracillariidae

*Bedellia orchilella* Walsingham, Lyonetiidae

#### **Apanteles carpatus** (Say)

*Tinea pellionella* (Linnaeus), Tineidae

*Tineola bisselliella* (Hummel), Tineidae

*Praeaces thecophora* (Walsingham), Tineidae

*Phereoeca uterella* (Walsingham), Tineidae

*Oecia oecophila* (Staudinger), Oecophorinae

*Hypsmocoma* species, Cosmopteriginae

**Apanteles dignus** Muesebeck*Keiferia lycopersicella* (Walsingham), Gelechiinae**Apanteles marginiventris** (Cresson)*Ethmia nigroapicella* (Saalmüller), Ethmiinae**Apanteles scutellaris** Muesebeck*Phthorimaea operculella* (Zeller), Gelechiinae**Apanteles** species*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae**Apanteles trifasciatus** Muesebeck*Opogona aurisquamosa* (Butler), Tineidae**Blacus cremastobombyciae** Fullaway*Cremastobombycia lantanella* Busck, Gracillariidae**Bracon gelechia** Ashmead*Ithome concolorella* (Chambers), Chrysopeleiinae**Bracon mellitor** Say*Cryptophlebia illepidia* (Butler), Tortricidae*Crociosema blackburnii* (Butler), Tortricidae*Epinotia lantana* (Busck), Tortricidae*Pectinophora gossypiella* (Saunders), Gelechiinae**Bracon omiodivorum** (Terry)*Epiphyas postvittana* (Walker), Tortricidae*Amorbia emigratella* Busck, Tortricidae*Episimus utilis* Zimmerman, Tortricidae**Bracon swezeyi** Bridwell*Bactra straminea* (Butler), Tortricidae*Chedra microstigma* (Walsingham), Momphinae**Bracon** species misidentified as **terryi** Bridwell*Mapsidius chenopodii* Swezey, Scythrididae**Chelonus (Microchelonus) blackburnii** Cameron*Plutella capparidis* Swezey, Yponomeutidae*Acrolepia assectella* (Zeller), Yponomeutidae*Pectinophora gossypiella* (Saunders), Gelechiinae*Phthorimaea operculella* (Zeller), Gelechiinae*Keiferia lycopersicella* (Walsingham), Gelechiinae*Chedra microstigma* (Walsingham), Momphinae*Asymphorodes dimorpha* (Busck), Cosmopteriginae**Chelonus (Microchelonus) phthorimaeae** Gahan*Phthorimaea operculella* (Zeller), Gelechiinae**Orgilus swezeyi** Fullaway*Opogona aurisquamosa* (Butler), Tineidae*Stoeberhinus testaceus* Butler, Gelechiinae

**Panhormius pallidipes** Ashmead*Phthorimaea operculella* (Zeller), Gelechiinae*Keiferia lycopersicella* (Walsingham), Gelechiinae**Phanerotoma hawaiiensis** (Ashmead)*Stoeberhinus testaceus* Butler, Gelechiinae**Ichneumonidae****Atrometus** species*Merimnetria elegantior* (Walsingham), Gelechiinae**Atrometus tarsatus** Ashmead*Hypsmocoma trimaculata* Walsingham, Cosmopteriginae**Coccygomimus punicipes** (Cresson)*Spheterista reynoldsiana* (Swezey), Tortricidae*Epiphyas postvittana* (Walker), Tortricidae*Amorbia emigratella* Busck, Tortricidae*Cryptophlebia illepida* (Butler), Tortricidae*Ethmia nigroapicella* (Saalmüller), Ethmiinae*Hypsmocoma ekaha* Swezey, Cosmopteriginae*Hypsmocoma literata* Walsingham, Cosmopteriginae*Pectinophora gossypiella* (Saunders), Gelechiinae**Coccygomimus sanguinipes** (Cresson)*Cryptophlebia illepida* (Butler), Tortricidae**Echthromorpha agrestoria fuscator** (Fabricius)*Spheterista reynoldsiana* (Swezey), Tortricidae*Epiphyas postvittana* (Walker), Tortricidae*Amorbia emigratella* Busck, Tortricidae*Hypsmocoma trivittella* (Swezey), Cosmopteriginae**Gelis tenellus** (Say)*Agonoxena argaula* Meyrick, Agonoxenidae*Hypsmocoma empedota* Meyrick, Cosmopteriginae*Hypsmocoma literata* Walsingham, Cosmopteriginae**Horogenes ("Olesicampe", "Limnerium") blackburni** (Cameron)*Spheterista infaustana* (Walsingham), Tortricidae*Spheterista pleonectes* (Walsingham), Tortricidae*Bradleyella thoracina* (Walsingham), Tortricidae*Stenoptilodes littoralis rhynchophora* (Meyrick), Pterophoridae*Mapsidius auspicata* Walsingham, Scythrididae*Mapsidius chenopodii* Swezey, Scythrididae*Phthorimaea operculella* (Zeller), Gelechiinae*Keiferia lycopersicella* (Walsingham), Gelechiinae**Horogenes chilonis** (Cushman)*Bactra straminea* (Butler), Tortricidae*Cryptophlebia illepida* (Butler), Tortricidae

**Horogenes polynesiale** (Cameron)*Plutella xylostella* (Linnaeus), Yponomeutidae**Hyposoter exiguae** (Viereck)*Stenoptilodes littoralis rhynchophora* (Meyrick), Pterophoridae**Idechthis** species*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae**Pristomerus hawaiiensis** Perkins

(NOTE: Two or three species probably have been confused under this name, and all of the records following it require verification.)

*Spheterista infaustana* (Walsingham), Tortricidae*Spheterista pleonectes* (Walsingham), Tortricidae*Eccoptocera foetorivorans* (Butler)?, Tortricidae*Cryptophlebia illepida* (Butler), Tortricidae*Cydia conspicua* (Walsingham), Tortricidae*Cydia plicata* (Walsingham), Tortricidae*Cydia walsinghami* (Butler), Tortricidae*Crociosema blackburnii* (Butler), Tortricidae*Crociosema marcidella* (Walsingham), Tortricidae*Epinotia lantana* (Busck), Tortricidae*Stenoptilodes taprobanes brachymorpha* (Meyrick), Pterophoridae*Carposina graminicolor* (Walsingham), Carposinidae*Carposina nigronotata* (Walsingham), Carposinidae*Carposina solutella* (Walsingham), Carposinidae*Carposina trigonotata* (Walsingham), Carposinidae*Carposina* new species 1, Carposinidae*Carposina* new species 2, Carposinidae*Carposina*, new species 5, Carposinidae*Carposina*, new species 9, Carposinidae*Alucita objurgatella* (Walsingham), Alucitidae*Mapsidius auspicata* Walsingham, Scythrididae*Ithome concolorella* (Chambers), Chrysopeleinae*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae*Phthorimaea operculella* (Zeller), Gelechiinae*Pectinophora gossypiella* (Saunders), Gelechiinae*Merimnetria* (*Aristoteliodes*) *elegantior* Walsingham, Gelechiinae**Pycnophion fuscipennis** Perkins*Hyposmocoma chilonella* Walsingham, Cosmopteriginae**Trathala ("Cremastus", "Zaleptopygus") flavo-orbitalis** (Cameron)*Lepidobregma minuscula* (Walsingham), Tineidae*Spheterista infaustana* (Walsingham), Tortricidae*Spheterista reynoldsiana* (Swezey), Tortricidae*Spheterista santalata* (Swezey), Tortricidae*Bradleyella metallurgica* (Walsingham), Tortricidae*Bactra straminea* (Butler), Tortricidae

*Bactra truculenta* (Cameron), Tortricidae  
*Cryptophlebia illepida* (Butler), Tortricidae  
*Crociosema blackburnii* (Butler), Tortricidae  
*Crociosema marcidella* (Walsingham), Tortricidae  
*Epinotia lantana* (Busck), Tortricidae  
*Carposina graminicolor* (Walsingham), Carposinidae  
*Agonoxena argaula* Meyrick, Argonoxenidae  
*Thyrocopa* species, Xyloryctinae  
*Chedra microstigma* (Walsingham), Momphinae  
*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae  
*Asymphorodes dimorpha* (Busck), Cosmopteriginae

## CHALCIDOIDEA

### Trichogrammatidae

#### **Trichogramma minutum** Riley

*Epiphyas postvittana* (Walker), Tortricidae  
*Amorbia emigratella* Busck, Tortricidae  
*Bactra venosana* (Zeller), Tortricidae  
*Pectinophora gossypiella* (Saunders), Gelechiinae

### Eulophidae

#### **Derostenus fullawayi** Crawford

*Cremastobombycia lantanella* Busck, Gracillariidae  
*Philodoria hibiscella* (Swezey), Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae  
*Philodoria micropetala* Walsingham, Gracillariidae  
*Philodoria pipturiella* Swezey, Gracillariidae  
*Bedellia orchilella* Walsingham, Lyonetiidae

#### **Cirrospilus** species?

*Cremastobombycia lantanella* Busck, Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae

#### **Diglyphus begini** (Ashmead)

*Philodoria marginestrigata* (Walsingham), Gracillariidae

#### **Diglyphus** species? (**Solenotus**, **Diaulinus**)

*Philodoria hibiscella* (Swezey), Gracillariidae

#### **Euderus metallicus** (Ashmead)

*Opostega* species, Opostegidae  
*Cryptophlebia illepida* (Butler), Tortricidae  
*Cremastobombycia lantanella* Busck, Gracillariidae  
*Caloptilia mabaella* (Swezey), Gracillariidae  
*Philodoria auromagnifica* Walsingham, Gracillariidae  
*Philodoria basalis* Walsingham, Gracillariidae  
*Philodoria haucicola* (Swezey), Gracillariidae  
*Philodoria hibiscella* (Swezey), Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae

*Philodoria micropetala* Walsingham, Gracillariidae  
*Philodoria naenaeiella* (Swezey), Gracillariidae  
*Philodoria neraudicola* (Swezey), Gracillariidae  
*Philodoria pipturicola* Swezey, Gracillariidae  
*Philodoria pipturiella* Swezey, Gracillariidae  
*Philodoria ureraella* (Swezey), Gracillariidae  
*Philodoria urerana* (Swezey), Gracillariidae  
*Bedellia orchilella* Walsingham, Lyonetiidae  
*Bedellia oplismeniella* Swezey, Lyonetiidae  
*Carposina inscripta* (Walsingham), Carposinidae  
*Carposina nigronotata* (Walsingham), Carposinidae  
*Carposina subumbrata* (Walsingham), Carposinidae  
*Alucita objurgatella* (Walsingham), Alucitidae  
*Hyposmocoma empedota* Meyrick, Cosmopteriginae  
*Hyposmocoma liturata* Walsingham, Cosmopteriginae  
*Merimnetria* (*Aristoteliodes*) *multiformis* (Meyrick), Gelechiinae  
*Merimnetria* (*Aristoteliodes*) *thurifica* (Meyrick), Gelechiinae

**Necremnus** species? (misspelled “*Eucremnus*” by Swezey, 1954:73)

*Philodoria dubautiella* (Swezey), Gracillariidae

**Pauahiana lineata** Yoshimoto

*Opostega maculata* Walsingham, Opostegidae

**Pauahiana maculatipennis** (Ashmead) (“*Necremnus*”)

*Philodoria* (*Eophilodoria*) *hibiscella* (Swezey), Gracillariidae

**Pauahiana metallica** Yoshimoto

*Philodoria* (*Philodoria*) *splendida* Walsingham, Gracillariidae

**Pauahiana swezeyi** Yoshimoto

*Philodoria* (*Eophilodoria*) *hibiscella* (Swezey), Gracillariidae

**Pnigalio externa** (Timberlake)

*Cremastobombycia lantanella* Busck, Gracillariidae  
*Philodoria dubautiella* (Swezey), Gracillariidae  
*Philodoria hauicola* (Swezey), Gracillariidae  
*Philodoria hibiscella* (Swezey), Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae  
*Philodoria neraudicola* (Swezey), Gracillariidae  
*Philodoria pipturicola* Swezey, Gracillariidae  
*Bedellia orchilella* Walsingham, Lyonetiidae  
*Swezeyula lonicerae* Zimmerman and Bradley, Cynodiidae  
*Hyposmocoma trivitella* (Swezey), Cosmopteriginae  
*Merimnetria* (*Aristoteliodes*) *elegantior* (Walsingham), Gelechiinae

**Sympiesis** (“**Ophelinus**”) **mauiensis** Ashmead

*Hyposmocoma chilonella* Walsingham, Cosmopteriginae

**Sympiesis vagans** (Timberlake)

*Cremastobombycia lantanella* Busck, Gracillariidae  
*Philodoria hauicola* (Swezey), Gracillariidae

*Philodoria hibiscella* (Swezey), Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae  
*Swezeyula lonicerae* Zimmerman and Bradley, Cynodiidae

**Tetrastichus** "near **sokolowskii** Kurjdmov"

*Plutella xylostella* (Linnaeus), Yponomeutidae

**Zagrammosoma flavolineatum** Crawford

*Philodoria marginestrigata* (Walsingham), Gracillariidae  
*Swezeyula lonicerae* Zimmerman and Bradley, Cynodiidae

**Eupelmidae**

**Eupelmus cushmani** (Crawford)

*Agonoxena argaula* Meyrick, Agonoxenidae

**Eupelmus peles** Perkins

*Carposina solutella* (Walsingham), Carposinidae  
*Merimnetria (Aristoteliodes) elegantior* (Walsingham), Gelechiinae

**Eupelmus pelodes** Perkins?

*Cydia plicata* (Walsingham), Tortricidae

**Eupelmus** species

*Cryptophlebia illepida* (Butler), Tortricidae  
*Carposina subumbrata* (Walsingham), Carposinidae  
*Alucita objurgatella* (Walsingham), Alucitidae  
*Batrachedrodes sophroniella* (Walsingham), Momphinae  
*Trissodoris honorariella* (Walsingham), Cosmopteriginae  
*Hyposomocoma chilonella* Walsingham, Cosmopteriginae  
*Merimnetria (Aristoteliodes) elegantior* (Walsingham), Gelechiinae  
*Merimnetria (Aristoteliodes) multiformis* (Meyrick), Gelechiinae

**Lepideupelmus setiger** (Perkins)

*Hyposmocoma empedota* Meyrick, Cosmopteriginae  
*Hyposmocoma trimaculata* Walsingham, Cosmopteriginae

**Pteromalidae**

**Zatropis tortricidis** Crawford

*Cremastobombycia lantanella* Busck, Gracillariidae  
*Philodoria marginestrigata* (Walsingham), Gracillariidae  
*Ithome concolorella* (Chambers), Chrysopeleiinae

**Chalcididae**

**Brachymeria agonoxenae** Fullaway

*Agonoxena argaula* Meyrick, Agonoxenidae

**Brachymeria obscurata** (Walker)

*Decadarchis simulans* (Butler), Tineidae  
*Spheterista reynoldsiana* (Swezey), Tortricidae  
*Epiphyas postvittana* (Walker), Tortricidae  
*Amorbia emigratella* Busck, Tortricidae  
*Crociosema blackburnii* (Butler), Tortricidae  
*Pectinophora gossypiella* (Saunders), Gelechiinae

**Brachymeria polynesialis** (Cameron)*Agonoxena argaula* Meyrick, Agonoxenidae**Stomatoceras pertorvum** Girault*Pectinophora gossypiella* (Saunders), Gelechiinae*Stoeberhinus testaceus* Butler, GelechiinaeUndetermined **Chalcidoidea***Neodecadarchis flavistriata* (Walsingham), Tineidae*Philodoria urerana* (Swezey), Gracillariidae**BETHYLOIDEA****Bethylidae****Perisierola emigrata** Rohwer*Pectinophora gossypiella* (Saunders), Gelechiinae*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae*Cryptophlebia illepida* (Butler), Tortricidae*Epinotia lantana* (Busck), Tortricidae**Scleroderma chilonellae** Bridwell*Hypsmocoma chilonella chilonella* Walsingham, Cosmopteriginae**Scleroderma semnoprepiae** Bridwell*Hypsmocoma coprosmae* (Swezey), Cosmopteriginae*Hypsmocoma pittospori* (Swezey), Cosmopteriginae**Scleroderma** species*Hypsmocoma chilonella triocellata* Walsingham, Cosmopteriginae**Sierola acuta** Fullaway*Neodecadarchis flavistriata* (Walsingham), Tineidae**Sierola aristoteliae** Fullaway*Merimnetria (Aristoteliodes) elegantior* (Walsingham), Gelechiinae**Sierola capuana** Fullaway*Pararrhaptica longiplicata* (Walsingham), Tortricidae**Sierola cryptophlebiae** Fullaway*Cryptophlebia illepida* (Butler), Tortricidae**Sierola epagogeana** Fullaway*Spheterista infaustana* (Walsingham), Tortricidae**Sierola flavocollaris** Fullaway*Merimnetria (Aristoteliodes) elegantior* (Walsingham), Gelechiinae**Sierola gracilariae** Fullaway*Caloptilia mabaella* (Swezey), Gracillariidae



**Sierola koa** Fullaway*Cryptophlebia illepida* (Butler), Tortricidae**Sierola molokaiensis** Ashmead? (probably not this species)*Neodecadarchis flavistriata* (Walsingham), Tineidae**Sierola opogonae** Fullaway*Opogona omoscopa* (Meyrick)?, Tineidae**Sierola philodoriae** Fullaway*Philodoria splendida* Walsingham, Gracillariidae**Sierola planiceps** Fullaway*Philodoria dubautiella* (Swezey), Gracillariidae**Sierola pulchra** Fullaway*Philodoria ureraella* (Swezey), Gracillariidae**Sierola tantalea** Fullaway*Merimnetria* (*Aristoteliodes*) *homoxyla* (Meyrick), Gelechiinae**Sierola timberlakei** Fullaway*Batrachedrododes sophroniella* (Walsingham), Momphinae**Sierola** species*Spheterista cassia* (Swezey), Tortricidae*Spheterista oheoheana* (Swezey), Tortricidae*Cryptophlebia illepida* (Butler), Tortricidae*Philodoria urerana* (Swezey), Gracillariidae*Carposina solutella* (Walsingham), Carposinidae**DIPTERA**

The only record which I have found of a dipterous parasite of any Hawaiian species of Microlepidoptera is the following foreign species of Tachinidae:

**Lespesia archippivora** (Riley) (“**Frontina archippivora** Williston”)*Mapsidius iridescens* Walsingham, Scythrididae**NEMATODA**

A “*Gordius* worm” emerged from an adult of *Carposina* new species 4 captured by Dr. Swezey.

**PREDATORS**

Records of predators of Hawaiian Microlepidoptera are few and incomplete. Although some birds prey upon the larvae, pupa, and adults of some moths, and the moths are caught by various species of Odonata, I have few records of the species eaten. I have, for example, only three notes concerning Micro-

lepidoptera as prey of the voracious immigrant ant *Pheidole megacephala*, and this alone reflects our enormous ignorance of predation.

## ORTHOPTERA

### TETTIGONIIDAE

**Xiphidiopsis lita** Hebard

*Amorbia emigratella* Busck, Tortricidae

## ODONATA

### COENAGRIIDAE

**Megalagrion** species

*Hyposmocoma* species, Cosmopteriginae

Most species of Odonata in Hawaii must capture large numbers of Microlepidoptera, but we know almost nothing of the food habits of adult Odonata.

## HYMENOPTERA

### FORMICIDAE

**Iridomyrmex humilis** Mayr

*Amorbia emigratella* Busck, Tortricidae

**Pheidole megacephala** (Fabricius)

*Amorbia emigratella* Busck, Tortricidae

*Ethmia nigroapicella* (Saalmüller), Ethmiinae

*Hyposmocoma* species, Cosmopteriginae

The number of species of Microlepidoptera attacked by this ant is very large, but most of the species of prey have not been recorded by name. It probably attacks any larva it can find. See the discussion of this destructive ant on pp. 95–97.

### VESPIDAE

**Polistes aurifer** (Saussure)

*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae

**Pachodynerus nasidens** (Latreille)

*Amorbia emigratella* Busck, Tortricidae

*Epinotia lantana* (Busck), Tortricidae

*Anatrachyntis rileyi* (Walsingham), Cosmopteriginae

**Nesodynerus rudolphi** (Dalla Torre)

*Amorbia emigratella* Busck, Tortricidae

*Crociosema blackburnii* (Butler), Tortricidae

**Odynerus nigripennis** Holmgren*Epiphyas postvittana* (Walker), Tortricidae**Odynerus** species*Epiphyas postvittana* (Walker), Tortricidae*Eccoptocera foetorivorans* (Butler), Tortricidae*Eccoptocera*, new species, TortricidaeVarious Tortricidae (favorite prey of *Odynerus*)*Thyrocopa* species, Xyloryctinae**AVES****DREPANIDIDAE****Hemignathus (Heterorhynchus)** species*Thyrocopa* species, Xyloryctinae**Loxops (Oreomyza)** species*Carposina* species, Carposinidae**MUSCICAPIDAE****Chasiempis sandwichensis***Carposina* species, Carposinidae*Thyrocopa* species, Xyloryctinae*Hyposmocoma* species, Cosmopteriginae

## THE IMMATURE STAGES OF LEPIDOPTERA

Sometimes it almost appears that we forget that every moth is preceded by an egg, a larva, and a pupa. These stages, however, are so different from one another that the study of each of them is almost the equivalent of studying different phyla of organisms. The study of moth eggs might be compared with the study of Foraminifera, although I would say that to prepare a monograph of the eggs of most of the Hawaiian Lepidoptera would be more time-consuming and more difficult than to prepare a monograph of the living Hawaiian Foraminifera. Many Foraminifera can be collected easily by the thousands. The assembly of even a partially complete collection of the eggs of the Hawaiian Lepidoptera would be an exceedingly difficult task which would occupy one's time for many years. We know almost nothing about the eggs of Hawaiian Lepidoptera. There is no general classification of lepidopterous eggs, and it would now be practically impossible to identify an egg of an Hawaiian moth from the egg alone. Many lepidopterous eggs are objects of great beauty, and a study of them could be a source of esthetic, as well as professional gratification (see Döring, 1955).

If we compare the study of lepidopterous eggs with the study of Foraminifera, we might compare the study of larvae with the study of the worms. The study of moth larvae is a difficult and specialized task, yet in all the world there are only a few persons qualified to write on limited groups of larvae. We know very little about the larvae of Hawaiian moths, and only a few have been adequately described. With the exception of a few species, mostly of economic importance, it has been virtually impossible to identify larvae of Hawaiian Lepidoptera. We have had no classification of even the genera of Hawaiian moth larvae.

The pupae form yet another distinctive assemblage very different from eggs, larvae, or adults, and the study of the pupae is equivalent to the study of yet another major group of organisms. Little is known about the pupae of Hawaiian moths, for very few have been collected, described, or figured. No classification of Hawaiian moth pupae exists, and, with the exception of a few common species, it has been almost impossible to identify the pupa of an Hawaiian moth submitted at random.

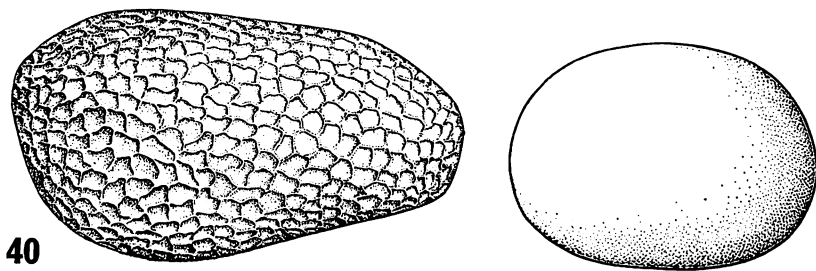


Figure 40—Examples of two kinds of microlepidopterous eggs. Left, the coarsely reticulated egg of *Acrolepia assectella* (Zeller), Yponomeutidae (after Frediani, 1954). Right, the smooth, iridescent egg of *Phthorimaea operculella* (Zeller), Gelechiidae. (After Bartoloni, 1951.) See figures 119, 126, 180, and 631 for other eggs.

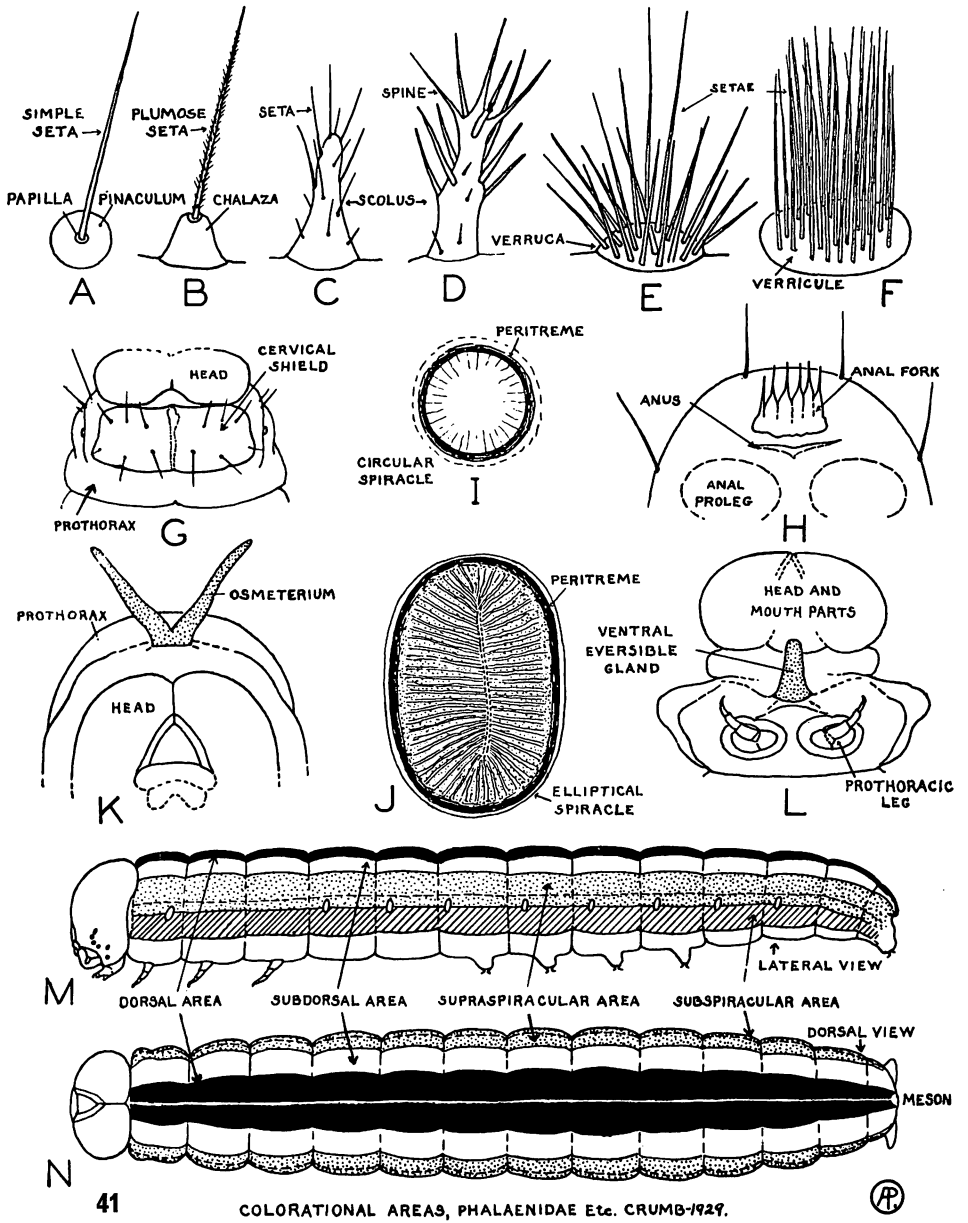


Figure 41—Details of lepidopterous larvae. (After Peterson, 1962.)

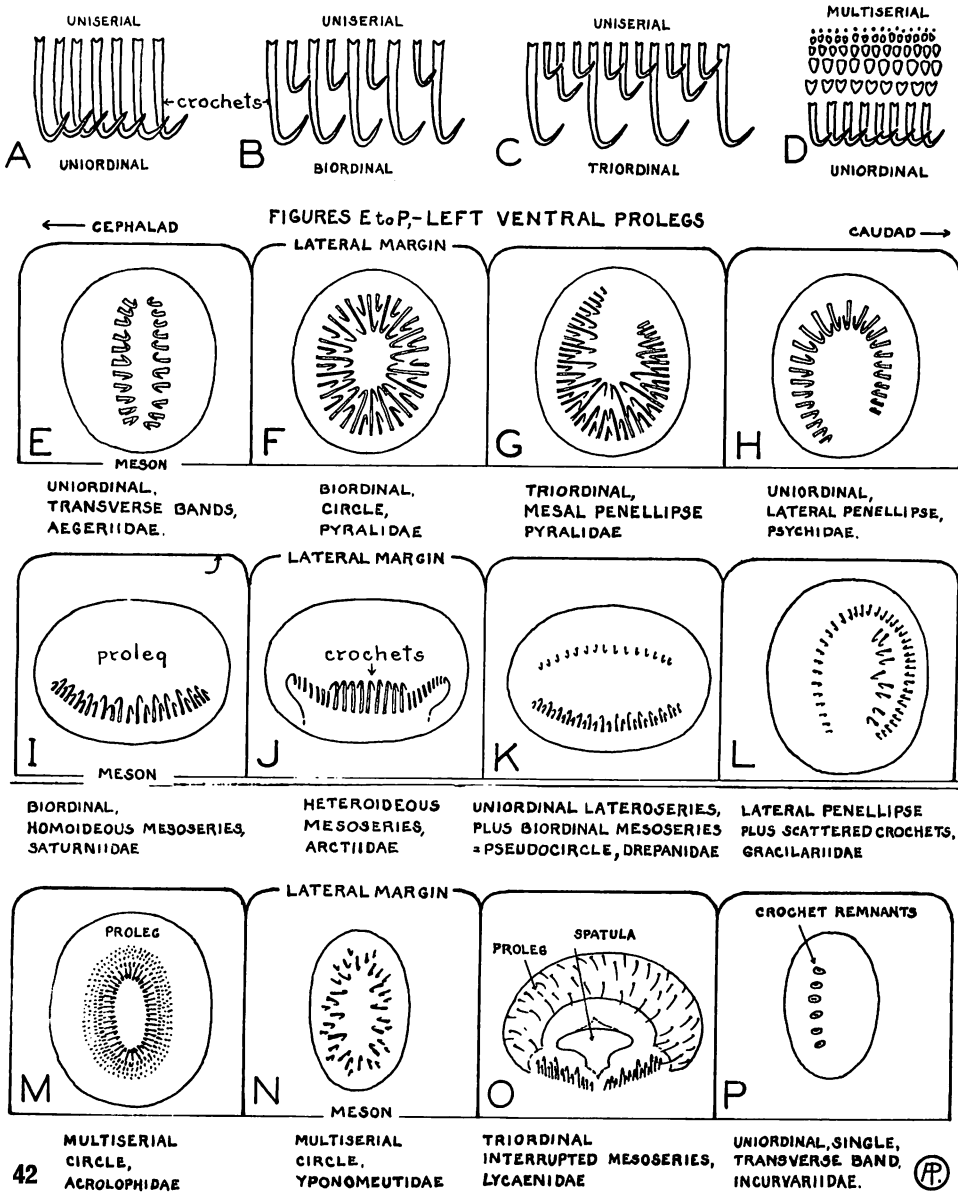


Figure 42—Details of the prolegs of larvae of Lepidoptera (after Peterson, 1962). A to D, various arrangements of crochets: uniserial=arising from a single line; uniordinal=all subequal in length; biordinal=two different lengths; homodeous=crochets in each series subequal throughout; heteroideous=crochets of unequal size in parts of the same series. E to P, left ventral (as opposed to anal) prolegs.

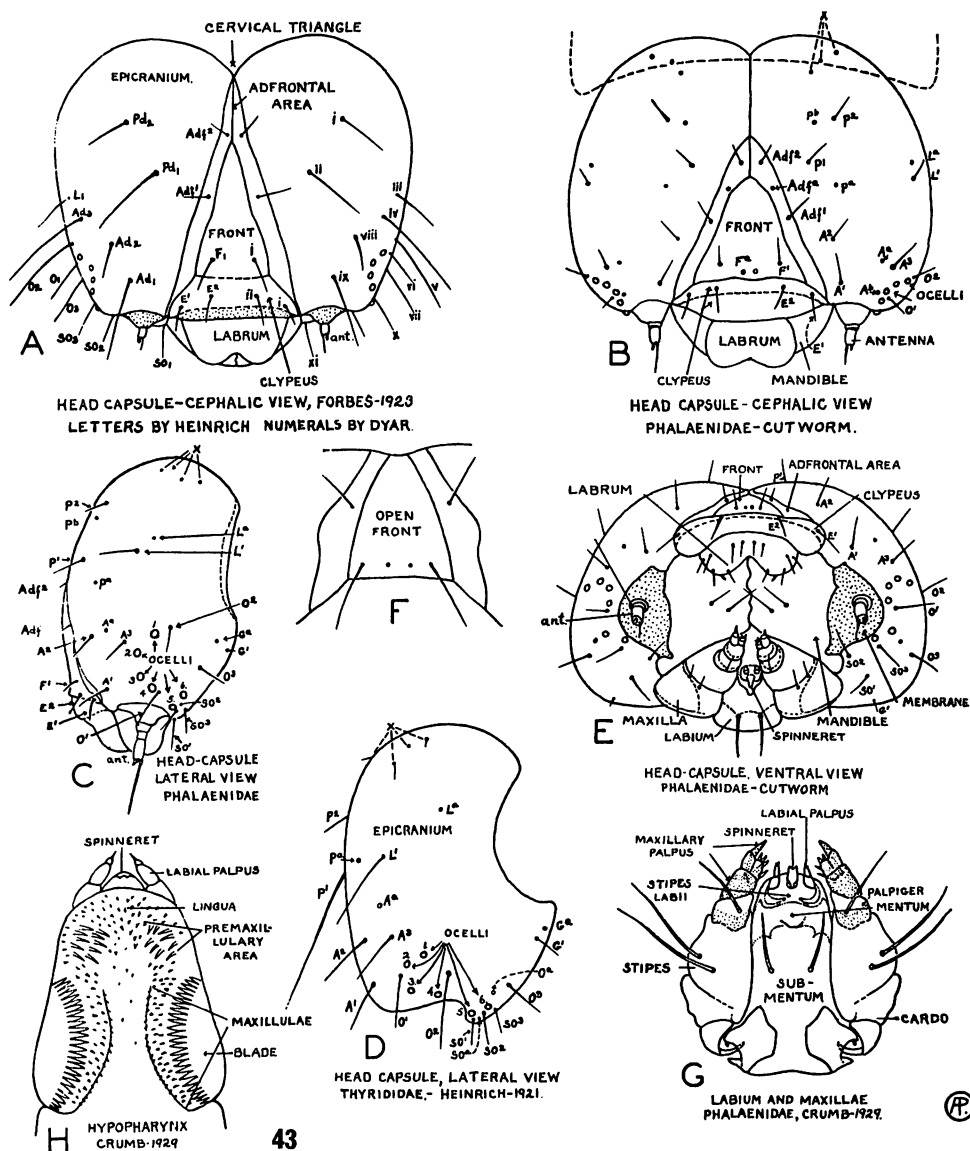


Figure 43—Details of the heads of lepidopterous larvae. The setal groupings are: *A* (*Ad*), anterior; *Adf*, adfrontal; *E*, epistomal; *F*, frontal; *G*, genal; *L*, lateral; *O*, ocellar; *P* (*Pd*), posterior; *SO*, subocellar; *X*, ultraposterior. *A*, distribution of primary setae with the names after Heinrich and others and the numbers after Forbes, 1923, with corrections. *B*, *C*, *D*, *E*, setae labeled according to Heinrich (the Fracker system reversed the numbering of the ocelli). *F*, part of the front of a head of a gracillariid demonstrating what is called an "open front" on which the adfrontals do not meet before reaching the cervical or vertical triangle and on which there is no median adfrontal suture; compare *A* and *B*. (After Peterson, 1962.)

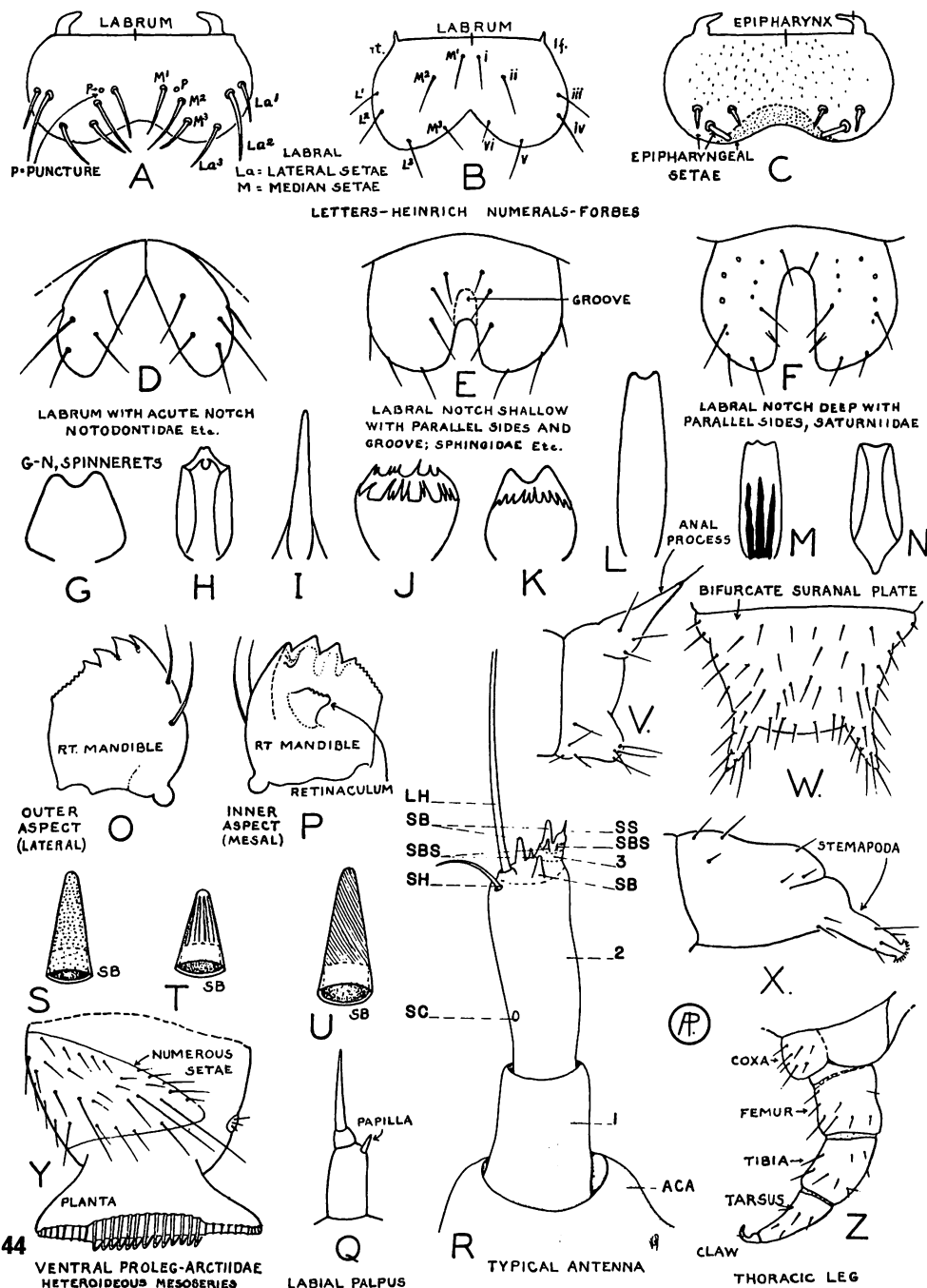


Figure 44—Details of lepidopterous larvae (after Peterson, 1962). A to F, various labra; G to N, various kinds of spinnerets; R, typical three-segmented antenna. ACA, antacoria; LH, long hair (sensillum trichodeum); SB, sensillum basiconicum; SBS, small sensillum basiconicum; SC, sensillum campaniformium; SH, short hair (sensillum trichodeum); SS, sensillum styloconicum; 1, 2, 3, segments of the antenna. S to U, large sensilla basiconica with three different types of sculpture: S, common in Rhopalocera; T, characteristic of sphingids; U, characteristic of most Heterocera.



I had hoped to present here illustrations of a representative series of Hawaiian moth eggs, but this has been impossible. I had hoped to include a classification of the larvae of Hawaiian moths with detailed illustrations of examples of larvae of most of the genera. This I have been able only partly to accomplish under the restrictions placed on my work. I had hoped to make at least a superficial study of representative pupae of Hawaiian moths with illustrations of pupae of most of the genera, but I was forced to abandon my studies when they were in their early stages. These failures are most deeply regretted.

The most extensive work with which I am acquainted which treats of lepidopterous eggs is that of Döring, 1955. The most important general work on lepidopterous pupae is that of Edna Mosher, 1916. Hinton, 1946*b*, proposed a new general classification of the kinds of insect pupae, and details from his studies are quoted below. An early work of general nature is that of

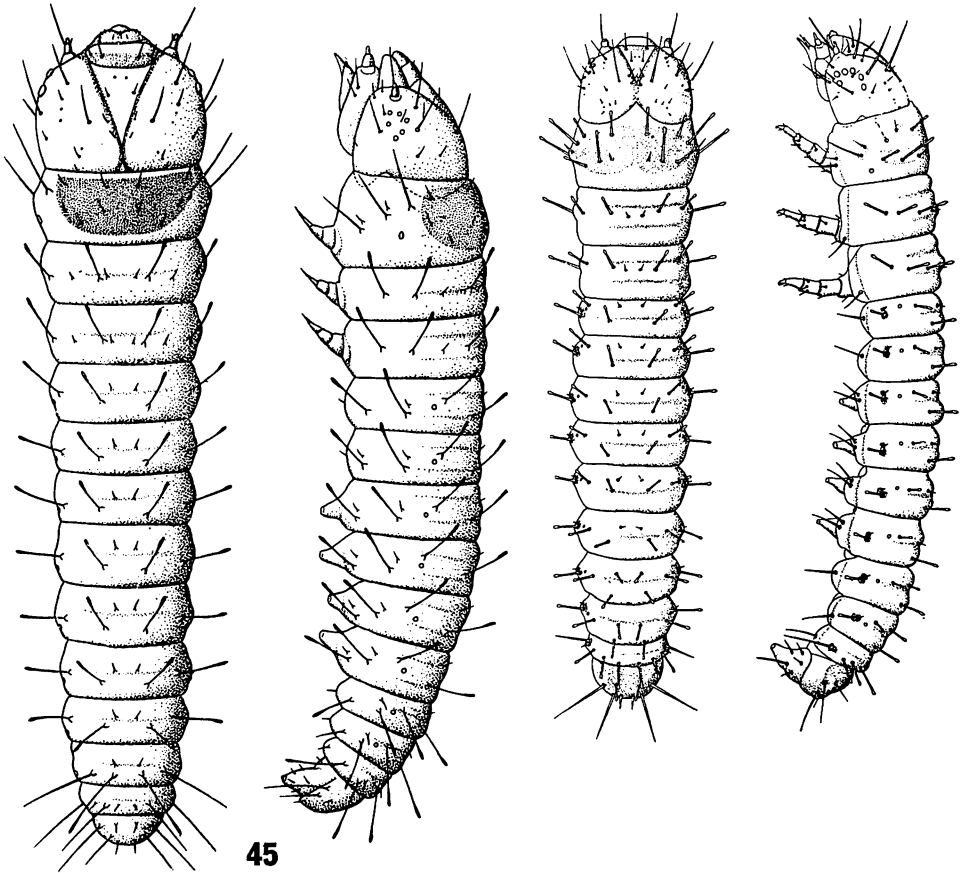


Figure 45—First instar larvae of *Acrolepia assectella* (Zeller), Yponomeutidae (after Frediani, 1954), left, and *Phthorimaea operculella* (Zeller), Gelechiidae (after Bartoloni, 1951), right. Compare figure 46 of the mature larvae.

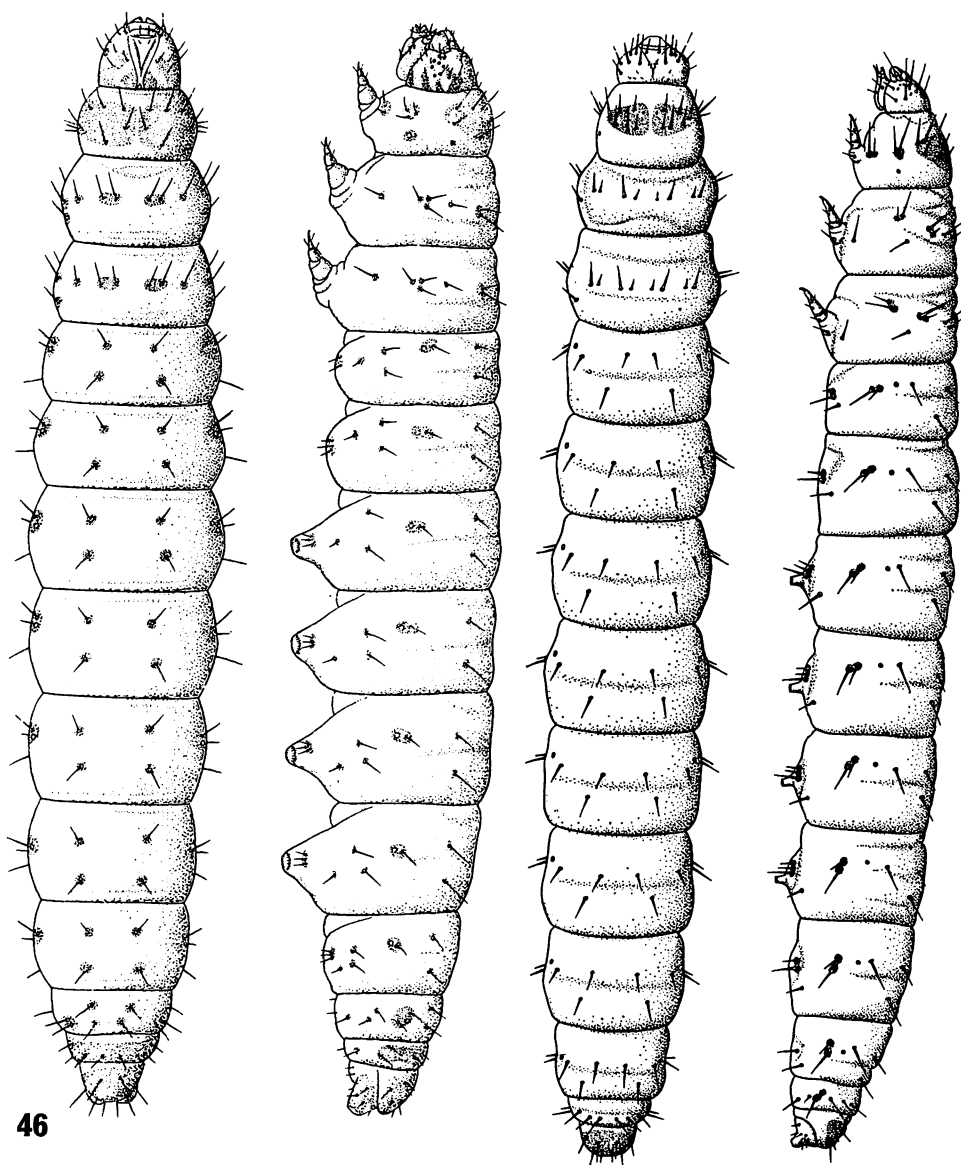


Figure 46—Mature larvae of *Acrolepia assectella* (Zeller), Yponomeutidae (after Frediani, 1954), left, and *Phthorimaea operculella* (Zeller), Gelechiidae (after Bartoloni, 1951), right. Compare figure 45 of the first stage larvae, and note the changes in chaetotaxy.

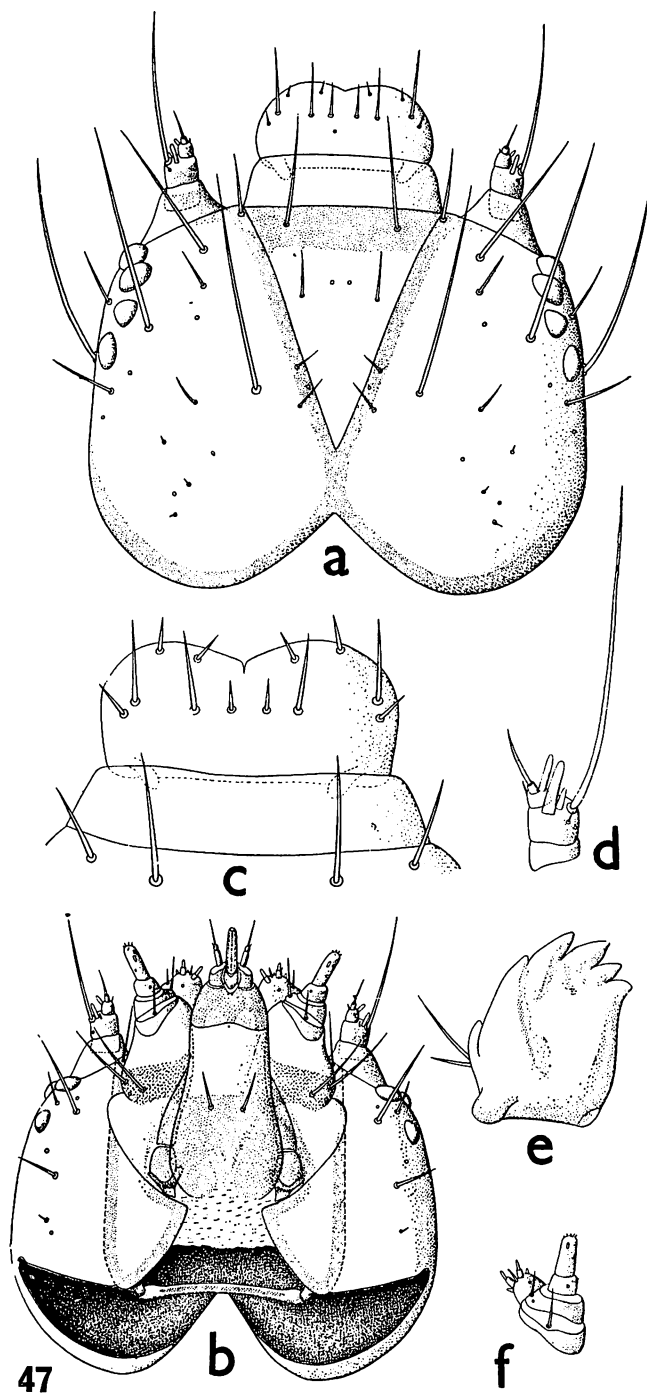


Figure 47—Details of the first instar larva of *Phthorimaea operculella* (Zeller), Gelechiidae (rearranged from Bartoloni, 1951). *a* and *b*, frontal and caudal views of the head; *c*, dorsal view of clypeus and labrum; *d*, antenna; *e*, right mandible, internal side; *f*, ventral aspect of distal part of left maxilla. Compare figure 48.

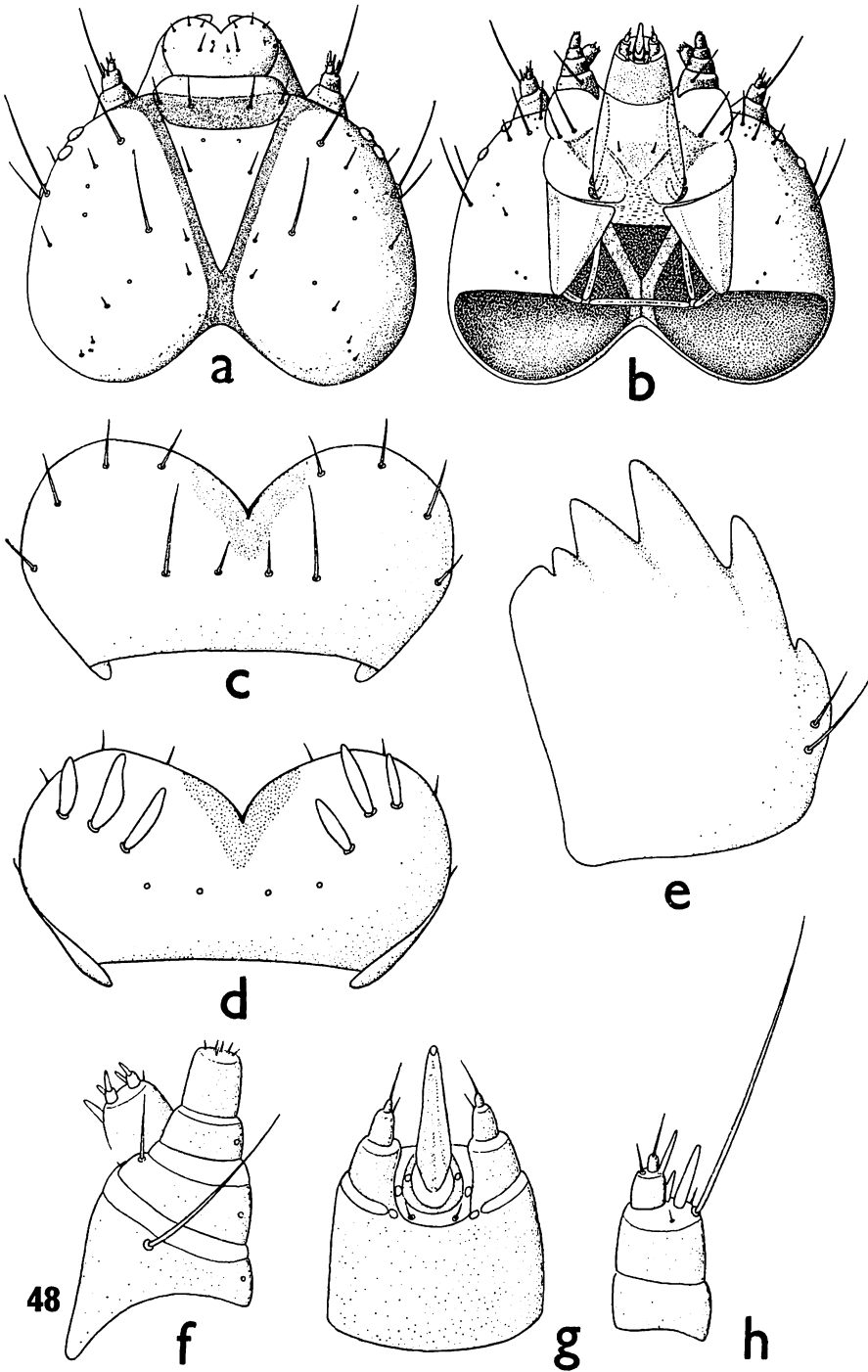


Figure 48—Details of the first instar larva of *Acrolepia assectella* (Zeller), Yponomeutidae (rearranged from Frediani, 1954). *a, b*, frontal and caudal views of the head; *c, d*, dorsal and ventral aspects of the labrum; *e*, right mandible, external aspect; *f*, ventral aspect of left maxilla; *g*, ventral aspect of prementum with spinneret and labial palpi; *h*, antenna. Compare figure 47.

Tutt (1899:30–60) whose initial chapters deal with the external and internal structure of lepidopterous larvae. The pioneer work on larvae done by Dyar (1894) and expanded by Fracker in 1915 was revised in 1930. In 1923, Forbes, in his well-known *Lepidoptera of New York and Neighboring States*, published modified Fracker keys to the larvae and modified Mosher keys to the pupae of most of the families of North American Lepidoptera, but they require much revision and expansion. There are various modern studies of representatives of moth larvae such as those of Beck (1960), Bollmann (1955), Crumb (1956), Gerasimov (1935, 1952), Hasenfuss (1960), Hinton (1952, 1955, 1956a, b), McGuffin (1958), Mutuura (1956, 1962), Peterson (1948,

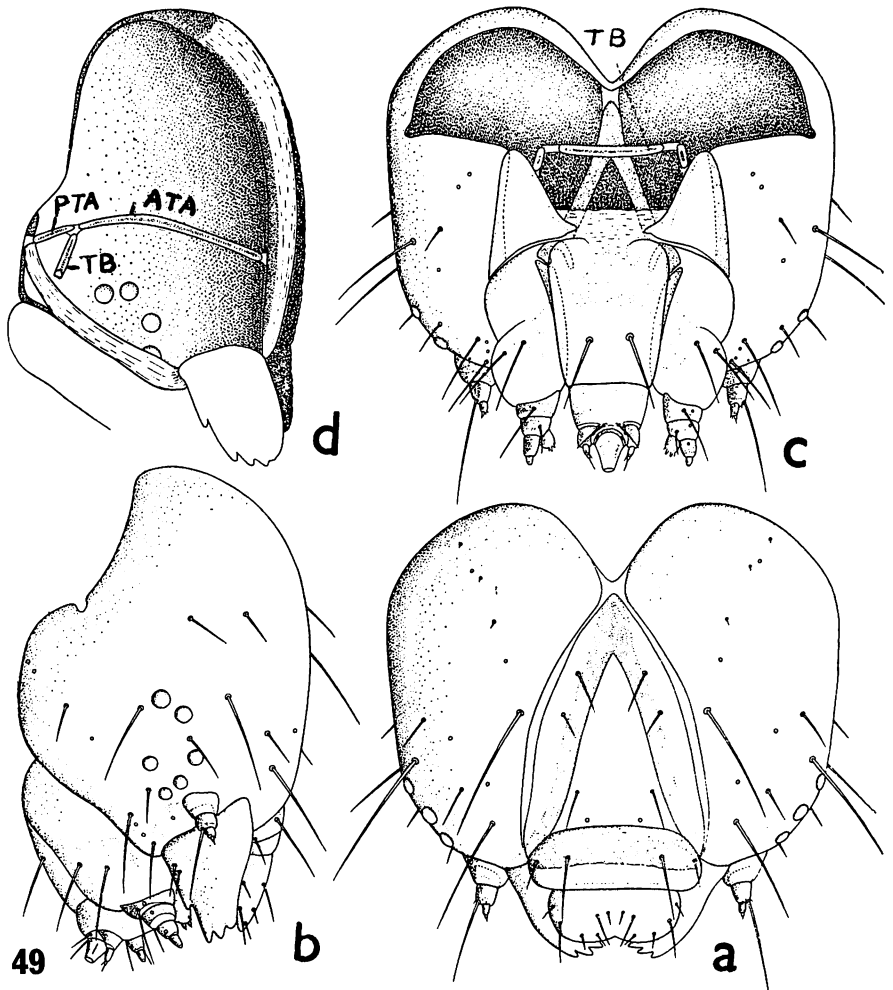


Figure 49—Details of the head of a mature larva of *Acrolepia assectella* (Zeller), Yponomeutidae (rearranged from Frediani, 1954). *a*, frontal, *b*, right lateral, and *c*, caudal aspects of the head with an internal view of a longitudinal section at *d*. *ATA*, anterior arm of tentorium; *PTA*, posterior arm of tentorium; *TB*, tentorial bridge. Compare figure 50.

1951, 1956, 1962), Swatschek (1958), Werner (1958), and, notably, MacKay 1959 to 1968 (on the Tortricidae and Aegeriidae of North America), but such studies are exceptions. The literature on the immature stages of Lepidoptera is, as for most orders of insects, mostly inadequate, and the different nomenclatures used by various authors in naming the setae renders the study of larvae difficult and confusing. The book by Peterson (1962 or other editions) is an especially useful introduction and guide for the student, and it should be used in company with the works of Hinton and MacKay. McGuffin also included a most helpful general discussion in his 1958 paper. The most remarkable of modern publications on lepidopterous larvae are the two sumptuously illustrated volumes by Syūti Issiki and his associates entitled *Early Stages of Japanese Moths in Colour* [scientific names are in Roman type]. Volume I of that series includes a detailed, illustrated account of larval chaetotaxy by Mutuura, but it is in Japanese and thus unfortunately not understandable

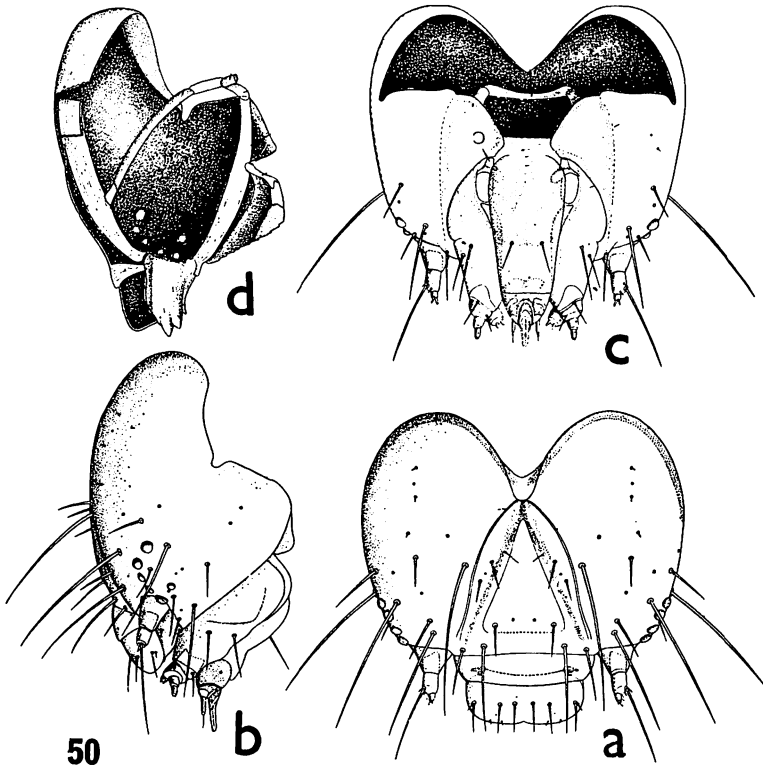


Figure 50—Details of the head of a mature larva of *Phthorimaea operculella* (Zeller), Gelechiidae (rearranged from Bartoloni, 1951). *a*, frontal, *b*, lateral, *c*, caudal, and *d*, internal aspect in longitudinal section. Compare figure 49.

by most entomologists outside of Japan. The illustrations, however, are of much value. These outstanding volumes must be of great assistance to Japanese entomologists, and we in other countries would be most fortunate if we could emulate the Japanese in their production of such beautifully illustrated, informative books.

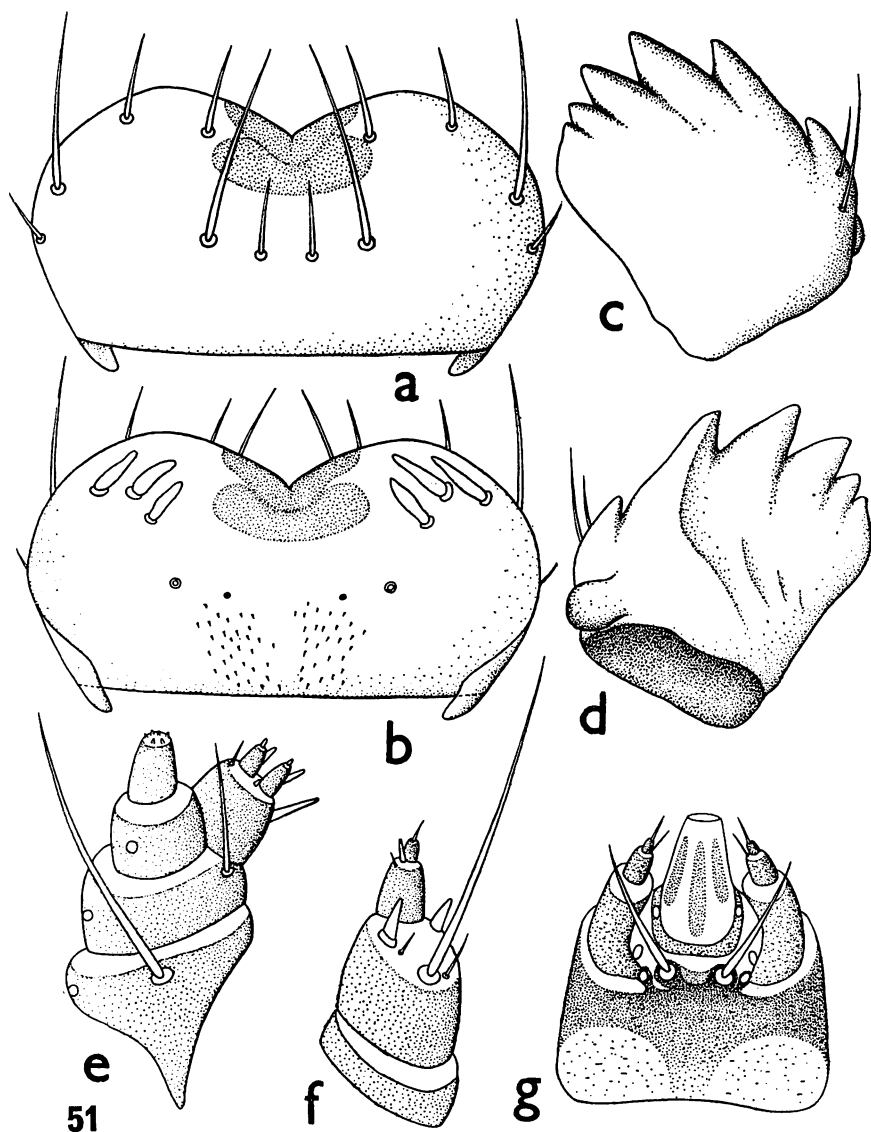


Figure 51—Details of the mouthparts of a mature larva of *Acrolepia assectella* (Zeller), Yponomeutidae (after Frediani, 1954). *a*, dorsal, and *b*, ventral aspects of the labrum; *c*, ectal and *d*, ental aspects of right mandible; *e*, distal part of right maxilla, ventral aspect; *f*, antenna; *g*, prementum with spinneret and labial palpi. Compare figure 52.

The lack of adequate collections of preserved larvae and pupae of Lepidoptera is another great handicap to the progress of the proper study of the order. Because study of the immature stages of moths can produce information of the greatest importance for use in proper classification, it is surprising to observe how many persons who rear Lepidoptera make no effort to preserve specimens of the immature stages. Every effort should be made to encourage

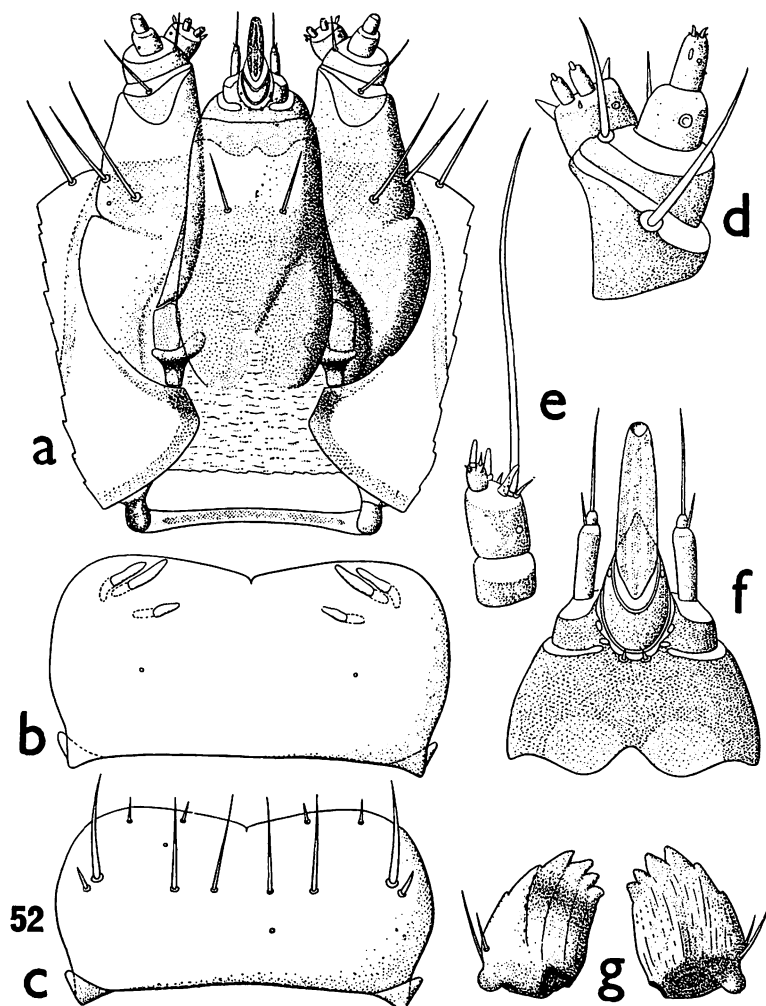


Figure 52—Details of the mouthparts of a mature larva of *Phthorimaea operculella* (Zeller), Gelechiidae (after Bartoloni, 1951). *a*, ventral aspect of the labium and maxillae; *b* and *c*, labrum in ventral and dorsal aspects; *d*, ventral view of the distal part of the left maxilla; *e*, antenna; *f*, prementum with spinneret and labial palpi; *g*, mandibles. Compare figure 51.



such persons to preserve specimens of the immature stages and to deposit them in institutions where they will be properly curated. The British Museum (Natural History), the Entomological Research Institute in Ottawa, the United States National Museum, and some other great research centers which maintain collections of the immature stages of Lepidoptera are in urgent need of specimens. They will welcome the assistance of anyone who can supply properly associated, preserved material.

Margaret MacKay (1968:337) has said:

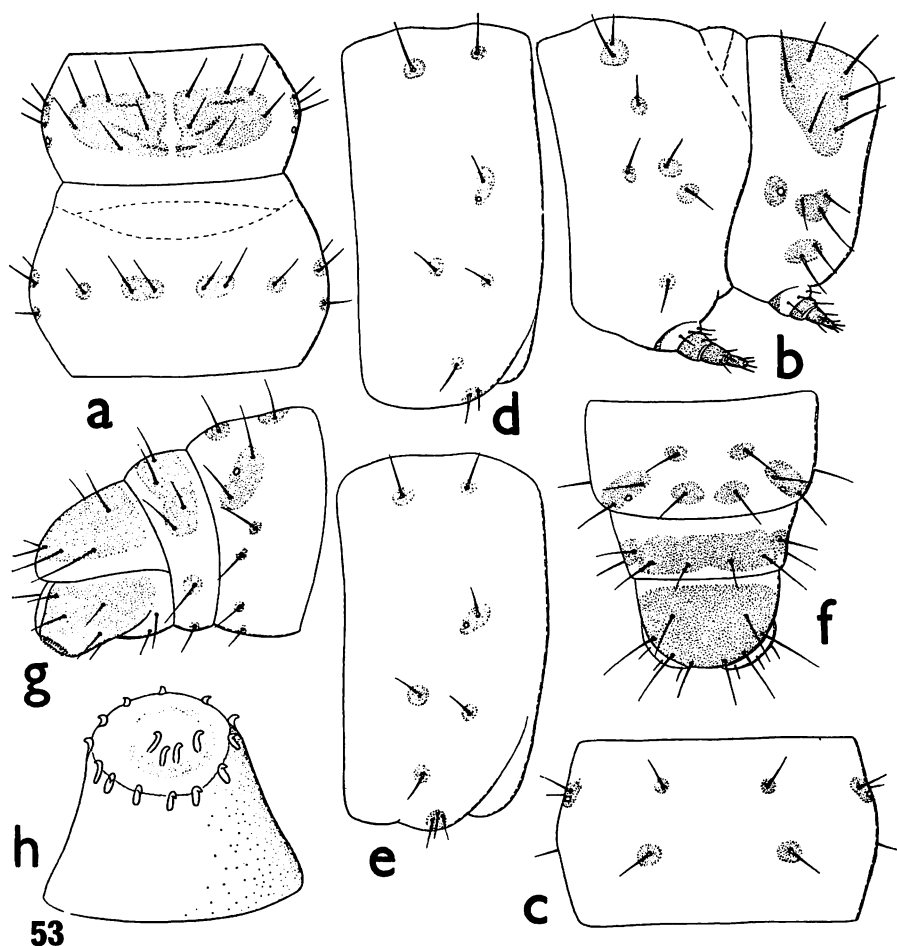


Figure 53—Details of the mature larva of *Acrolepia assectella* (Zeller), Yponomeutidae (after Frediani, 1954). a, dorsal aspect of pro- and mesothorax; b, lateral aspect of same; c, dorsal aspect of the first abdominal segment; d, lateral aspect of same; e, dorsal aspect of the second abdominal segment; f and g the three caudal abdominal segments in dorsal and lateral aspects; h, a proleg. See also figure 54 for other parts.

The importance of studies of immature stages should not have to be stressed, yet perhaps we need to be reminded of the following facts. Morphological studies of immatures (and their natural outcome—taxonomic systems) are a necessary part of the research on species and species groups, because if a species cannot be recognized in most or all of its stages of growth then ecological information about that species cannot be effectively employed in its control or beneficial use (MacKay 1964). Guesswork in the identification of immature material is not good enough in these days of extensive world travel and increased possibilities of pest introductions. Immature stages, especially the larval instars, provide as much, if not more, scope for phylogenetic studies as do the adults, and the most nearly perfect taxonomic systems can be developed *only* by the inclusion of the results of such studies. Few projects are of more practical value to a farmer, fruit grower or forester than research on the lepidopterous stage that injures his product. And, for the development of a reference collection on which these studies can be based, immature stages and adults must be *accurately* associated by rearing from eggs and by collecting immatures in the field. One man spent most of his lifetime in collecting larvae and associated adults of one family alone, the Aegeriidae—a most difficult task because of the root-boring habits of so many of the larvae. . . .

Students working intensively on the morphology and taxonomy of lepidopterous immatures are practically nonexistent. So far as I know, I alone, not only on this continent but in the world, work full time and publish regularly on this subject, and then on only one phase of it. . . .

To conclude, can we continue to disregard basic morphological and taxonomic research on the immature stages of Lepidoptera? Can we continue to stress integrated control programs and to ignore basic knowledge of the insect to be controlled? By doing this we are also, in effect, broadening the gap that already exists between an experimental or economic biologist and his faculty to perceive and record detail, a faculty that *should* be present in any student trained to be an entomologist but which appears to be used very little by many today. The coordinated efforts of several entomologists with the necessary qualifications could produce, in one generation, large studies containing information that would go far to eliminate our enormous ignorance of these immature stages. Why not a beginning now?

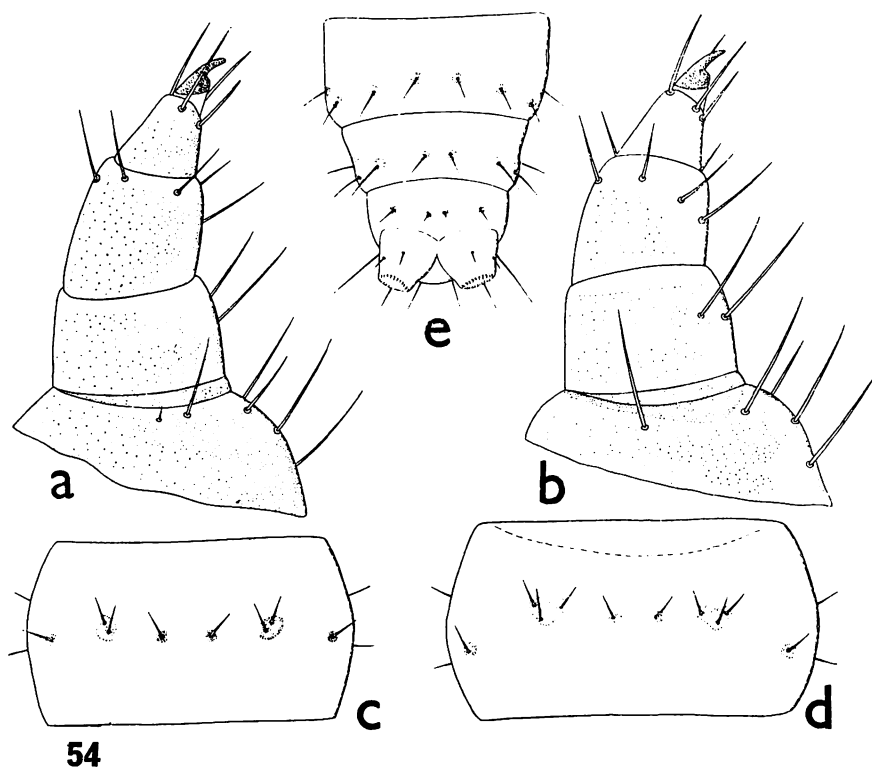


Figure 54—Details of the mature larva of *Acrolepia assectella* (Zeller) continued from figure 44 (after Frediani, 1954). *a*, anterior and *b*, posterior aspects of a mesothoracic leg; *c* and *d*, ventral aspects of the first and second abdominal segments; *e*, ventral view of the caudal abdominal segments.

## THE LARVA

The study of lepidopterous larvae necessitates careful study of chaetotaxy. Several major nomenclatures have been proposed for naming the setae, and this multitude of systems may be confusing to the student. Because of the various dates of issue of the publications one must use, it is necessary to be able to translate the various systems into the modern method currently in use. Hinton, MacKay, Mutuura, and others have made recent serious attempts to bring stability to the nomenclature and to place the system on a sound base, but a universally acceptable system has yet to be devised. Hinton's system, or modifications of it, is in most general use today. Miss MacKay's monographs (see the bibliography) are of great assistance to all students of lepidopterous larvae. Her paper *Problems in Naming the Setae of Lepidopterous Larvae* (1963a) should be consulted for comments on the Hinton and Mutuura studies.

The details which I have quoted herein regarding larvae of various Hawaiian moths mostly utilize the systems of naming the setae which were used by the authors quoted, and one may find it necessary to translate the nomenclature into the modern system if one is not familiar with the older nomenclatures. To assist in the translations, I have included some illustrations of comparative chaetotaxy, and it is hoped that these charts will eliminate some of the confusion that the reader no doubt will encounter.

## THE PREPARATION OF LARVAE FOR STUDY

It is possible to see the characters of taxonomic importance on many larvae without any special preparation, but it usually will be necessary to treat specimens with caustic or to clear, stain, and properly mount the head capsule and the pelt if one is to describe, illustrate, or make detailed studies of small larvae or of old, faded, preserved specimens. It may be advisable, also, to remove the mandibles, labium, and maxillae from the head and to mount them separately. There are various methods used to prepare specimens for study, and Hinton (1956a:252-253) has found the following to be acceptable:

It should be stressed that it is necessary to stain and mount the cuticle in order to distinguish all of the setae, especially the microscopic setae of caterpillars as small as those of the TINEIDAE. Unless the cuticle be stained, it is frequently not possible to recognize with any accuracy the shape and arrangement of the pinnacula, which are often most useful in distinguishing genera and species. A satisfactory method is as follows: larvae are immersed in 10 per cent. KOH for two or three days [they may also be treated with hot potash as outlined above for preparing genitalia]. A slit is first cut along one side from the anus to the anterior margin of the prothorax leaving the head attached and the thorax and abdomen can then be opened out and any tissue that still adheres scraped away. Following this the specimen is washed vigorously in water and afterwards in dilute acetic acid. It is then stained in weak carbol fuchsin for one or two days, which secures much more even staining than strong carbol fuchsin for shorter periods. After dehydration in the usual way, the head is detached. The thorax and abdomen are spread out and flattened in cedar-wood oil and mounted in Canada balsam. The mouth-parts are removed from the head, and both are mounted separately.

It is important to be able to use the larval cuticle shed on pupation, since this is sometimes the only larval material available of a species. The thorax and abdomen of such shed cuticles are always crumpled. Mounts can, however, be made from them which are nearly as good as those made from whole larvae. The cuticle is kept for two or three days in 10 per cent. KOH in an open watch glass. During this time the solu-

tion absorbs carbon dioxide from the atmosphere, and some carbonates are formed. When the cuticle is soft, acetic acid is added. The carbon dioxide evolved from the carbonates enclosed by the cuticle blows the latter out to its original shape and the thorax and abdomen can then be opened and stained as described above.

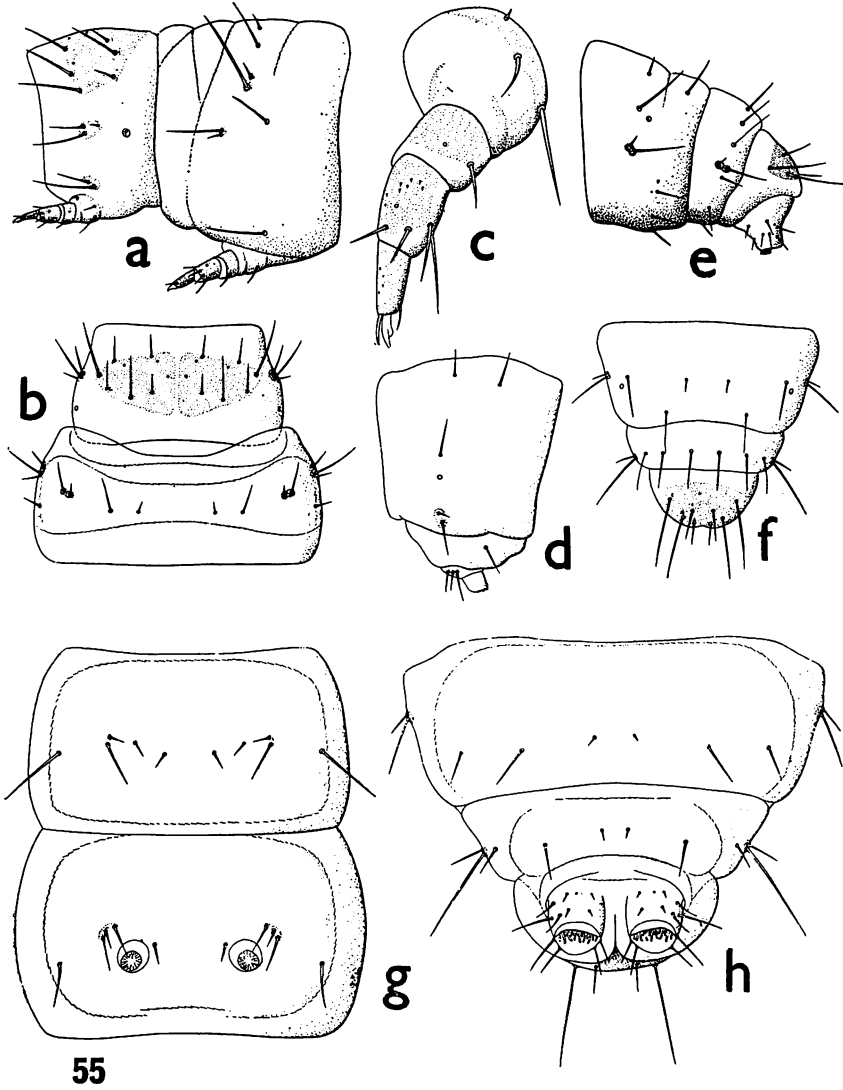


Figure 55—Details of the mature larva of *Phthorimaea operculella* (Zeller), Gelechiinae (rearranged from Bartoloni, 1951). *a* and *b*, lateral and dorsal aspects of the pro- and mesothorax; *c*, postero-lateral aspect of a leg; *d*, lateral view of the fifth abdominal segment; *e* and *f*, lateral and dorsal aspects of the three caudal abdominal segments; *g*, ventral aspect of the second and third abdominal segments; *h*, ventral aspect of the three caudal abdominal segments.

Some difficulty may be experienced in making an even cut along the sides, especially in very small larvae. This difficulty can be overcome by making a knife from the edge of a razor blade. The edge is broken off with pliers and inserted in a glass tube of suitable calibre. It is then fastened firmly with sealing wax. The very slender knife thus made is inserted through the anus. A pin held in the other hand is rubbed back and forth on the cuticle over the cutting edge until the cuticle is cut. A cut can thus be made wherever desired without in any way tearing the cuticle, as the knife is not moved during the process of cutting.

Good results can also be obtained more rapidly, especially for purposes of identification, by placing the larva in a tube containing a modest amount of 10 percent KOH and then hanging the tube in hot or gently boiling water until digestion is completed (*never* heat the KOH directly); another method is to place the specimens overnight in cold KOH. Most specimens will be well "digested" in a few minutes to about one-half hour in hot KOH. For purposes of cursory examination and identification, it may suffice simply to "digest" the soft parts and clean out the contents of the skin to see the setae and other parts more easily without the necessity of having to make a permanent slide mount. All important features may be seen on some specimens so treated, but others will require staining. One may tear a hole in one side of the middle section of the abdomen to enable one to clean out the contents of the abdomen and thorax. The contents may be removed by inserting the tips of very fine forceps through the hole and removing pieces of undigested material and/or by pressing the skin with a dissecting needle in a sort of pumping action which will force most of the debris out through the hole torn in the side. When clean, the skin may be placed in Mercurochrome for a few minutes to stain. It is then washed and cleaned further in water and then in alcohol. It may then be placed in alcohol or glycerin for study. After several minutes in glycerin, a certain amount of clearing will become evident and some of the difficult-to-see microscopical setae may become more easily observable.

It takes some practice before one can make superior permanent mounts, but any serious student of small larvae should learn to make such mounts. One should have available for study both whole specimens preserved in fluid and slide-mounted dissections.

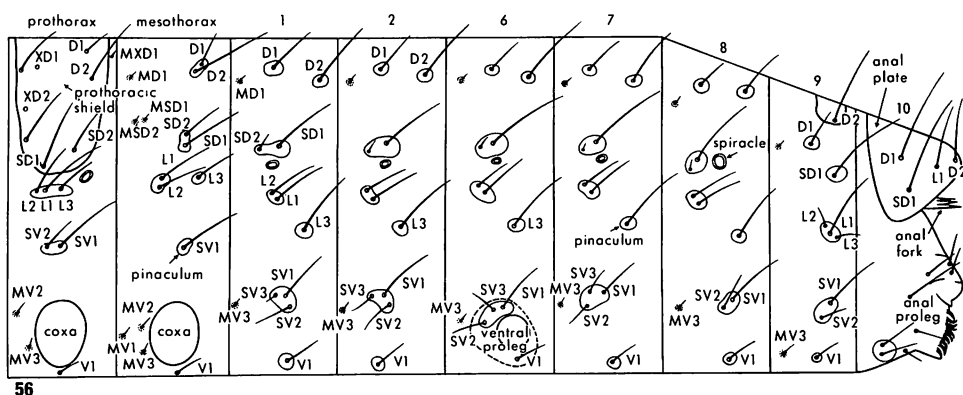


Figure 56—Setal map of the larva of *Epiphyas postvittana* (Walker), Tortricidae. (From Common, 1970, with permission.) Note that the metathorax and abdominal segment 3, 4, and 5 are not illustrated. The part labeled "anal plate" is also called the "anal shield".

In the foregoing quotation, Hinton outlined his technique for preparing cast, dried, larval skins so that they can be studied. If one rears a moth, one should often be able to find the cast larval skin in the cocoon, in the larval burrow, or near the location where the larva has pupated. One may not have seen the larva (which may be unknown) and it may not be possible to find other larvae of the species or to associate with assurance larvae seen with the moth reared. In such instances the shed skin will usually reveal details of critical or diagnostic importance. If the skin is carefully collected into alcohol, it can later be treated with KOH in the usual manner. Frequently it will be found that the softened, relaxed skin can be extended to reveal most or all of the characters of diagnostic importance without the necessity of using the more complicated Hinton system which is applicable to particularly difficult specimens. It is important to place the cast cuticle first into about 70 percent alcohol when it is collected. This will protect it and will enable it quickly to sink into the KOH when it is being prepared. Entirely satisfactory preparations can be made as follows: (1) place the alcohol-wetted skin in cold 10 percent KOH overnight; (2) then carefully rinse and extend the skin in water to which some acetic acid may be added; (3) place the skin into Mercurochrome for a few minutes for staining; (4) place in clean water to rinse further and clean; (5) finally, place skin in about 70 percent alcohol. The specimen may then be transferred to glycerin for study or it can be passed through the alcohols to 95 percent or absolute and then mounted in Euparal if desired.

I have studied excellent blown larval skins on which almost all characters, except perhaps those of the anal area and parts of the head, were easily seen. In fact, some characters appear to be more easily seen on blown, dried larvae than on those preserved in fluid, especially when the larvae in alcohol are old and faded. A collection of carefully prepared blown larvae placed with the moth collection is a great asset and can render invaluable service to all who have occasion to study or to identify larvae. A collection of the common species and the economic species of one's area is especially valuable. Many of the amateur British entomologists make beautifully prepared blown larval skins. Such skins are easily handled as pinned specimens when placed with the moths.

It is, of course, possible to study many larvae in a completely satisfactory manner without ever making cleared and stained preparations of their skins. Many larvae have their important characters clearly visible. On the other hand, various characters of many larvae, especially small ones with fine or obscure setae, cannot be seen unless one does make preparations of their skins, heads, and head appendages.

Larvae should be killed by placing them in near- or gently-boiling water for a few minutes. This will prevent their turning black in alcohol. They may then be preserved almost indefinitely in 70 to 80 percent alcohol to which a small amount of glycerin has been added. Some workers prefer to use a solution of nine parts of 80 percent alcohol and one part glacial acetic acid to kill and to preserve the specimens, but other workers do not recommend this as a long-term preservative. Specimens collected into this solution are said

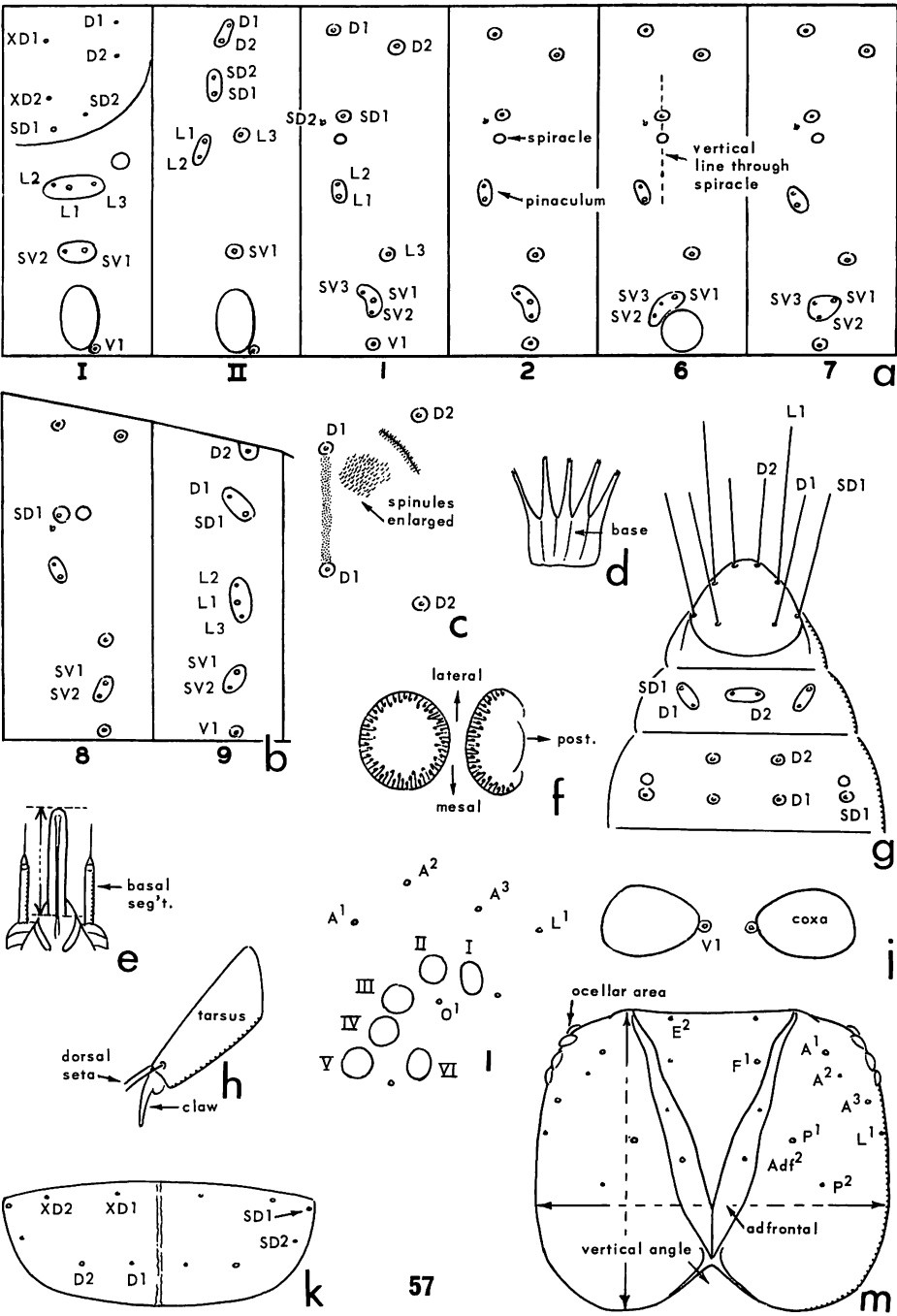


Figure 57—See legend on page 129.

not to turn black, and the technique has proven useful during extended field trips. There are various other materials used by various workers, but the alcohol + glycerin mixture is a proven and simple method which is known to have preserved larvae entirely satisfactorily over periods of many years.

The holding of larvae in various desired positions for study under the microscope and for drawing often proves difficult or exasperating. The following procedure is recommended:

Holding biological specimens, such as insect larvae, in certain positions for microscopic examination can be very simply accomplished by using small glass beads, produced originally for gas chromatography, as a supporting medium. The beads can either be used dry or immersed in a liquid depending on how the specimens are preserved.

As an example, beetle and fly larvae can be held in any position using about 15 g of glass beads of approximate diameter 0.2–0.3 mm (60 mesh) immersed in 70 per cent alcohol. It is possible to keep a specimen in a constant and exact position, without incurring any damage, for procedures such as general examination, measurement of spiracles, drawing, photography (the reflection from the beads often enhances the lighting) or for teaching purposes.

Suitable glass beads can be obtained from most commercial laboratory suppliers. If they are not available then fine white sand may be used, but this is not entirely satisfactory. Care must be taken to avoid spillage of the beads or else tubes and microscopes tend to slide around the bench. A few drops of glycerine added to the preservative will keep the beads together in case it evaporates off when the beads are not in use. (Houston, 1972: 187.)

One can make very slender dissecting knives, as mentioned by Hinton (p. 126, above). With a suitable pair of pliers, carefully break off very narrow chips of various lengths from the edges of razor blades. With practice one can easily prepare what is required, and the chips can be fitted into handles to suit one's desires. Some larger larvae can be cut open by the use of very fine scissors, but most microlepidopterous larvae are too small to be conveniently cut open with scissors.

It is sometimes found that the larvae of allied species of moths are more easily identified than are the adults. In fact, some species of moths almost defy separation by external characters of the adults. Such a case is that of the well-known pink bollworm of cotton and the Queensland pink bollworm. No satisfactory method has yet been proposed to separate the adults of these moths by external examinations, although the genitalia do display differences. The larvae, however, are easily distinguishable, and, if given only parts of larvae such as a head capsule, thorax, an abdominal segment, or even a proleg, one can separate and identify the species.

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Figure 57—Details of a tortricoid larva. *a*, setal map of the pro- and mesothorax and abdominal segments one, two, six, and seven, left lateral aspect; *b*, setal map of abdominal segments eight and nine, left lateral aspect; *c*, arrangement of the dorsal setae on the first abdominal segment with the dermal spinules greatly enlarged and also shown as if viewed in outline on a curved surface; *d*, anal fork; *e*, spinneret and labial palpi in ventral aspect (the arrows indicate the length used in measurements); *f*, crochets of a proleg of abdominal segment six and the anal proleg of the left side; *g*, dorsal aspect of abdominal segments eight, nine, and ten; *h*, tarsus and claw of a left thoracic leg; *i*, ocelli and associated setal sockets; *j*, metathoracic coxae, ventral aspect; *k*, prothoracic shield; *m*, frontal view of head capsule (mandibles removed). (Drawing kindly loaned by Margaret MacKay.)



The most important and helpful publication on larval chaetotaxy is the report by Hinton (1946*b*) mentioned previously. All workers who wish to study lepidopterous larvae must acquaint themselves with that monograph. The 1956 and 1962 studies by Mutuura are also of importance, but some of his interpretations have not been accepted.

The setae of the head are identified on figure 64 herewith. It will be noted that there are also various sensory pores and minute setae (V1, V2, AFa, Fa, Aa, Pa, La, Ga, Oa, SOa), as well as long, conspicuous setae. Some larvae which have highly retractile heads have the more posterior setae reduced or obscure. Our minute, specialized, prognathous, leaf-mining *Opostega* is a genus whose members have greatly reduced setae when mature, but the first instar larvae display the basic setal pattern. Hinton (1946*a*:9) significantly stated that "The general uniformity of pattern exhibited by the cranial setae is remarkable and is unknown in any other order of insects which approaches the Lepidoptera in number of species." One can only be astonished by the

GREEK LETTERS		NAME OF LETTER	TRANSLITERATION
A	$\alpha$	alpha	a
B	$\beta$	beta	b
$\Gamma$	$\gamma$	gamma	g
$\Delta$	$\delta$	delta	d
E	$\epsilon$	epsilon	e
Z	$\zeta$	zeta	z
H	$\eta$	eta	$\bar{e}$
$\Theta$	$\theta$	theta	th
I	$\iota$	iota	i
K	$\kappa$	kappa	k
$\Lambda$	$\lambda$	lambda	l
M	$\mu$	mu	m
N	$\nu$	nu	n
$\Xi$	$\xi$	xi	x
O	$\omicron$	omicron	o
$\Pi$	$\pi$	pi	p
P	$\rho$	rho	r
$\Sigma$	$\sigma$	sigma	s
T	$\tau$	tau	t
$\Upsilon$	$\upsilon$	upsilon	u
$\Phi$	$\phi$	phi	ph
X	$\chi$	chi	kh
$\Psi$	$\psi$	psi	ps
$\Omega$	$\omega$	omega	o

Figure 58—The Greek alphabet. Some systems of larval chaetotaxy use Greek names or letters, and this table will assist those who have occasion to consult papers using the Greek.

remarkable uniformity not only of the setae of the head but of the entire body. Hinton's valuable 1946*a* comparative table on the names of the cranial setae as used by various authors is reproduced here as figure 59. See also Hinton, 1948*a*.

The thoracic and abdominal setae are also divided into microscopic (or proprioceptor setae as Hinton called them) and long or tactile setae. Comparative charts of their names as used in three basic systems are included here as figures 60–63.

The microscopical setae bear the prefix "M" and are labeled MD1, MSD1, MV1, etc. These setae, or their sockets or "pores", are often difficult or impossible to locate unless a cleared skin is prepared, and staining is often required to make them evident. Hinton (1946*a*:16) said that:

The microscopic setae are all primary; and they are nearly identical in numbers and position throughout the order. Furthermore, with successive moults there is no change in their number or significant change in their position, so that in respect to these setae the last instar larva is precisely the same as the first instar larva. . . . The distribution of the microscopic setae is the same in the leaf-miner *Eriocrania* . . . as in the specialized arboreal *Sphinx*, two forms whose common ancestor was not later than the beginning of the Cretaceous, or, in other words, two forms which have had no connection with each other for at least 110 million years.

## HEAD

DYAR, 1896 FORBES, 1910	HEINRICH, 1916	RIPLEY, 1923	GERASIMOV, 1935	HINTON
IX VIII IV —	Anterodorsal Ad—1 " Ad—2 " Ad—3 " Ad—2a	Seta of vertex V9 " V8 " V4 Sensorium of vertex SV3	Anteriores prima A1 " secunda A2 " tertia A3 Porus anteriores Aa	A1 A2 A3 Aa
VII V — —	Ocellar O—3 " O—2 " O—1 " O—1a	Seta of vertex V7 " V5 " V6 —	Ommatalis prima O1 " secunda O2 " tertia O3 Porus ommatalis Oa " Ob	O1 O2 O3 Oa Ob (not named)
XI VI X — — —	Subocellar SO—1 " SO—2 " SO—3 " SO—2a — —	Seta of vertex V11 " V12 " V10 — — —	Subommatalis prima SO1 " secunda SO2 " tertia SO3 Porus subommatalis SOa " SOb " SOc	SO1 SO2 SO3 SOa SOB SOc (not named) (not named)
III —	Lateral L—1 " L—1a	Seta of vertex V3 —	Lateralis L1 Porus lateralis La	L1 La
II I — —	Posterodorsal Pd—1 " Pd—2 " Pd—1a " Pd—2a	Seta of vertex V2 " V1 Sensorium of vertex SV2 " SV1	Posteriores prima P1 " secunda P2 Porus posteriores Pa " Pb	P1 P2 Pa Pb
— — — — —	Secondary tubercles	Occipital seta O3 " O2 " O1 — Occipital sensorium SO	Verticalis prima V1 " secunda V2 " tertia V3 Porus verticalis Va " Vb	V1 V2 V3 (= Pb) Va
— — —	Genal G—1 — Genal G—1a	Seta of vertex V13 — Postgenal sensorium PAS	Genalis G1 — Porus genalis Ga	G1 G2 Ga
— —	Fr.—1 Fr.a	Frontal seta F1 " sensorium FS	Frontalis F1 Porus frontalis Fa	F1 Fa
— — —	Adf.1 Adf.2 Adf.a	Adfrontal seta A2 " A1 " sensorium ADS	Fronto-lat. prima Fr.1.1 " secunda Fr.1.2 Porus fronto-lat. Fr.1.a	AF1 AF2 AFa
— —	Ep. 1 Ep. 2	Clypeal seta C2 " C1	Clypealis prima C11 " secunda C12	C1 C2

Figure 59—Hinton's chart (1946*b*) showing various systems of naming the setae of the lepidopterous larval cranium.

## THORAX AND ABDOMEN

	FRACKER		GERASIMOV		HINTON	
	JUGATAE	FRENATAE	HEPIALIDAE	OTHERS		
Prothorax	Gamma	Alpha	IX	X	Tactile	XD1
	Epsilon	Gamma	IIIa	IX	"	XD2
	Alpha	Beta	X	I	"	D1
	Beta	Delta	I	II	"	D2
	Rho	Epsilon	II	IIIa	"	SD1
	Delta	Rho	III	III	"	SD2
	Eta	Kappa	V	IV	"	L1
	Kappa	Eta	IV	V	"	L2
	Theta	Theta	VI	VI	"	L3
	Pi	Nu	VIIa	VIIa	"	SV1
	Nu	Nu	VIIb	VIIb	"	SV2
	Sigma	Sigma	VIII	VIII	"	V1
	—	—	—	Xa	Proprioceptor	MXD1
	Tau	—	VIIc	VIIc	"	MV2
	Phi	—	VIIId	VIIId	"	MV3
Meso- and metathorax	Alpha	Alpha	I	I	Tactile	D1
	Beta	Beta	II	II	"	D2
	Rho	Rho	III	III	"	SD1
	Delta	Epsilon	IIIa	IIIa	"	SD2
	Kappa	Kappa	V	IV	"	L1
	Epsilon	Eta	IV	V	"	L2
	Theta	Theta	VI	VI	"	L3
	Pi	Pi	VIIa	VIIa	"	SV1
	—	Nu	—	—	"	SV2
	Sigma	Sigma	VIII	VIII	"	V1
	Gamma	—	Xa	Xa	Proprioceptor	MD1
	—	—	—	Xb	"	MD2
	Gamma	—	IXa	IXa	"	MSD1
	Gamma	—	IXb	IXb	"	MSD2
	Nu	—	VIIb	VIIb	"	MV1
	Tau	—	VIIc	VIIc	"	MV2
Abdomen, 1-9 .	Omega	Omega	VIIId	VIIId	"	MV3
	Alpha	Alpha	I	I	Tactile	D1
	Beta	Beta	II	II	"	D2
	Rho	Rho	III	III	"	SD1
	Epsilon	Epsilon	IIIa	IIIa	"	SD2
	Theta	Kappa	IV	IV	"	L1
	Kappa	Eta	V	V	"	L2
	Eta	Mu	VI	VI	"	L3
	Pi	Pi	VIIa	VIIa	"	SV1
	Nu	Nu	VIIb	VIIb	"	SV2
	Tau	Tau	VIIc	VIIc	"	SV3
	Sigma	Sigma	VIII	VIII	"	V1
	—	—	X	Xa	Proprioceptor	MD1
	—	—	—	Xb	"	MD2
	Omega	—	VIIId	VIIId	"	MV3

Figure 60—Hinton's chart (1946b) showing the names of the setae of the thorax and abdomen of larval Lepidoptera according to the systems of Fracker (1915), Gerasimov (1935), and Hinton (1946b). It should be noted that in his important monograph (1956a) on *The Larvae of the Species of Tineidae of Economic Importance*, Hinton, without explanation, changed his names for the prothoracic shield setae to XD2 (= SD1), XD1 (= XD2), SD2 (= D2), D2 (= D1), D1 (= XD1) and SD1 (= SD2). (Note: the 1946 designations are inside the parentheses in the foregoing sentence.) Margaret MacKay (1963a:996) said that "it seems . . . that, of the six setae usually found on the prothoracic shield, it is still not known which four are homologous with the four setae on the dorsum of each of the other segments, i.e., Hinton's D1, D2, SD1 and SD2." Miss MacKay also noted that, "though two of the systems of identifying the setae of lepidopterous larvae (Hinton, 1946; Mutuura, 1956) are highly useful, there are several problems which remain unanswered in each of them. Homologies are difficult to establish even by Mutuura's system, which is based on the homology of the muscular system of each segment and the positions of the setae in relation to the muscular attachments." Miss MacKay's paper (1963a), *Problems in Naming the Setae of Lepidopterous Larvae*, should be consulted for critical and constructive comment.

The long or “tactile” setae are more variable in number and position than are the microscopic setae, and it is these long setae which we use generally for the separation and identification of species and higher categories. The primitive arrangement of the setae is usually found in first stage larvae; there may be considerable change in the setae in later instars. Usually it is the last instar larva that one uses to identify a given species, and it is the chaetotaxy of the last instar larva which is usually illustrated. Few first-stage larvae are known or have been described.

The prothorax has two long setae on each side which are not found on the other thoracic or abdominal segments. These extra setae are called XD1 and XD2. The other setae on the thoracic and abdominal segments are the

HEAD

GERASIMOV	HINTON	GERASIMOV	HINTON	GERASIMOV	HINTON
A1	A1	SOa	SOa	Va	( = Pb)
A2	A2	SOb	—	Vb	Va
A3	A3	SOc	—	G1	G1
Aa	Aa	L1	L1	—	G2
O1	O1	La	La	Ga	Ga
O2	O2	P1	P1	F1	F1
O3	O3	P2	P2	Fa	Fa
Oa	Oa	Pa	Pa	Fr.1.1	AF1
Ob	—	Pb	Pb	Fr.1.2	AF2
SO1	SO1	V1	V1	Fr.1.a	AFa
SO2	SO2	V2	V2	C11	C1
SO3	SO3	V3	V3	C12	C2

ABDOMINAL SEGMENTS I TO IX

GERASIMOV			FRACKER		HINTON	BOLLMANN	MUTUURA
	Hepialidae	Jugatae		Frenatae			
I	I	α		α	D 1	D 1	T 2
II	II	β		β	D 2	D 2	T 1
III	III	ρ		ρ	SD 1	LD 1	ST 1
IIIa	IIIa	ε		ε	SD 2	LD 2(m)	ST 2
IV	IV	θ		κ	L 1	L 1	PN 1/SC 1/SC 2
V	V	κ		η	L 2	L 2	SC 1/SC 2
VI	VI	η		μ	L 3	L 3	C 1
VIIa	VIIa	π		π	SV 1	VL 1	SS 1
VIIb	VIIb	ν		ν	SV 2	VL 4	SS 2
VIIc	VIIc	τ		τ	SV 3	VL 3	SS 3
VIIId	VIIId	ω		—	MV 3	VL 2(m)	MS 1
VIII	VIII	σ		σ	V 1	V 1	S 1
IXa	IXa	γ		—	—	—	—
IXb	IXb	γ		—	—	—	—
Xa	X	—		—	MD 1	D 3m	PMT 1
Xb	—	—		—	MD 2	D 4m	—

Figure 61—Martin’s 1962 comparative tables of five systems of nomenclature for lepidopterous larval chaetotaxy.

dorsals, D1, D2; the subdorsals, SD1, SD2; the laterals, L1, L2, L3; the subventrals, SV1, SV2, SV3; and the ventrals, V1. Some of these setae may be absent on some of the segments of some species, other species may have supernumerary setae in some of the positions, and some species have secondary setae in other areas.

The arrangement of the setae on the meso- and metathorax is usually the same on each segment, and usually only one of these segments is illustrated.

The chaetotaxy of the abdominal segments 1 to 6 is usually uniform except for the changes necessary to accommodate the prolegs on those segments which bear them. There may be differences in the chaetotaxy of segments 7 and 8, and the chaetotaxy of segments 9 and 10 is conspicuously different. The arrangements can best be appreciated by studying the accompanying figures which I have selected to demonstrate numerous features. The true legs of the thorax usually have several setae in various positions, but they appear not to have received much attention. They deserve more study.

### PROTHORAX

FRACKER	FORBES	HEINRICH	HINTON (1946)
alpha	alpha	Ia	XD1
beta	beta	IIa	D1
gamma	gamma	Ib	XD2
delta	delta	IIb	D2
epsilon	epsilon	Ic	SD1
rho	rho	IIc	SD2
theta	theta	III	L3
kappa	kappa	IV	L1
eta	eta	V	L2
pi	pi	VI	SV1
nu	nu	VI	SV2
tau	—	VII	MV group
sigma	—	VIII	V1

### MESOTHORAX AND METATHORAX

FRACKER	FORBES	HEINRICH	HINTON (1946)
alpha	ia	Ia	D1
beta	ib	Ib	D2
epsilon	iiia	IIa	SD2
rho	iib	IIb	SD1
theta	iii	III	L3
kappa	iv	IV	L1
eta	v	V	L2
pi	vii	VI	SV1
nu	vii	VI	SV2
tau	ix	VII	MV group
omega	—	—	MV group
sigma	viii	VIII	V1

Figure 62—Comparative nomenclature for lepidopterous larval thoracic chaetotaxy as used by Forbes and Heinrich compared with that of Fracker and Hinton (1946b).

Spiracles are located on the prothorax and on abdominal segments 1 to 8. The prothoracic spiracle is often the largest, but the spiracle on the eighth abdominal segment is usually distinctly larger than those on the other abdominal segments, and it may be much larger than any other spiracle.

Setal "maps" are drawn as if the larva were sliced along the middorsal and midventral lines and one-half of the body were spread out flat. The setae are then drawn as on a flat surface. This may cause some confusion to the beginning student of larvae, but once the method is understood its convenience will become evident. I prefer, however, to prepare more natural appearing illustrations. On occasion it is advisable also to draw separate setal maps of the dorsum. This is especially true of the pronotum and abdominal segment 10.

A useful publication for identifying the larvae of some of the common, widely spread species, including some species of economic importance, is *Keys for the Identification of Some Lepidopterous Larvae Frequently Intercepted at Quarantine* by Capps (1956 and 1963). The numerous illustrations of key characters given in that paper are of value in assisting one to become familiar with various features used in the classification of larvae. Peterson's 1948 monograph will also assist in the identification of various pest species. Dr. Swezey (1944c) abstracted details from the 1939 edition of the Capps report and added some original details which he published under the title of *Keys to Some Lepidopterous Larvae Found in Gardens and Homes in Hawaii*. Although there are certain faults in the abstract, it is a useful preliminary contribution for use in Hawaii.

Little attention has been given the larvae of Hawaiian Lepidoptera, and none of the endemic species heretofore have been described adequately. The larvae of few Hawaiian species are to be found preserved in collections, and even the species of economic importance are poorly represented. It is noteworthy that many economic entomologists, who so frequently demand so much from the systematists and who have to do with the study and control of many species of moths, rarely preserve immature stages, even of those specimens

### ABDOMINAL SEGMENTS I to IX

FRACKER	FORBES	HEINRICH	HINTON (1946)
alpha	i	I	D1
beta	ii	II	D2
epsilon	iii <sub>a</sub>	III <sub>a</sub>	SD2
rho	iii	III	SD1
kappa	iv	IV	L1
eta	v	V	L2
mu	vi	VI	L3
pi	vii	VII	SV1
nu	vii	VII	SV2
tau	vii	VII	SV3
omega	ix	—	MV group
sigma	viii	VIII	V1

Figure 63—Comparative nomenclature for the chaetotaxy of lepidopterous abdominal segments as used by Forbes and Heinrich compared with that of Fracker and Hinton (1946b). For figure 63-A, see page 138.

they rear in the laboratory. All too often they appear to consider it too much bother to collect specimens of the species they see day after day and to present correctly preserved material to museums for study and future reference. There is even a reluctance to supply pertinent materials for a study such as this, whose purpose is not to satisfy the ego of the author but to serve others (including especially the economic entomologists, who may not be skilled taxonomists).

For many years Dr. Swezey made a special study (mostly during holidays and weekends) of the hostplant relationships of the Hawaiian moths, and he is the only person in Hawaii who has devoted much time to such study. He described a few species superficially, and it is a great loss that his collections were never described adequately. He mentioned only a few of the setae, and he did not comment upon many of the important features of the larvae. He evidently used the Forbes' system of nomenclature for the chaetotaxy. I have appended here a table (figure 62) showing the Forbes, Heinrich, and Hinton systems to assist in "translating" these systems of naming the setae.

The term *pinaculum* appears to have been proposed by Tillyard (1926:406), and I have followed his spelling. This is the form used by MacKay and others, and it is used in Torre-Bueno's *Glossary of Entomology*. Some authors, including Hinton, spell the term *pinnaculum*.

I owe a particular debt of gratitude to Miss Margaret MacKay, Entomology Research Institute, Ottawa, who not only loaned many of her excellent illustrations of larvae for reproduction herein, but who also made a number of drawings especially for this text. Had it not been for an overwhelming burden of other work and serious illness, she would have prepared other illustrations from which all readers of this work would have benefitted.

## LARVAL KEY A

## KEY TO THE MAIN GROUPS OF LEPIDOPTEROUS LARVAE IN HAWAII

1. Larvae with either one or two large, hornlike or tentaclelike processes on abdominal segment 8, or with a pair of tentaclelike processes (which may or may not be retractile) on thorax, or with processes on both abdomen and thorax, or body with numerous, large, spinose processes; all larvae large to very large when mature.....2
  - Larvae never with such processes; larvae large or small ..... 4
- 2(1). Body with rows of many large spinose processes; large, very spiny larvae; see Volume 7:454....  
..... **Nymphalidae.**
  - Body with processes arising only from the pronotum or from pronotum and abdominal tergite 8 ..... 3
- 3(2). Dorsum with only a single hornlike process and that arising from the middle of abdominal tergite 8; see Volume 7:428.....**Sphingidae.**
  - With a pair of tentaclelike processes, fixed or retractile, on the thorax, and with or without processes on abdominal tergite 8.....3a
- 3a(3). With a bifurcate, retractile, tentaclelike process (osmetarium) arising from the anterior edge of the pronotum (usually retracted and not visible unless the larva is agitated); on *Citrus* (figure 63-A).....**Papilionidae.**
  - With a pair of fixed tentacle-like processes arising from dorsum of thorax and another pair from abdominal tergite 8; on *Asclepiadaceae*; see Volume 7:472.....**Danaiidae.**
- 4(1). Abdomen with numerous, usually dense, secondary setae or hairs (distinct from microtrichia)....5
  - Abdomen with primary setae only or with a few supplementary setae associated with the primaries, and derm between them usually appearing mostly bare excepting for the microtrichia or microscopical dermal spicules or sculpturing; although some of the secondary setae may be long, they are never dense on dorsum ..... 8



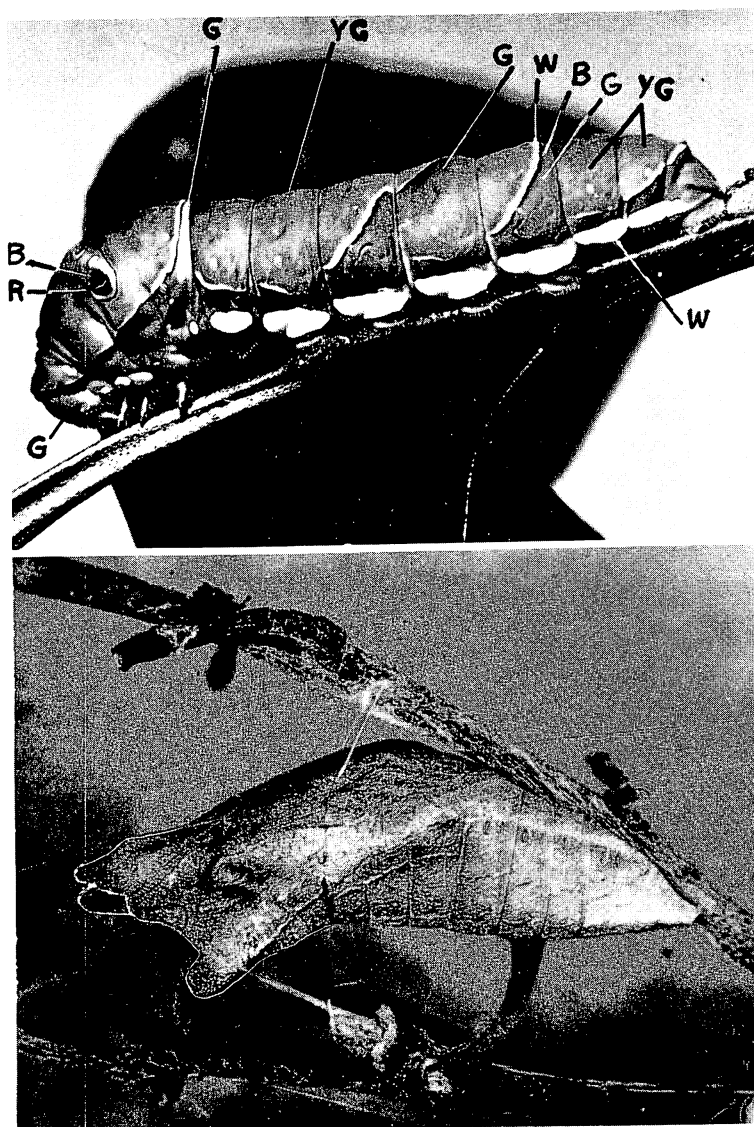


Figure 63-A—Larva and pupa of *Papilio xuthus* Linnaeus. Larva about 40 mm. long. Pupa about 35 mm. long. Color code for larva: B, black; G, green; R, red; YG, yellow green; W, white. The figure of the pupa is mounted on the plate in a more horizontal position than is normal—usually the larvae pupate in a more nearly vertical position. This species became established in Hawaii after my Volume 7 on the Macrolepidoptera was published, and details concerning it should be incorporated in a supplementary volume on the Hawaiian Lepidoptera. (From color photographs of Hawaiian specimens supplied by George Funasaki.)

- 5(4). With only three pairs of ventral prolegs (on abdominal segments 4, 5 and 6); with conspicuous verrucae and numerous conspicuous secondary setae; crochets in uniordinal mesal arcs; spiracles with peculiar, raised, explanate rims; on *Melastoma malabathricum* (Indian rhododendron); *Selca brunella* Hampson in the ..... **Nolidae.**

Without such a combination of characters; with four pairs of ventral prolegs.....6

- 6(5). Body unlike normal lepidopterous larvae, sluglike, depressed, subfusiform (broadest at middle) and with head highly retractile and often hidden above by thorax; derm appearing granular because of dense asperities; crochets of prolegs triordinal and interrupted by a fleshy lobe which projects from the sole (planta) of the

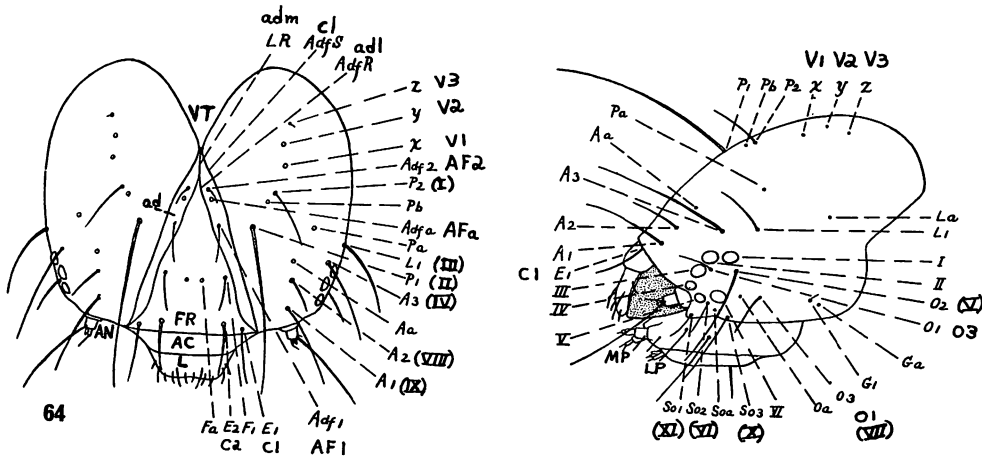


Figure 64—Frontal and lateral sketches of the head capsule of *Anatrachyntis rileyi* (Walsingham), Cosmopteriginae, with various parts labeled. The basic drawings are from Busck, 1917:348, and the original lettering gives the names of the setae according to the Heinrich system. I have added the early nomenclature of Dyar as numbers 1 to XI enclosed in parentheses. The original numbers 1 to 6 which are not enclosed in parentheses indicate the ocelli, and I have added the modern revised system of Hinton, 1946. The Hinton system retains most of the Heinrich designations. The Hinton changes are: *AF* for Heinrich's *Adf* series; *C1* and *C2* for Heinrich's *E1* and *E2*; *V1*, *V2*, and *V3* for Heinrich's *X*, *Y*, *Z*; *O3* for *O1*, and *O1* for *O3* of Heinrich; *adm* (median adfrontal suture) for Heinrich's *LR* (longitudinal ridge or epicranial stem); *C1* (cleavage line or frontal suture) for Heinrich's *AdfS* (adfrontal suture); *adl* (lateral adfrontal suture) for Heinrich's *AdfR* (adfrontal ridge). *AC*, anteclypeus; *ad*, adfrontal area; *AN*, antenna; *FR*, frons or front; *L*, labrum; *LP*, labial palpi with the spinneret between them; *MP*, maxillary palpi; *VT*, vertical triangle.

For a comparative table of the names of the cranial setae as used by various authors see figure 59. See Hinton, 1948:843, for a commentary on the dorsal cranial areas.

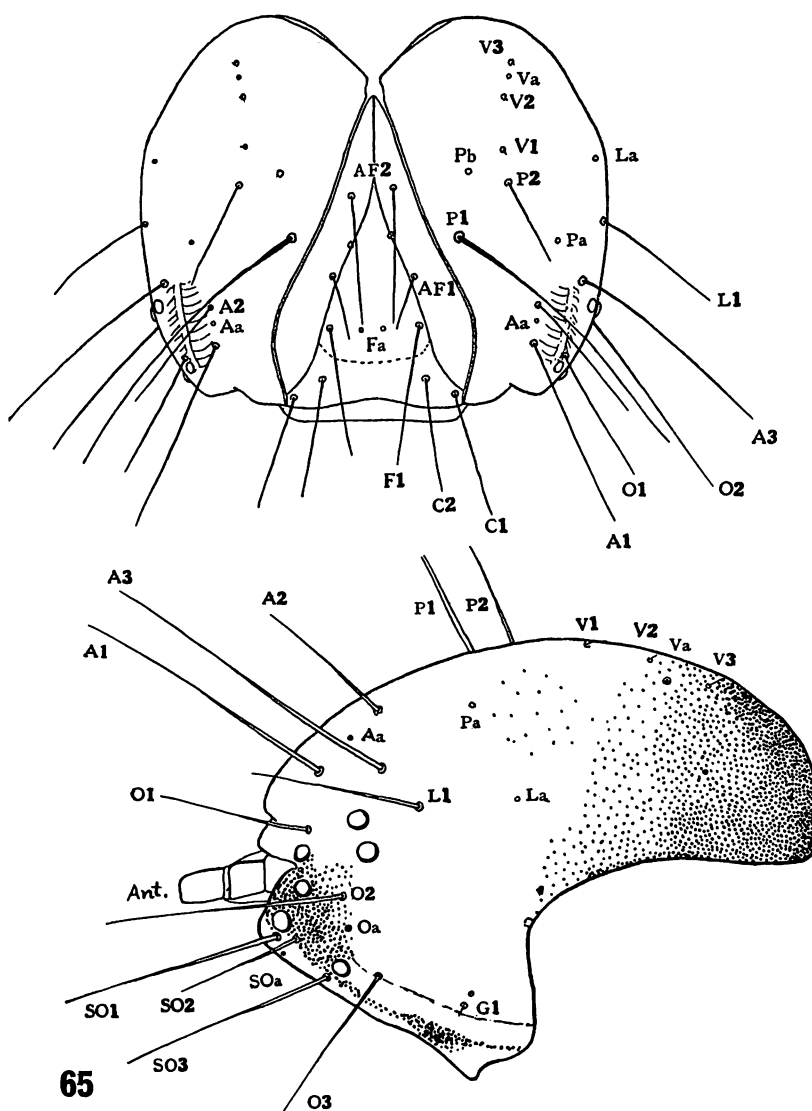


Figure 65—Heads of two species of Tineidae to show chaetotaxy according to Hinton, 1956. Top, *Nemapogon parasitella* (Hübner), mandibles and antennae omitted, frontal view. Bottom, left side of head capsule, mandibles omitted, of *Nemapogon ruricolella* (Stainton).

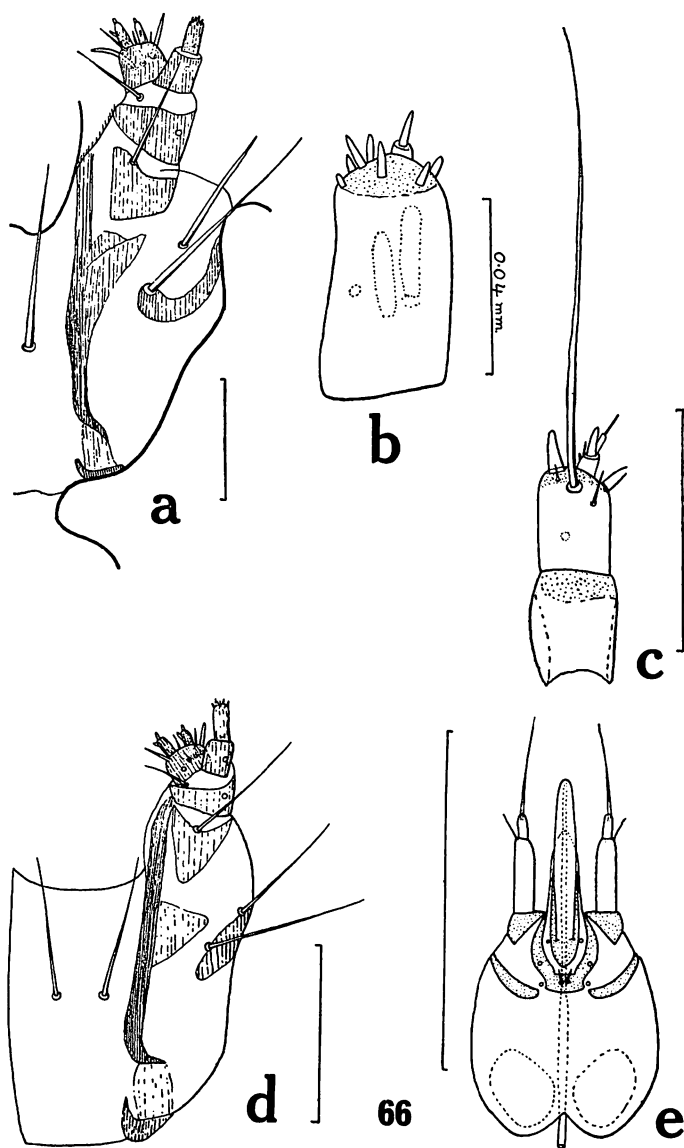


Figure 66—Details of parts of the head of some tineid larvae (rearranged from Hinton, 1956). *a*, ventral aspect of left maxilla and part of postmentum; *b*, ventral aspect of apex of palpus; *c*, right antenna of *Nemapogon parasitella* (Hübner). *d*, ventral aspect of postmentum and left maxilla; *e*, ventral aspect of prementum including labial palpi and spinneret of *Nemapogon granellus* (Linnaeus).

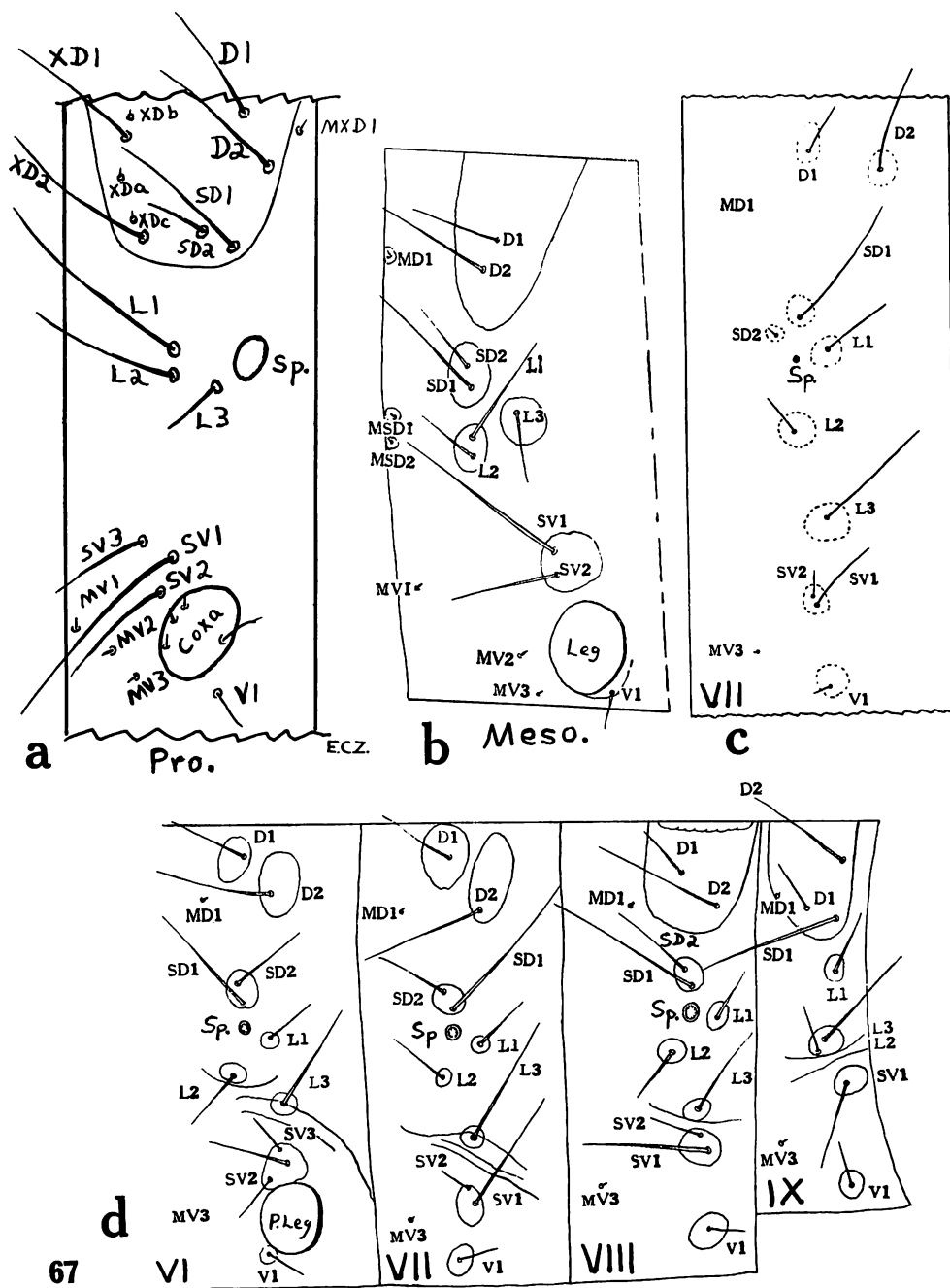


Figure 67—Setal maps of parts of some lepidopterous larvae. *a*, a hypothetical prothorax with the setae labeled in accordance with the Hinton system. *b*, mesothorax of *Amydria vastella* (Zeller); *c*, abdominal segment 7 of *Nemapogon ruficoilella* (Stainton); *d*, abdominal segments 6, 7, 8, and 9 of *Amydria vastella* (Zeller). Figures *b*, *c*, and *d* are of Tineidae and are rearranged from Hinton, 1956. All segments are seen in left lateral aspect. Note the different sizes and disposition of the setae on the two abdominal segments 7. *Sp*, spiracle; *P.Leg*, proleg.

proleg; usually in flowers or seed pods; see  
 Volume 7:477 ..... **Lycaenidae.**  
 Body of larva subcylindrical; head exposed;  
 proleg crochets not interrupted by such a fleshy  
 lobe ..... 7

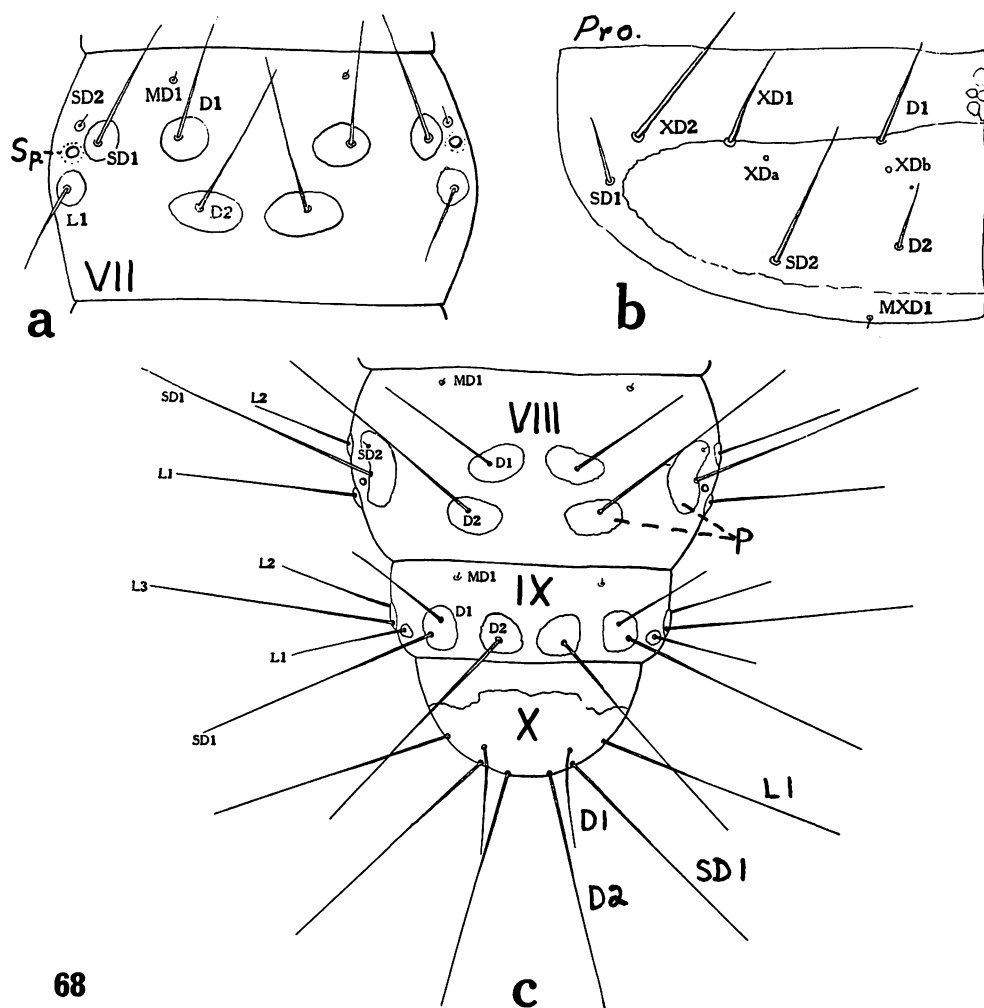


Figure 68—Details of some lepidopterous larval tergites to indicate setal nomenclature. *a*, abdominal segment 7 of *Scardia boleti* (Fabricius); *b*, left side of pronotum of the same species; *c*, the three caudal abdominal segments of *Nemapogon fulvimitrella* (Sodoffsky). All figures are of Tineidae and are adapted from Hinton, 1956. *P*, pinacula; *Sp*, spiracle.

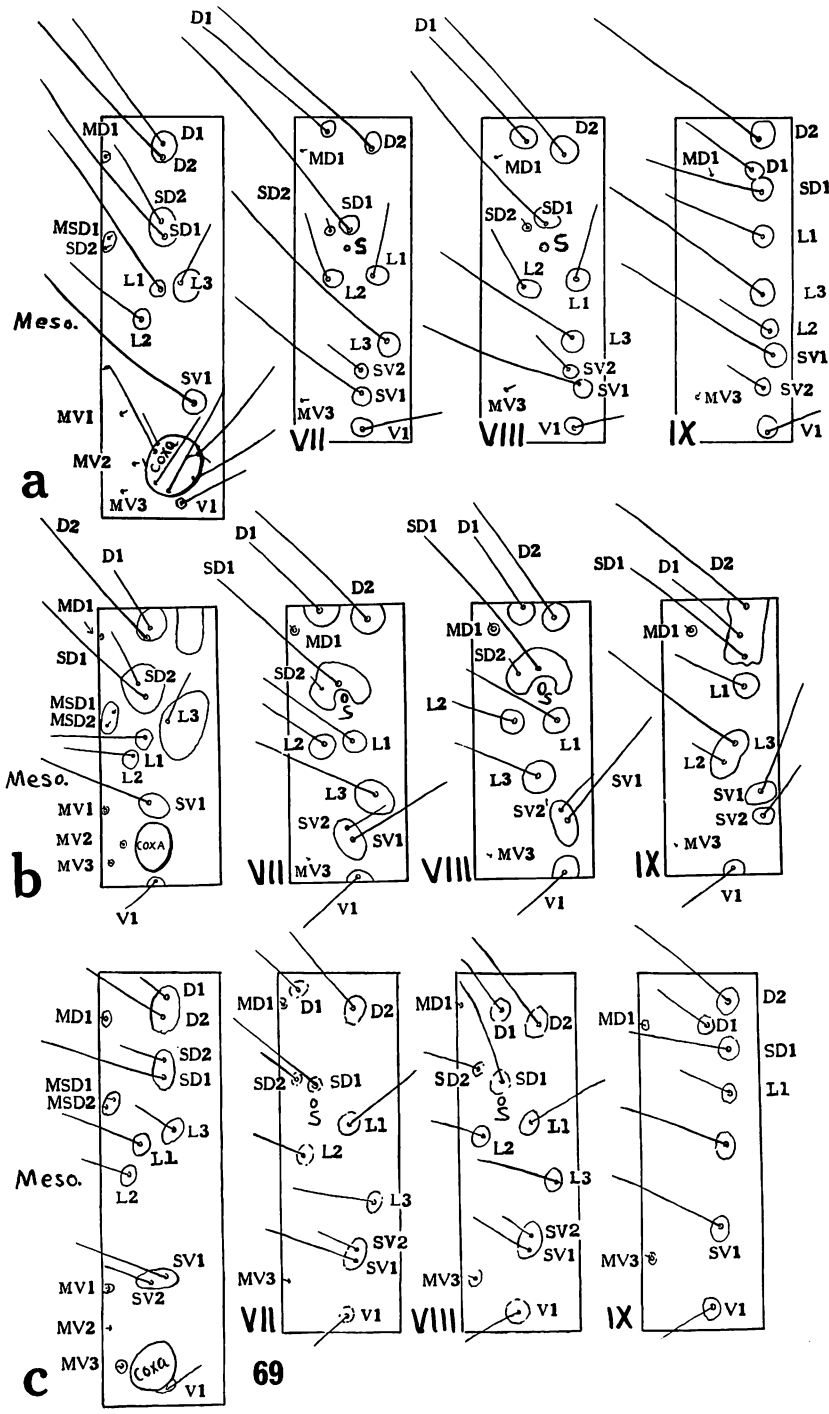


Figure 69—See legend on page 145.

- 7(6). Abdominal tergites divided into six annulets; prolegs not unusually long; spiracles conspicuous; derm covered with fine pile and appearing velvety; green caterpillars on crucifers; see Volume 7:447..... **Pieridae**.  
 Abdominal tergites not so annulated; prolegs obviously long and slender; proleg crochets uniordinal; abdominal spiracles very small; **Pterophoridae** or on palms and as on figures 625, 626, **Agonoxenidae** .....  
 ..... part of **Microlepidoptera**, see Key C.
- 8(4). With only a single pair of ventral prolegs (in the known Hawaiian species) and these on the 6th abdominal segment; often large larvae; none are leaf miners; see Volume 7:36.....  
 ..... **Geometridae**.  
 a. Subanal plate (the sclerite between the caudal prolegs) strongly produced caudad into an acute point; SV setal group on abdominal segment 5 trisetose.....  
 ..... **Ennominae**.  
 b. Subanal plate apically obtuse, not strongly produced; SV setal group on abdominal segment 5 bisetose..... **Larentiinae**.  
 With two to four pairs of ventral prolegs, or with none on some small leaf miners.....9
- 9(8). Ventral prolegs greatly reduced or wanting; some leaf miners.....  
 ..... part of **Microlepidoptera**; see Key C.  
 Ventral prolegs always distinct, two, three or four pairs developed.....10

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Figure 69—Setal maps of three genera of Tineidae to illustrate chaetotaxy of the mesothorax and abdominal segments VII, VIII, and IX, in left lateral aspect (adapted from Hinton, 1956). *a*, *Haplotinea ditella* (Pierce and Metcalfe); *b*, *Nemapogon parasitella* (Hübner); *c*, *Tineola bisselliella* (Hummel). These examples will serve to demonstrate how larvae within a single group can be differentiated by their chaetotaxy. Note the differences in the pinacula and the different arrangements of the setae on each species. For example, on abdominal segment IX of *a*, *SD1*, *D1*, and *D2* are borne from separate pinacula, but the pinacula of *SD1* and *D1* touch each other, whereas on *b*, all three setae are borne from a single large pinaculum and on *c*, each pinaculum is distinct and separated. On the mesothorax of *a* and *b*, there is only one *SV* seta, but on *c* there are two *SV* setae. On *a* and *b*, the pinacula of *V1* is free from the coxa, but on *c* it adjoins the coxa. On *a*, the *SV* setae of abdominal segment VII are on distinctly separated pinacula, but on *b* and *c* each *SV* setal group is borne from a common pinaculum. On *a*, *SV2* is directly dorsad of *SV1*, but on *b*, *SV2* is cephalad of *SV1*. On the same segments, also, *SD1* are on separate small pinacula, but on *b* these two setae are on one large pinaculum that partly surrounds the spiracle. On abdominal segment IX of *c* there is only one *L* seta and only one *SV* seta, but on *a* and *b* there are two *L* setae and two *SV* setae. Thus, there are only seven setae on each side of segment IX on *c*, but on *a* and *b* each has nine setae.



- 10(9). With only two pairs of ventral prolegs and these on abdominal segments 5 and 6; many of the larger abdominal setae stout and with blunt tips  
 .....some **Noctuidae**.  
 With three or four pairs of ventral prolegs. ....10A
- 10A(10). Abdominal segment 3 lacking prolegs. ....**Nolidae**.  
 Abdominal segment 3 with prolegs. ....11
- 11(10). Prothorax with the prespiracular L group of setae containing three setae. ....  
 .....majority of **Microlepidoptera**; see Key C.  
 Prothorax with only two setae in the prespiracular L group. ....12
- 12(11). Crochets of ventral prolegs arranged in a transverse line (mesoseries); see Volume 7:197. ....  
 .....**Noctuidae**.  
 Crochets of prolegs arranged in a circle, penellipse, or double row. ....13
- 13(12). Crochets of ventral prolegs uniordinal. ....14  
 Crochets of ventral prolegs biordinal or triordinal  
 .....most of **Pyralidae**; see Key B.
- 14(13). Abdominal segments 1 and 8 each with seta SD1 surrounded by a sclerotized, pigmented ring which encloses an unpigmented area around the setae (may be difficult to see on the 1st abdominal segment on some unprepared larvae; other segments may also have similar rings or crescents). .... part of **Pyralidae**; see Key B.  
 Abdominal segments 1 and 8 lacking such pigmented rings surrounding uncolored areas around setae SD1; **Alucitidae** and **Carposiniidae** of the. ....**Microlepidoptera**; see Key C.

### LARVAL KEY B

#### KEY TO THE SUBFAMILIES OF PYRALID LARVAE IN HAWAII

1. Larvae aquatic, case-makers; cephalic setae 01, 02, and 03 in an almost straight line. ....**Nymphulinae**.  
 Larvae not aquatic, not case-makers; cephalic setae 01, 02, and 03 forming an angle. ....2
- 2(1). Crochets of ventral prolegs arranged usually in a broken circle (penellipse); 8th abdominal segment lacking a sclerotized ring around an unpigmented area at base of seta SD1. ....3

- Crochets of ventral prolegs arranged in complete circles; 8th abdominal segment with a narrow or moderately broad, pigmented, sclerotized ring surrounding an unpigmented disc enclosing base of seta SD1 (do not confuse the rim of the setal socket for this pigmented ring) . . . . . 5
- 3(2). Abdominal segment 10 with setae V1 usually distinctly farther apart than those on segment 9 . . . . . **Pyraustinae.**
- Abdominal segment 10 with setae V1 either closer together than those on segment 9 or subequally separated . . . . . 4
- 4(3). A line drawn between setae SD1 and L1 on abdominal segment 8 passes cephalad of the spiracle; abdominal segment 9 with setae V1 much farther apart than the V1 setae on segment 10 . . . . . **Crambinae.**
- A line drawn between setae SD1 and L1 on abdominal segment 8 passes caudad of spiracle; abdominal segments 9 and 10 with setae V1 subequally separated . . . . . **Scopariinae.**
- 5(2). Mesothorax with each seta SD1 surrounded by an unpigmented disc which in turn is enclosed or nearly enclosed by a sclerotized, irregular, pigmented ring . . . . . **Phycitinae.**
- Seta SD1 on mesothorax not surrounded by such rings . . . . . 6
- 6(5). Prothorax with the prespiracular L setae in a subhorizontal row; abdominal segment 1 with seta SD1 surrounded by a narrow, usually irregular, pigmented ring which encloses an unpigmented disc at base of the seta (frons short and broad; spiracles large and with dark peritremes) . . . . . **Galleriinae.**
- Prothoracic L setae in a vertical or subvertical row; abdominal segment 1 without such pigmented rings around the base of each SD1 seta . . . . . **Pyralinae.**

### LARVAL KEY C

#### AN ANALYSIS OF THE LARVAL HABITS OF SOME HAWAIIAN MICROLEPIDOPTERA AND PYRALIDAE WITH A KEY

1. Larvae aquatic; case-makers . . . . . SECTION A  
Larvae terrestrial . . . . . 2

- 2(1). Larvae forming portable cases (do not mistake cocoons or pupal cases for larval cases) . . . . . SECTION **B**  
 Larvae not forming portable cases . . . . . 3
- 3(2). In or on such animal products as woolens, hair, fur, feathers, and arthropod remains . . . . . SECTION **C**  
 In or on plants or plant material . . . . . 4
- 4(3). In stored grains, nuts, dried fruit materials, tobacco, or feeding stuffs . . . . . SECTION **D**  
 Not in such materials . . . . . 5
- 5(4). On fern fronds . . . . . SECTION **E**  
 Not on fern fronds . . . . . 6
- 6(5). In silken tunnels in moss and lichens . . . . . SECTION **F**  
 Not in moss or lichens . . . . . 7
- 7(6). Among *Pritchardia* palm leaf tomentum . . . . . SECTION **G**  
 Not so . . . . . 8
- 8(7). Boring in rotting wood (see also 17) . . . . . SECTION **H**  
 Not boring in rotting wood . . . . . 9
- 9(8). In or on grasses . . . . . SECTION **I**  
 Not in or on grasses . . . . . 10
- 10(9). On flower heads or on flowers . . . . . SECTION **J**  
 Not so . . . . . 11
- 11(10). Leaf miners (contrast stem borers at 16) . . . . . SECTION **K**  
 Not leaf miners . . . . . 12
- 12(11). Stem gall makers . . . . . SECTION **L**  
 Not stem gall makers . . . . . 13
- 13(12). Leaf rollers, leaf tiers, or tiers of young apical foliage . . . . . SECTION **M**  
 Not so . . . . . 14
- 14(13). Larvae living externally on living leaves, sometimes protected by a slight webbing but not rolling or tying leaves together . . . . . SECTION **N**  
 Without such habits . . . . . 15
- 15(14). Larvae in or on fruits, buds, berries, seeds, or in seed pods . . . . . SECTION **O**  
 Not so . . . . . 16
- 16(15). Borers in living stems, twigs, petioles, or tubers . . . . . SECTION **P**  
 Not borers in living plants . . . . . 17
- 17(16). Larvae apparently "scavengers" in plant debris or on the surfaces of various plant parts—dead or living—such as bark, dead leaves, or on the surfaces of fruit, in decaying leaves, under dead bark, etc.; prespiracular **L** group of prothoracic setae

- containing either two or, most often, three setae  
 ..... SECTION Q  
 Not so; prespiracular L group of prothoracic setae  
 containing only two setae.....18  
 18(17). Larvae in soil in or about roots of grasses. ....SECTION R  
 Larvae in bees' nests. ....SECTION S

## SECTION A

## AQUATIC LARVAE BEARING CASES

Two introduced aquatic species of the subfamily Nymphulinae of the Pyralidae are known to be established in Hawaii. These are discussed and illustrated on pages 266–272 of Volume 8. The larvae of the two species are conspicuously different and may be easily separated. The larvae in their portable cases might be mistaken for Trichoptera if examined only superficially.

1. Body with numerous gill filaments (Volume 8, figure 212)  
 ..... **Paraponyx fluctuosalis** (Zeller).
2. Body without gill filaments (Volume 8, figure 215) .....  
 ..... **Synclita oblitalis** (Walker).

## SECTION B

## TERRESTRIAL LARVAE FORMING PORTABLE CASES

The larvae of several families of Lepidoptera are case-makers, but in Hawaii only some species of the Tineinae and the Cosmopteriginae (in addition to the aquatic pyralid Nymphulinae) are known to build portable cases. Too little is known about the Hawaiian species to enable an extensive key to be prepared. Lepidopterous larvae bearing cases and found in buildings or in areas occupied by man in Hawaii belong to the Tineidae, whereas those found in the forests will usually belong to *Hyposmocoma* in the Cosmopteriginae. A number of species of *Hyposmocoma* case-bearers are also found in the lowlands, but they do not occur normally in buildings.

1. Larvae found in animal products such as woolens, furs,  
 feathers, in birds' nests, amongst arthropod remains,  
 etc. ....2  
 Not such species.....4
- 2(1). Procoxae very narrowly separated, touching or nearly  
 touching.....**Praeacedes thecophora** (Walsingham).  
 Procoxae obviously separated .....3
- 3(2). Abdominal segments 1 to 9 with the SV setae minute;  
 derm with dense more or less flat-topped micro-  
 scopical tubercles.....  
 ..... **Tinea pellionella** (Linnaeus).

- Abdominal segments 1 to 9 with long SV setae; derm  
clothed with dense, slender microtrichia. . . . .
- ..... **Niditinea spretella** (Denis and Schiffermüller).  
4(1). Larvae found usually crawling on walls, often in cellars. .5  
Not so. . . . .6
- 5(4). Procoxae touching or nearly touching each other but  
not fused; head with seta O3 in the black postocellar  
vitta and caudad of O2 and adjacent to the ocellus;  
mesothorax with the SV setae forming a subhorizon-  
tal row; figure 133. . . . .
- ..... **Praeacedes thecophora** (Walsingham).  
Procoxae fused together; head with the O2 seta far  
caudad of the ocellus and caudad and far dorsad of  
the level of O3 which is far below the postocellar  
dark vitta; mesothorax with the SV setae forming a  
subvertical row; figures 141, 142. . . . .
- ..... **Phereoeca alutella** (Rebel).  
6(4). Larvae (but usually the pupae) found in neatly cut out  
ovate sections of dead *Pandanus* leaves (this is a pupal  
case, but it may be confused with a larval case [see  
also 10(9) of Section K]) . . . . .
- ..... **Trissodoris honorariella** (Walsingham).  
Larvae found in vegetable debris, on rocks, tree trunks,  
under bark, in dead wood, etc. . . . .7
- 7(6). Abdominal segments 1 to 8 with the L1 and L2 setae  
widely separated . . . . .
- ..... **Crypsithyroides obumbrata** (Butler).  
Abdominal segments 1 to 8 with setae L1 and L2  
closely approximated . . . . . **Hypsmocoma**.

## SECTION C

LARVAE NOT FORMING PORTABLE CASES BUT FOUND IN OR ON SUCH  
ANIMAL PRODUCTS AS WOOLENS, HAIR, FUR, FEATHERS,  
AND ARTHROPOD REMAINS

(For case-bearing larvae found in these materials, see Section B.)

1. SV setal group on meso- and metathorax unisetose. . .  
..... **Erechthias zebrina** (Butler).  
SV setal group on meso- and metathorax bisetose. . . . .2
- 2(1). SV setae of meso- and metathorax in a slightly oblique  
or nearly horizontal line; spiracles of 8th abdominal  
segment subequal in diameter to those on segment 7;  
9th abdominal segment with two L setae. . . . .
- ..... **Tineola biselliella** (Hummel).

- SV setae of meso- and metathorax in a vertical or subvertical line; spiracles of abdominal segment 8 much larger than those of segment 7; 9th abdominal segment with three L setae ..... 3
- 3(2). Abdominal segments 1 to 8 with the SV setae each on a separate pinaculum; abdominal segment 9 with setae D1 and SD1 on separate pinacula; derm of abdominal segments armed with microscopic subtriangular processes ..... **Trichophaga**.  
 Abdominal segments 1 to 8 with the SV setae on the same pinaculum; abdominal segment 9 with setae D1 and SD1 on the same pinaculum; derm of abdomen armed with slender microtrichia... **Monopis**.

## SECTION D

LARVAE IN STORED GRAINS, NUTS, DRIED FRUIT MATERIALS,  
TOBACCO, OR FEEDING STUFFS

1. Prespiracular L group of setae on prothorax trisetose ..... 2  
 Prothorax with the L group of setae bisetose;  
**Pyralidae** ..... 5
- 2(1). Prolegs greatly reduced and each with only about two crochets; larvae feed inside kernels of grain;  
**Gelechiinae** ..... **Sitotroga cerealella** (Olivier).  
 Prolegs developed ..... 3
- 3(2). Head with adfrontals ending far below vertical triangle; abdominal segments 1 to 8 with setae L1 and L2 close together; **Oecophorinae** .....  
 ..... **Endrosis sarcitrella** (Linnaeus).  
 Head with adfrontals reaching vertical triangle; abdominal segments 1 to 8 with setae L1 and L2 widely separated; **Tineidae** ..... 4
- 4(3). Ventral prolegs with a line or band of recurved spinelets on the cephalic sides dorsad of crochets  
 ..... **Lindera** and **Setomorpha**.  
 Ventral prolegs without such spinelets .....  
 ..... **Nemapogon granellus** (Linnaeus).
- 5(1). Crochets of ventral prolegs arranged in a broken circle (penellipse); **Crambinae** .....  
 ..... **Euchromius ocellus** (Haworth).  
 Crochets of ventral prolegs arranged in complete circles ..... 6

- 6(5). Prespiracular L setae on prothorax arranged in a subhorizontal (slightly oblique) line; **Galleriinae** ..... 7
- Prespiracular L setae on prothorax arranged in a subvertical line ..... 8
- 7(6). Length of mature larva more than 20 mm.; abdominal setae arising mostly from distinct pinacula and peritremes (sclerotized rims) of spiracles with their caudal and cephalic margins subequal in thickness.....**Aphomia gularis** (Zeller).  
Length of mature larva about 15 mm.; abdominal setae mostly lacking pinacula and caudal margins of peritremes of spiracles about twice as thick as their cephalic margins .....  
.....**Corcyra cephalonica** (Stainton).
- 8(6). Mesothorax with the SD setal pinaculum surrounded or nearly surrounded by an irregular pigmented ring; **Phycitinae** ..... 10  
Mesothoracic SD setae not surrounded by such rings; **Pyralinae** ..... 9
- 9(8). Head with adfrontals extending above the level of the P1 setae and to about the level of the P2 setae .....**Pyralis manihotalis** Guenée.  
Head with adfrontals extending up only to about the level of the P1 setae .....  
.....**Hypsopygia mauritialis** (Boisduval).
- 10(8). Head with adfrontals reaching vertical triangle and head thus lacking a coronal suture (the medial suture which extends from the frons to the vertical triangle when these parts are separated by a distance).....**Ectomyelois ceratoniae** (Zeller).  
Head with vertical triangle and adfrontals conspicuously separated and the two parts connected by a distinct coronal suture ..... 11
- 11(10). Pronotum extensively pigmented and with the pigmentation enclosing the spiracle (this species was previously reported in Volume 8:360, as *aliena* Swezey) .....  
.....**Cryptoblabes gnidiella** (Millière).  
Not so ..... 12
- 12(11). Head with frons extending far above middle of head and with distance between setae P1 and P2 subequal to distance between top of adfrontals

and vertical triangle; pinacula not evident on thorax or abdominal segments 1 to 8; mesothorax and abdominal segment 8 with the SD1 setae surrounded by yellowish rings; in many kinds of stored food products and grain.....

.....**Plodia interpunctella** (Hübner).

Head with frons extending only about halfway between clypeus and vertical triangle and distance between setae P1 and P2 much less than the distance between top of adfrontals and vertical triangle; pinacula dark and conspicuous; mesothorax and abdominal segment 8 with the SD1 setae surrounded by brown or blackish rings.....13

13(12). Abdominal segment 8 with seta SD2 separated from spiracle by a distance subequal to diameter of spiracle.....14

Eighth abdominal segment with seta SD2 separated from spiracle by about two or three times the diameter of a spiracle.....15

14(13). Setae D2 on most abdominal segments not more than two and one-half times as long as setae D1; eighth abdominal segment with seta SD2 closer to spiracle than diameter of spiracle; head with the puncture between setae P1 and P2 much smaller than the diameter of the setal sockets; living larvae, even if partly pink, lacking pink vittae.....**Cadra ("Ephestia") cautella** (Walker).

Setae D2 on most abdominal segments at least three times as long as setae D1; eighth abdominal segment with seta SD2 separated from spiracle by at least the diameter of a spiracle; head with the puncture between setae P1 and P2 about as large as the diameter of the setal sockets; living larvae with pink vittae.....**Cadra ("Ephestia") figulilella** (Gregson).

15(13). Mature larva 15 to 20 mm. long; mandible (viewed from beneath) with outer margin continuous with the second tooth (counting from inner edge), because the third tooth is more ventromesad than normal and not situated on the outer margin; prothorax with diameter of spiracle subequal to distance between setae L1 and L2; abdominal



segment 8 with the diameter of spiracle as great or greater than the pale area within the dark ring surrounding base of seta SD1 . . . . . **Anagasta kühniella** (Scott).

Mature larva 10 to 15 mm. long; mandible (viewed from beneath) with the third tooth situated on outer margin so that the outer margin of the mandible is continuous from base with the third tooth; prothorax with diameter of spiracle obviously less than distance between setae L1 and L2; abdominal segment 8 with spiracle distinctly smaller than the pale area within the dark ring surrounding base of seta SD1 . . . . . **Ephestia elutella** (Hübner).

## SECTION E

## LARVAE FOUND ON FERN FRONDS

1. Feeding on fern sporangia; the very small larvae not described, but possibly the anterior two of the pre-spiracular L group setae on the prothorax not forming a subvertical line. . . . . **Batrachedrodes**.
2. Feeding on fern tissue; prespiracular L group setae on prothorax with the anterior two setae arranged in a vertical line; abdominal segments 1 to 8 with setae L1 and L2 in a subhorizontal line . . . . . **Hyposmocoma**.

## SECTION F

## LARVAE IN SILKEN TUNNELS IN MOSS OR LICHENS

1. Prothorax with only two prespiracular L group setae; abdominal segment 8 with seta SD1 above spiracle; **Pyralidae**. . . . . **Eudoria** (= *Scoparia* of Volume 8).  
Prothorax with three L group setae; abdominal segment 8 with seta SD1 directly in front of spiracle. . . . . **Hyposmocoma**.

## SECTION G

## LARVAE FEEDING IN PRITCHARDIA PALM LEAF TOMENTUM

**Hyposmocoma (Euperissus) palmivora** Meyrick.  
**Hyposmocoma (Euperissus) pritchardiae** (Swezey).

## SECTION H

## LARVAE BORING IN ROTTING WOOD

(Contrast with Section Q.)

1. The three prespiracular L group setae on prothorax arranged in a subhorizontal line. . . . . **Thyrocopa.**
2. The two most cephalic of the prothoracic L setae arranged in a subvertical line . . . . . **Hyposmocoma.**

## SECTION I

## LARVAE IN OR ON GRASSES

1. In tufts of dead grass or within dead grass stems. . . . . 2  
In or on living grass . . . . . 4
- 2(1). Abdominal segments 1 to 8 with setae L1 and L2 widely separated. . . . . **Decadarchis.**  
Abdominal segments 1 to 8 with setae L1 and L2 closely approximated . . . . . 3
- 3(2). Mature larvae probably nearer 20 mm. than 10 mm. in length; head with the top of the adfrontals far distant from the vertical triangle; prothoracic L group setae in a horizontal line . . . . . **Thyrocopa.**  
Mature larvae probably nearer 10 mm. long, but unknown to me . . . . . **Asymphorodes.**
- 4(1). Large external feeders; prothorax with only two setae in the prespiracular L group; pinacula large, pigmented, and very conspicuous. . . . . 5  
Very small leaf miners or stem borers or infesting flower heads; prothorax with three setae in the L group. . . . . 6
- 5(4). Larvae in silken tubes at bases of grass tufts; abdominal segment 10 with the V setae not more distantly separated than the V setae of segment 9. . . . .  
. . . . . **Nomophila noctuella** (Denis and Schifferrmüller).  
Larvae not forming silken tubes; abdominal segment 10 with the V setae much more distantly separated than the V setae of segment 9. . . . .  
. . . . . **Herpetogramma licarsisalis** (Walker).
- 6(4). Small leaf miners; the two L setae on abdominal segments 1 to 7 distantly separated and in a subvertical line; only one L seta on abdominal segments 8 and 9; ventral prolegs unequal in size and those on segments 3 and 6 greatly reduced. . . . . **Bedellia.**  
Small stem borers; setae L1 and L2 on abdominal segments 1 to 8 closely approximated; prolegs on abdominal segments 3 to 6 equally developed. . . . .  
. . . . . **Chedra.**

## SECTION J

## LARVAE ON FLOWER HEADS OR ON FLOWERS

1. Larvae very spiny and with conspicuous verrucae;  
part of **Pterophoridae** . . . . . 11
- Larvae normally (simply) setose . . . . . 2
- 2(1). Very small larvae in grasses; ventral prolegs un-  
equal in size, those on segments 3 and 6 greatly  
reduced . . . . . **Bedellia**.  
Not such larvae in grasses . . . . . 3
- 3(2). Prespiracular L group of setae on prothorax with  
only two setae; **Pyralidae** (see Volume 8 for  
details) . . . . . 4
- Prothorax with three setae in the prespiracular L  
group . . . . . 7
- 4(3). Pronotum extensively pigmented and embrowned  
as the head, the embrowned area enclosing the  
spiracle; mesothorax with the dark-rimmed basal  
socket of the SD1 seta surrounded by a con-  
spicuous white area which in turn is surrounded  
by a large, prominent, black or blackish, asym-  
metrically elevated pinaculum with most of its  
area caudad of the seta and the described macula-  
tion appearing eye-like when viewed from above;  
with two conspicuous, broad, dorsolateral, dark  
vittae (each may appear double) from mesono-  
tum to cauda between the D and SD setae, but  
color and pattern variable; on many hosts . . . .  
. . . . . **Cryptoblabes gnidiella** (Millière).  
Without such a combination of characters . . . . . 5
- 5(4). Mesothorax with each SD1 seta not enclosed by a  
sclerotized ring surrounding an unpigmented  
area; abdominal segment 10 with the V setae  
more distantly separated than the V setae of  
segment 9; prolegs elongated, slender; on legumes  
. . . . . **Maruca testulalis** (Geyer).  
SD1 setae of mesothorax each enclosed by a darkly  
pigmented ring surrounding an unpigmented  
area enclosing the setae; abdominal segment 10  
with the V setae not more distantly separated  
than those on segment 9; prolegs not elongated . . . . 6

- 6(5). On *Argyroxiphium* .....  
 ..... **Rhyncephestia rhabdotis** Hampson.  
 On *Wilkesia* (and on other plants not yet determined; on *Dubautia*?) .....  
 ..... **Homoeosoma alboparsum** (Butler).
- 7(3). Prolegs obviously slender and elongated, crochets uniordinal; part of **Pterophoridae** ..... 11  
 Prolegs normally short and broad ..... 8
- 8(7). Eighth abdominal segment with two SV setae on each side; anal fork present ..... 8a  
 Eighth abdominal segment with only one SV seta on each side; anal fork absent ..... 9
- 8a(8). On Malvaceae (*Abutilon*, *Hibiscus*, *Sida*); outer, dorsal distal seta of thoracic leg tarsi longer than inner seta ..... **Crocidosema**.  
 On *Lantana* and various other plants, but not known on Malvaceae; outer, dorsal, distal seta of thoracic leg tarsi subequal in length to the inner seta ..... **Epinotia lantanella** (Busck).
- 9(8). Abdominal segments 1 to 8 with seta SD1 in front of spiracle and setae L2 and L1 arranged in a subvertical line; head with vertical triangle deep and narrow, forming an acute angle; prothorax with the most caudal of the three prespiracular L setae more nearly on a horizontal line with the most ventral of the group or on a level between the two most anterior setae and not in line with the spiracle and most dorsal of the anterior setae; on many hosts ..... **Anatrachyntis**.  
 Abdominal segments 1 to 8 with seta SD1 distinctly above the spiracle and setae L2 and L1 arranged in a subhorizontal row; vertical triangle of head forming an angle of about 90 degrees or more obtuse. .... 10
- 10(9). Head with vertical triangle comparatively shallow and forming an obtuse angle (figure 705); SV setal group on abdominal segment 7 unisetose; proleg crochets uniordinal; on *Prosopis* and *Acacia* ..... **Ithome concolorella** (Chambers).  
 Head with vertical triangle forming an angle of about 90 degrees (obviously not as obtuse as in figure 705 of *Ithome*); proleg crochets biordinal; SV setal group on abdominal segment 7 bisetose; on *Pelea* and *Fagara* in the mountains ..... **Prays**.

11(1,7). **Pterophoridae**; see Volume 8:388–412. I have not had an adequate collection of pterophorid larvae to study and cannot give a key to the Hawaiian species. The following tabulation may be of some assistance in their determination:

- a. On *Boerhavia diffusa*; a very “spiny” larva  
..... **Megalorhipida defectalis** (Walker).
- b. On *Lantana* .....  
.. **Lantanophaga pusillidactyla** (Walker)  
or **Anstenoptila marmorodactyla** (Dyar).
- c. On *Geranium* .....  
**Stenoptilodes littoralis littoralis** (Butler).
- d. On *Erigeron albidus* .....  
..... **Lioptilodes parvus** (Walsingham).
- e. On *Plantago* (plantain) and *Vaccinium* .....  
..... **Stenoptilodes littoralis rhynchophora** (Meyrick).
- f. On *Ocimum* (basil), *Plectranthus*, *Antirrhinum*  
(snapdragon) ..... **Stenoptilodes taprobanes brachymorpha** (Meyrick).

#### SECTION K

##### LEAF MINERS

- 1. Large, brightly colored, orange or red larvae with black maculae feeding in colonies in cactus “pads”; see Volume 8:356–358, figures 293B–C  
..... **Cactoblastis cactorum** (Berg).  
Not so ..... 2
- 2(1). Legs and prolegs obsolete; frons of head expanded dorsad or caudad; very small larvae in *Pelea* leaves ..... **Opostega**.  
Legs and prolegs present; frons of head narrowed dorsad or caudad ..... 3
- 3(2). Thoracic legs obviously reduced and with ventral prolegs on abdominal segments 3, 4, and 5 only, hence with only three pairs of prolegs ..... 4  
Thoracic legs either fully developed or partly reduced; ventral prolegs on abdominal segments 3, 4, 5, and 6, thus four pairs are present although some or all may be reduced ..... 6
- 4(3). On *Diospyros* (= *Maba*); larvae not seen .....  
..... possibly **Caloptilia mabaella** (Swezey).  
Not on *Diospyros* ..... 5

- 5(4). Head with vertical triangle not extending below about one-third of the distance between top of head and base of mandibles; prothorax with the prespiracular L setae arranged in a subvertical row; common on *Lantana*.....  
 ..... **Cre mastobombycia lantanella** Busck.  
 Head with vertical triangle very deep and narrow, extending about halfway between top of head and base of mandibles; prothorax with the L group of prespiracular setae arranged in a subhorizontal shallow triangle; prosternum with a large, medial, nodulose, pigmented pad (on species seen by me); many species on many kinds of hosts, but none on *Lantana*; see the text. .... **Philodoria**.
- 6(3). Ventral prolegs unequal in size, those on segments 3 and 6 greatly reduced, those on segments 4 and 5 elongate; only one seta in the L group on abdominal segments 8 and 9, and the two L setae on segments 1 to 7 widely separated and in a subvertical line; details as on figure 498; one species a pest on sweetpotato, some species in grasses and others on various broad-leaved plants; see text for information..... **Bedellia**.  
 Not so.....7
- 7(6). Prothorax with three prespiracular L setae.....8  
 Prothorax with only two setae in the prespiracular L group .....12
- 8(7). On *Gossypium* (cotton); a slender larva about 6 mm. long with notably long, very slender abdominal prolegs which have few crochets arranged in incomplete rows which do not form circles; caudal prolegs each with only one crochet; thoracic and abdominal segments each with a pair of black dorsal maculae which, combined, form two dorsal rows of conspicuous black spots the length of the animal; derm with conspicuous, irregular dark areas produced by multitudes of minute black asperities; ocellar area and crown of head, except on mid-line, conspicuously black or blackish; thoracic legs extensively black; figures 481-C-481-E, 481-G... **Bucculatrix thurberiella** Busck.  
 Not such larvae and not found on *Gossypium*.....8A

- 8A(8). Abdominal segment 3 (and most others) with setae L1 and L2 widely separated and in a sub-horizontal line:  
 a. On onion and related plants.....  
       .....**Acrolepia assectella** (Zeller).  
 b. On *Nothocestrum* in the forests; see text.....  
       .....endemic species of **Acrolepia**.  
 Abdominal segments with setae L1 and L2 closely approximated .....9
- 9(8). Conspicuously pigmented larvae with coarse, dense, dermal microsculpture in *Lonicera* (honeysuckle) leaves; head with vertical triangle very deep and narrow, extending nearly halfway from top of head to base of mandibles; prothorax with the two most caudal of the three L setae in a sub-vertical line; abdominal segment 8 with seta SD1 directly above spiracle and the most cephalic of the L setae directly below the spiracle.....  
       ...**Swezeyula lonicerae** Zimmerman and Bradley.  
 Not so.....10
- 10(9). Larvae cut ovate pupal cases from dead *Pandanus* leaves, thus making conspicuous ovate "keyhole" perforations in the leaves; larvae very slender and elongate, the thoracic segments noticeably broader than the abdominal segments and mesothorax broadest; ventral proleg-bearing abdominal segments narrower cephalad than caudad and with the prolegs within the caudal one-third of the segments and thus appearing unusually far caudad.....**Trissodoris honorariella** (Walsingham).  
 Not so.....11
- 11(10). On tomato and related solanaceous plants; prothoracic shield with dark pigmentation on posterolateral margins; as in figures 1286–1293.....  
       .....**Keiferia lycopersicella** (Busck).  
 On *Gouldia*, *Hedyotis*, and *Psychotria* in the mountain forests; details of larvae unknown to me; see text  
       .....**Merimnetria**.  
 12(7). In cabbage, radish, turnip, mustard, and related plants; mature larva about 12 to 16 mm. long, whitish with pink lateral vittae; ventral proleg crochets in bi- or triordinal penellipses; **Pyralidae**.....**Hellula undalis** (Fabricius).  
 Not in such plants; ventral proleg crochets in uniordinal circles; **Carposinidae**.....**Carposina**.

## SECTION L

## STEM GALL MAKERS

1. Prothorax with only two prespiracular L group setae;  
**Phycitinae** .....2  
 Prothorax with three setae in the L group; **Gelechiinae** .....3
- 2(1). Evidently a lowland species attacking several introduced species of *Ageratum*, *Bidens*, *Dahlia*, and *Tagetes* (marigold)....**Unadilla humeralis** (Butler).  
 On *Bidens cosmoides* on Kauai.....  
 .....**Unadilla bidensana** (Swezey).
- 3(1). On *Schinus*.....**Crasimorpha infuscata** Hodges.  
 On *Gouldia*.....**Merimnetria**.

## SECTION M

## LEAF ROLLERS, LEAF TIERS, OR TIERS OF YOUNG APICAL FOLIAGE

On occasion, one may be confused by the larvae of certain Pyralidae that have habits similar to those of some of our Microlepidoptera. This is especially true of the leaf rollers and leaf tiers such as the Tortricidae and some Pyraustinae and Phycitinae of the Pyralidae. They may easily be distinguished by the fact that the Pyralidae have only two setae in the prothoracic L group whereas the Tortricidae have three setae in this group.

1. Prothorax with three prespiracular L group setae....2  
 Prothorax with only two L group setae; **Pyralidae**...11
- 2(1). Very spiny larvae with verrucae; see Volume 8.....  
 .....**Pterophoridae**.  
 Normally setose larvae without verrucae.....3
- 3(2). Eighth abdominal segment with two setae in each  
 SV group; **Tortricidae**.....4  
 Eighth abdominal segment with only one seta in  
 each SV group.....8
- 4(3). (Larval characters of Tortricidae unknown to me:  
*Bradleyella*, *Panaphelix*, *Paraphasis*, *Pararrhaptica*,  
*Spheterista*, *Mantua*, *Eccoptocera*, *Macraesthetica*; see  
 the text for details on these genera of Tortricidae.)  
 On *Rubus* (blackberry) or *Schinus* (Christmas-berry);  
 most or all of abdominal segments 1 to 8 with  
 seta SD2 not on the SD1 pinaculum.....5  
 Seta SD2 and SD1 on the same pinaculum on  
 abdominal tergites 1 to 8.....6



- 5(4). On *Rubus*; ventral setae (V1) on 9th abdominal ventrite much more distantly separated than the V1 setae on the 8th abdominal segment.....  
.....**Croesia zimmermani** Clarke.  
On *Schinus*; the V1 setae on the 8th and 9th abdominal ventrites subequally separated.....  
.....**Episimus utilis** Zimmerman.
- 6(4). On *Myrica*; mesonotum with the pinacula of the D1 and D2 setae subcircular.....  
.....**Strepsicrates smithiana** Walsingham.  
Mesonotum with the pinacula of the D1 and D2 setae longitudinally elongated.....7
- 7(6). Lateral margins of prothoracic shield bordered by a conspicuous dark vitta; abdominal ventrite 9 with the V1 setae about twice as distantly separated as those on 8...**Amorbia emigratella** Busck.  
Lateral margins of prothoracic shield concolorous with disc and without a dark border; setae V1 of 9th abdominal sternite only about as widely separated as those of the 8th abdominal sternite, or closer together...**Epiphyas postvittana** (Walker).
- 8(3). The D1 and D2 pinacula on abdominal segments 1 to 8 each containing three setae and the SV setal groups containing more than three setae...  
.....**Mapsidius**.  
Abdomen with the D1 and D2 setal groups each containing only one seta and the SV groups with three or fewer setae.....9
- 9(8). Crochets of ventral prolegs arranged in complete circles or ellipses; head with adfrontals ending distant from the vertical triangle; anal fork absent.....**Thyrocopa**.  
Crochets of the ventral prolegs arranged in anterior and posterior rows and not in circles; head with the adfrontals reaching vertical triangle; anal fork present.....10
- 10(9). On *Medicago* (alfalfa); head and pronotal shield brown and mesonotum without maculation; dorsal abdominal setae almost concolorous with the derm and inconspicuous; prothorax with the prespiracular L setae arranged in a distinct triangle.....**Dichomeris acuminatus** (Staudinger).

- On *Pluchea*; head and pronotal shield an unusual, polished, jet black and the pronotum and metanotum with extensive pigmentation; dorsal abdominal setae black, very conspicuous, and contrasting strongly with color of derm; prothorax with the L setae arranged in a nearly horizontal line and set in a prominent black macula . . . . . **Trichotaphe aenigmaticus** (Clarke).
- 11(1). Crochets of ventral prolegs arranged in triordinal complete circles; pale yellowish larvae with dark vittae feeding singly on *Euphorbia* and with the SD1 setae on the mesothorax and 8th abdominal segment surrounded by prominent, dark pigmented rings beyond an unpigmented area surrounding the setae; **Phycitinae** . . . . . **Genophantis**.  
 Ventral proleg crochets arranged in broken circles; (penellipses), or if they are in complete circles (as in at least some *Udea*), then the crochets are few and uniordinal on ectal sides; mesothorax and 8th abdominal segment lacking pigmented rings around pale areas surrounding bases of setae SD1; larvae either greenish or extensively dark colored; none known to attack *Euphorbia*;  
**Pyraustinae** . . . . . 12
- 12(11). Larvae appearing very dark or nearly black; abdomen with a prominent black vitta on each side, and the pinacula of the lateral setae ringed with darkly pigmented arcs or circles; feeding gregariously on webbed-together leaves of *Acacia koa* and *Sophora* . . . . .  
**Uresiphita polygonalis** (Denis and Schiffermüller).  
 Not so; usually mostly pale greenish solitary larvae and none known to attack *Acacia* or *Sophora* . . . . . 13
- 13(12). On *Solanum melongena* (eggplant) and perhaps on some other solanaceous plants; prothorax with the pinaculum containing the prespiracular L setae crescent-shaped; head with AF1 closer to F1 than to AF2 . . . . . **Lineodes ochrea** Walsingham.  
 Not so . . . . . 14
- 14(13). On *Morus* (black mulberry) and *Pseudomorus* (paper mulberry) . . . . **Glyphodes cyanomichla** (Meyrick).  
 Not so . . . . . 15
- 15(14). On *Ochrosia* or *Rauwolfia* . . . . .  
 . . . . . **Glyphodes exaula** (Meyrick).  
 Not so . . . . . 16

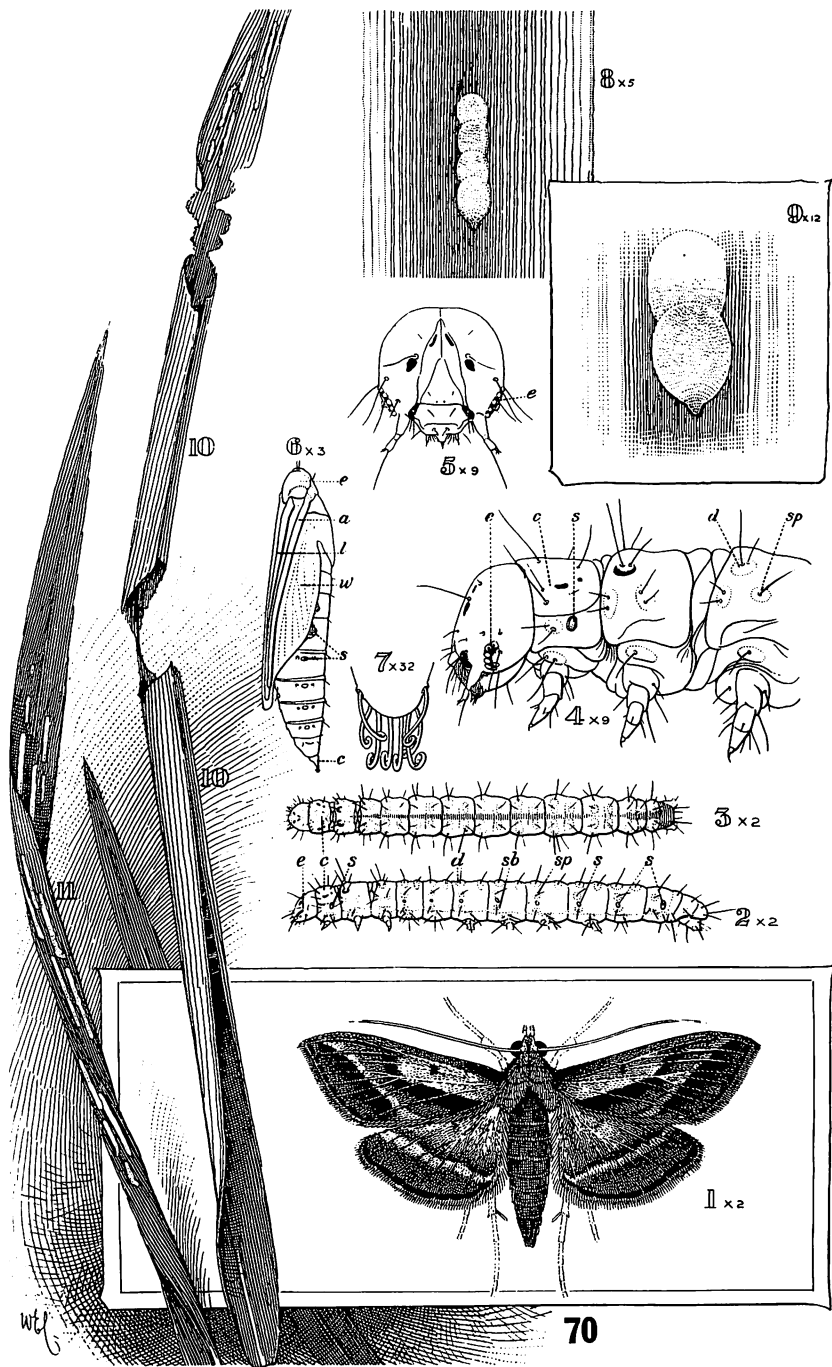


Figure 70—See legend at bottom of page 165.

- 16(15). On many genera of broad-leaved plants, but none known to attack legumes in Hawaii and none on monocots; head with frons extending dorsad of the P1 setae; ventral proleg crochets in complete circles but with few crochets on ectal sides in material seen (this may be a variable character, and it is possible that some species may have the crochets arranged in penellipses, but details are unknown to me)..... **Udea** (= *Oeobia*).  
 On grasses, bananas, sedges, lilies, palms, *Joinvillea*, and one species on legumes; head with frons not reaching dorsad of the level of the P1 setae; ventral proleg crochets arranged in penellipses (a broken circle with the open side ectad on the proleg); **Hedylepta**.....17
- 17(16). On grasses.....18  
 Not on grasses.....23
- 18(17). Laysan Island species.....  
 ..... **Hedylepta laysanensis** (Swezey).  
 Main island species.....19
- 19(18). On *Isachne distichophylla* at Kilauea, Hawaii; larvae not described in detail, but with more dark maculae than on figure 70 of *H. accepta*.....  
 ..... **Hedylepta giffardi** (Swezey).  
 Not so.....20
- 20(19). Prothoracic shield not black-margined laterad; as in figure 70..... **Hedylepta accepta** (Butler).  
 Prothoracic shield black-margined laterad.....21
- 21(20). Pinacula of abdominal segments not partly or entirely black-margined. **Hedylepta localis** (Butler).  
 Some or all of the pinacula of abdominal segments more or less black-margined.....22
- 22(21). Prothoracic shield conspicuously black-margined caudad and laterad.....  
 ..... **Hedylepta demaratalis** (Walker).  
 Prothoracic shield not black-margined caudad and only faintly black-margined laterad.....  
 ..... **Hedylepta continuatalis** (Wallengren).

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Figure 70—*Hedylepta accepta* (Butler), Pyralidae. 1, moth; 2, 3, lateral and dorsal aspects of larva; 4, head and thorax of larva; 5, frontal aspect of larval head (lettering for larva: *c*, cervical shield; *d*, dorsal setae; *e*, ocelli; *s*, spiracles; *sb* and *sp*, sub- and supraspiracular rows of pinacula); 6, lateral aspect of pupa with cremaster at 7 (*a*, antenna; *c*, cremaster; *e*, eye; *l*, leg; *s*, spiracles; *w*, wing); 8, egg cluster with two eggs enlarged at 9; 10, leaf tied together to form a larval retreat and showing characteristic damage; 11, feeding pattern of young larvae which eat from only one side and leave the opposite epidermis intact. (After Swezey, 1907.)

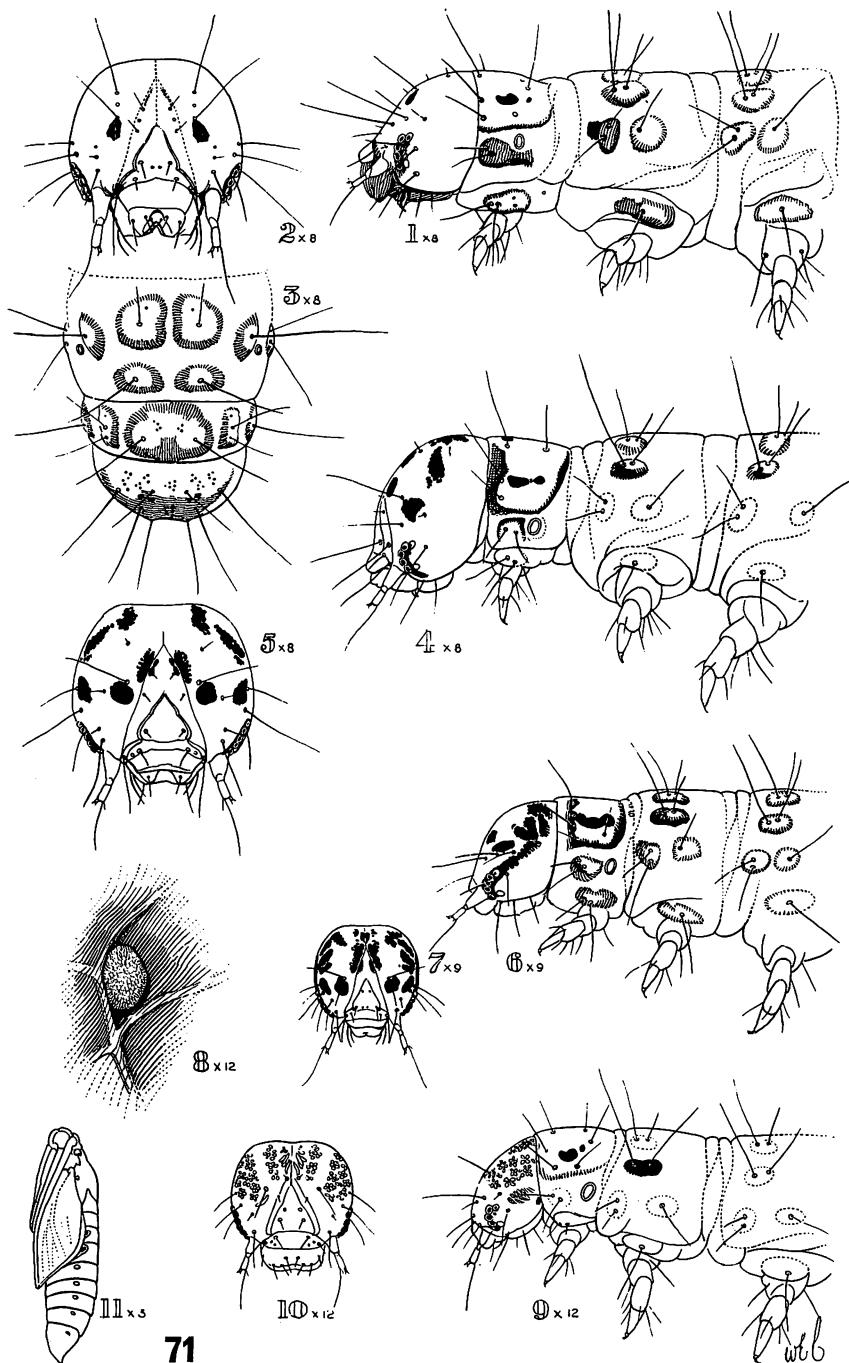


Figure 71—Details of *Hedylepta* and *Hymenia* preadult stages, Pyralidae. 1, 2, 3, *Hedylepta continuatalis* (Wallengren) (frontal aspect of head, lateral aspect of head and thorax, and dorsal aspect of caudal end of abdomen); 4, 5, *Hedylepta blackburni* (Butler); 6, 7, *Hedylepta monogona* (Meyrick), with an egg on the underside of an *Erythrina* leaf at 8; 9, 10, *Hymenia recurvalis* (Fabricius) with lateral aspect of a pupa at 11. The chaetotaxy may not be accurate in some drawings. (After Swezey, 1907.)

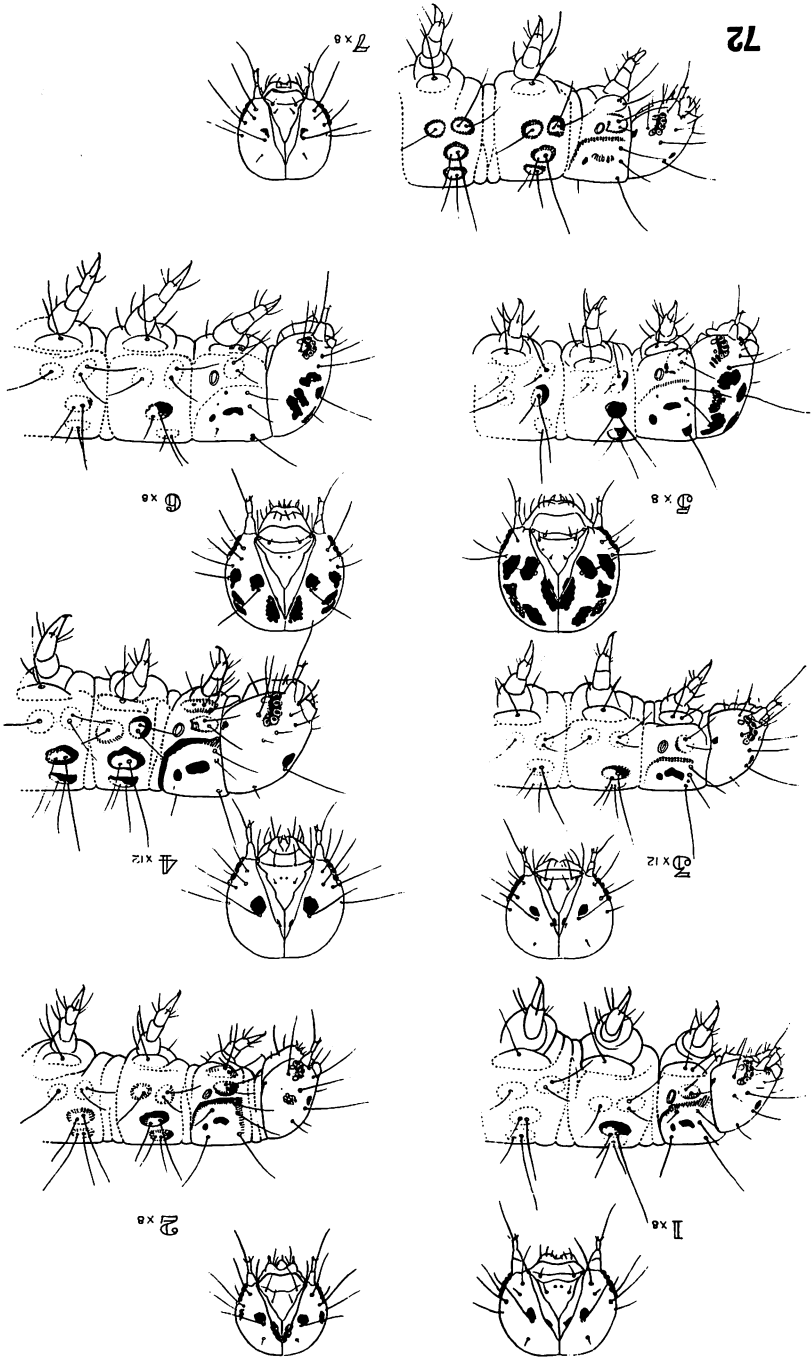


Figure 72—Details of the heads and thoraces of *Hedylepia* larvae, Pyralidae. 1, *scolaea* (Hampson) (Butler); 2, *tridias* (Meyrick); 3, *localis* (originally wrongly determined and published as *asaphthrombra* Meyrick); 4, *demoralis* (Walker); 5, *anastrepha* (Meyrick); 6, *antidoxa* (Meyrick); 7, *monogramma* (Meyrick). (After Swezey, 1907.)

23(17).	On sedges .....	24
	Not on sedges .....	26
24(23).	[Larva undescribed, but possibly belonging here; a lowland species from Oahu and probably extinct .....	
	<b>Hedylepta epicentra</b> (Meyrick)].	
	Mesothoracic D1 pinacula strongly black-margined cephalad, maculation as in figure 72(5) .....	
	<b>Hedylepta anastrepta</b> (Meyrick).	
	Mesothoracic D1 pinacula not strongly black-margined .....	25
25(24).	Head with a dark line on margin above the postero-ventral angle .....	
	<b>Hedylepta anastreptoides</b> (Swezey).	
	Head without such a line, maculation as in figure 72(6) .....	
	<b>Hedylepta antidoxa</b> (Meyrick).	
26(23).	On bananas .....	27
	Not on bananas .....	30
27(26).	[The larvae of <b>Hedylepta euryprora</b> (Meyrick), type locality Olaa, Hawaii, and <b>Hedylepta fullawayi</b> (Swezey), type locality Kona, Hawaii, are undescribed, and I am unable to supply further details regarding them.]	
	Head with two black maculae in front (near or at bases of setae P1) and without any other frontal black maculae .....	28
	Head with much more dark maculation .....	29
28(27).	Prothoracic shield more or less black-margined laterad, with two lateral, black maculae joined to form a black bar; Molokai and Maui .....	
	<b>Hedylepta musicola</b> (Swezey).	

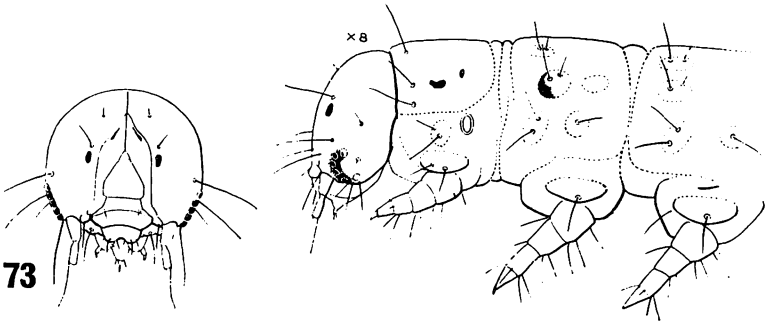


Figure 73—Details of the larval head and thorax of *Hedylepta meyricki* (Swezey), Pyralidae. (After Swezey, 1907.)

- Prothoracic shield not black-margined laterad and without such a black bar; maculation as in figure 73; Akaka Falls, Hawaii.....  
 .....**Hedylepta meyricki** (Swezey).
- 29(27). Side of head with the black ocellar macula extending considerably dorsad; upper part of head with a mosaiclike arrangement of brownish maculae; Kauai and Oahu mountains.....  
 .....**Hedylepta maia** (Swezey).
- Side of head with the black ocellar macula not extended dorsad; maculation of head as in figure 71(4,5); widely distributed in lowlands.....  
 .....**Hedylepta blackburni** (Butler).
- 30(26). On palms.....31  
 Not on palms.....33
- 31(30). A common species principally on coconut and occasionally on other palms in the lowlands; head and thoracic maculation as in figure 71(4,5)....  
 .....**Hedylepta blackburni** (Butler).
- Maculation different; forest species.....32
- 32(31). From *Pritchardia beccariana* northwest of Mountain View, Hawaii; "head and cervical plate mostly dark, nearly black, and all dorsal setae of the body segments situated in dark-outlined plates" (Swezey, 1948:260)...**Hedylepta pritchardii** (Swezey).
- From *Pritchardia* on the trail from Kokee to Kalalau Lookout, Kauai.....  
 .....an undescribed species of **Hedylepta**.
- 33(30). On *Astelia* and *Dianella* lilies.....34  
 Not on lilies.....36
- 34(33). Abdomen with many of the pinacula black-margined; maculation of head and thorax as in figure 72(7); on *Dianella*.....  
 .....**Hedylepta monogramma** (Meyrick).
- Abdominal pinacula mostly lacking dark pigmentation.....35
- 35(34). Mesothorax with the D2 pinacula strongly black-margined all around except dorsad, maculation as on figure 72(2); on *Astelia*.....  
 .....**Hedylepta iridias** (Meyrick).
- Mesothoracic D2 pinacula strongly black-margined only ventrad and cephalad, maculation as in figure 72(1); on *Astelia*.....  
 .....**Hedylepta scotaea** (Hampson).



- 36(33). On legumes; maculation of head and thorax as in figure 71(6, 7) . . . **Hedylepta monogona** (Meyrick).  
 On *Joinvillea* (Flagellariaceae) . . . . .  
 . . . . . **Hedylepta asaphombra** (Meyrick).

## SECTION N

LARVAE LIVING EXTERNALLY ON LIVING LEAVES, SOMETIMES  
 PROTECTED BY A SLIGHT WEBBING BUT NOT ROLLING OR TYING  
 LEAVES TOGETHER

1. Unusual larvae (figure 535), whose dorsal setae have conspicuously expanded apices; pinacula unusually strong; abdomen with the D1 and D2 setae arising in pairs from the same apically furcate tuberculiform process; on *Rubus* (blackberry) . . . . .  
 . . . . . **Schreckensteinia festaliella** Hübner.  
 Not so . . . . . 2
- 2(1). Highly colored black and yellow larvae living gregariously on *Cordia* leaves; see figure 643 . . . . .  
 . . . . . **Ethmia nigroapicella** (Saalmüller).  
 Not so . . . . . 3
- 3(2). Larvae eating small, narrow, elongate strips from the lower surfaces of coconut and certain other palm frond leaflets; larvae with numerous secondary setae; as in figures 625–626 . . . . .  
 . . . . . **Agonoxena argaula** Meyrick.  
 Not so . . . . . 4
- 4(3). Prothorax with three setae in the prespiracular L group . . . 5  
 Prothorax with only two setae in the L group . . . . . 8
- 5(4). Abdominal segments 1 to 8 with the L setae widely separated; ventral prolegs conspicuously elongated; on cabbage and allied plants . . . . . **Plutella**.  
 Abdominal segments 1 to 8 with the L setae closely approximated; not on crucifers . . . . . 6
- 6(5). Small larvae (5 to 6 mm. long) on tomato and occasionally on potato, eggplant, and allied plants; the three prespiracular L setae on prothorax arranged in a triangle with its apex ventrad and the two setae forming its dorsal base on a horizontal line with the spiracle; SD1 setae on abdominal segments 1 to 8 above the spiracle . . . . .  
 . . . . . **Keiferia lycopersicella** (Walsingham).  
 Not so; not on tomatoes or allied plants; mostly found on endemic plants in the forests . . . . . 7

- 7(6). Prothorax with the prespiracular L setal group arranged in a subhorizontal line. . . . . **Thyrocopa.**  
Prothorax with the anterior two of the three L group setae forming a subvertical line. . . . . **Hyposmocoma.**
- 8(4). Larvae common on beet, amarantaceous, and chenopodiaceous plants; larvae pale green (or reddish tinged when prepared to pupate), head pale brownish; about 20 mm. long when mature; ventral prolegs conspicuously long and slender, as long as the longest of the adjacent SV setae; head with its posterolateral margin (as seen from the side) broadly concavely arcuate and not angulate; feeding on undersides of leaves protected by a thin webbing. . . . . **Hymenia recurvalis** (Fabricius).  
Larvae common on cabbages, radishes, turnips, and many cruciferous plants; about 12 to 15 mm. long when mature; abdomen whitish with pinkish brown vittae; head black; ventral prolegs only moderately elongate, obviously shorter than the longest of the adjacent SV setae; posterolateral margin of head broadly V-shaped, obviously angulately indented; they spin silken tubes on the hostplant. . . . . **Hellula undalis** (Fabricius).

SECTION O

LARVAE IN OR ON FRUITS, BUDS, BERRIES, SEEDS, OR IN SEEDPODS

- 1. Prothorax with three setae in the prespiracular L group . . . . . 2  
Prothorax with only two setae in the L groups. . . . . 9
- 2(1). Eighth abdominal segment with two setae in the SV group; most Tortricidae. . . . . 3  
Eighth abdominal segment with only one seta in each SV group. . . . . 4
- 3(2). Anal fork strong and fully developed; on *Abutilon*, *Sida*, and *Hibiscus* (all Malvaceae). . . **Crociosema.**  
Anal fork absent, or at most weakly indicated on some specimens of *Cryptophlebia ombrodelta*; on many kinds of plants although not on Malvaceae, common on cultivated plants such as beans, *Litchi*, *Macadamia*, and, in the mountain forests, on *Acacia* . . . . . **Cryptophlebia.**

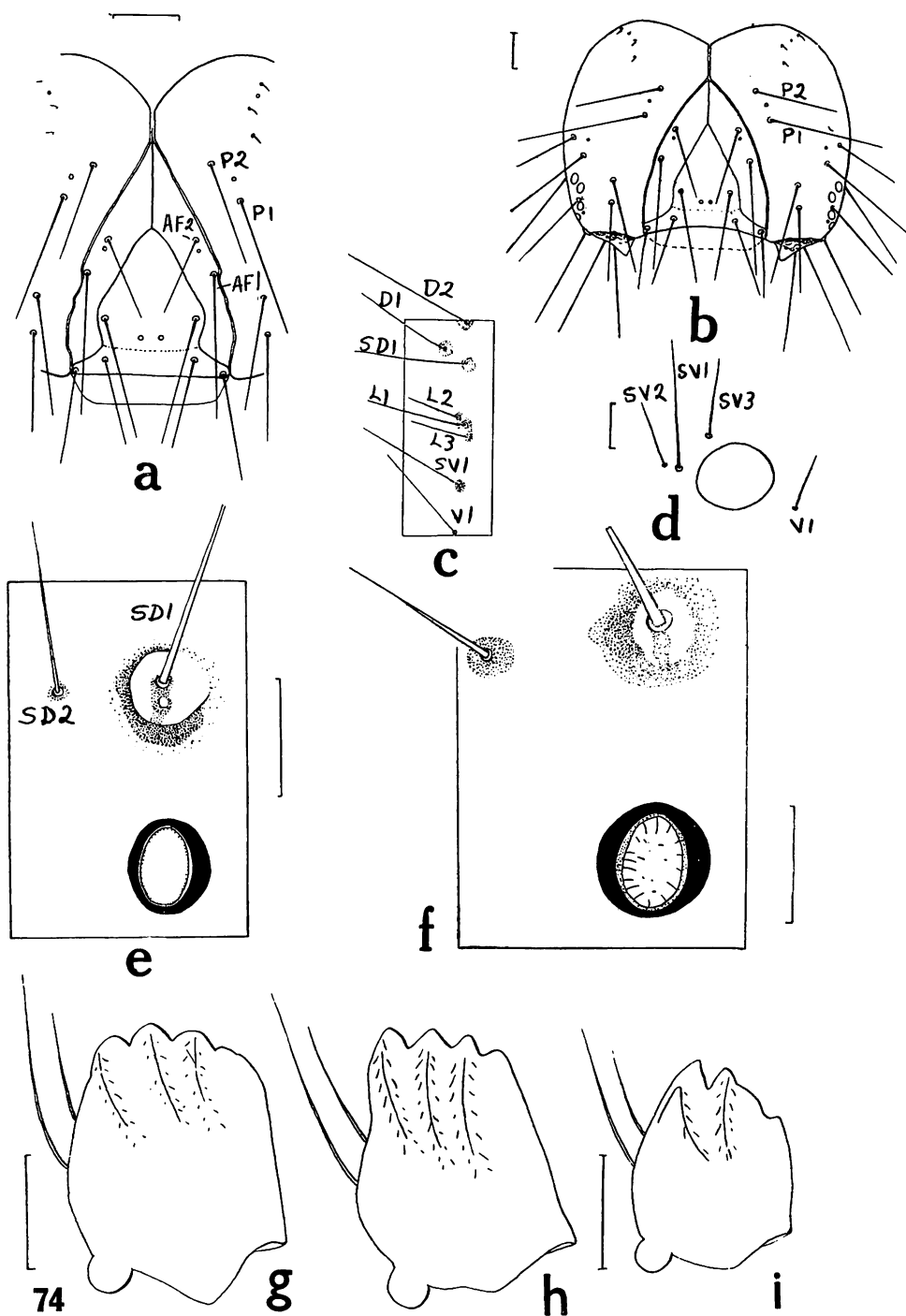


Figure 74—Details of the larvae of some Galleriinae. *a*, front of head of *Corcyra cephalonica* (Stainton); *b*, the same of *Aphomia gularis* (Zeller); *c*, ninth abdominal segment of *Aphomia*; *d*, subventral and ventral setae of the fourth abdominal segment of *Aphomia*; *e*, spiracular area of eighth abdominal segment of *Corcyra*; *f*, the same of *Aphomia*; *g*, ventro-mesal aspect of the right mandible of *Galleria*; *h*, the same of *Achroia*; *i*, the same of *Corcyra*. The scale lines represent 0.20 mm. (Modified from Hinton, 1943.)

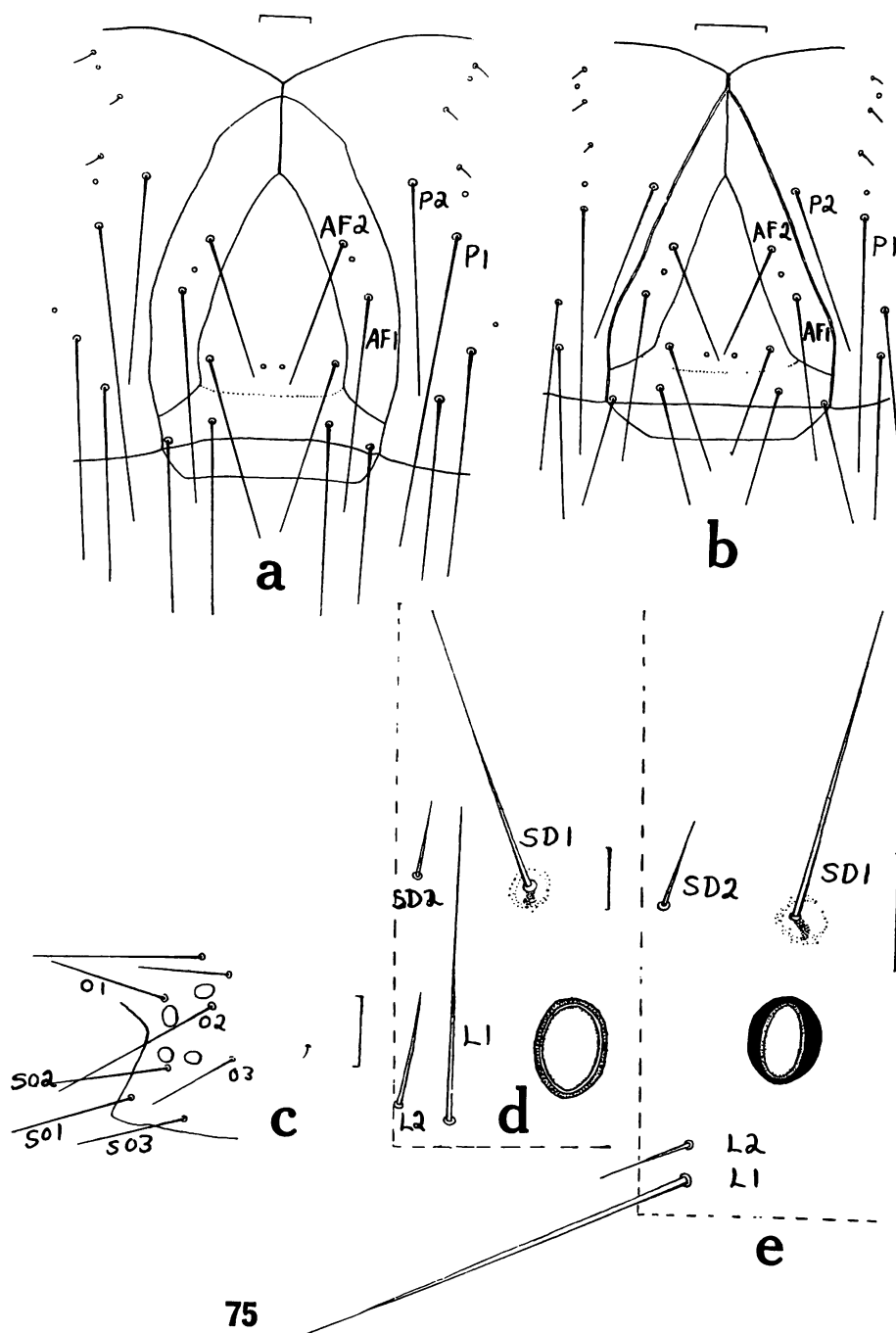


Figure 75—Details of the larvae of *Achroia grisella* (Fabricius) and *Galleria mellonella* (Linnaeus), Galleriinae. a, front of head of *Galleria*; b, front of head of *Achroia*; c, ocellar area of the head of *Galleria*; d and e, spiracular areas of the eighth abdominal segments of *Galleria* and *Achroia*. The scale lines represent 0.20 mm. (Modified from Hinton, 1943.)

- 4(2). Abdominal segments 1 to 7 with seta L1 separated from L2 by about five or more times the diameter of a setal socket and the two setae obviously not on the same pinaculum; in *Pelea* and *Fagara* fruits or seeds in the mountains. . . . . **Prays.**  
 Abdominal segments 1 to 7 with setae L1 and L2 approximate or on the same pinaculum. . . . . 5
- 5(4). On Leguminosae in the mountains. . . . . **Cydia.**  
 Not on Leguminosae in the mountains, or, if so, then the submentum has an ovate medial impression. . . . . 6

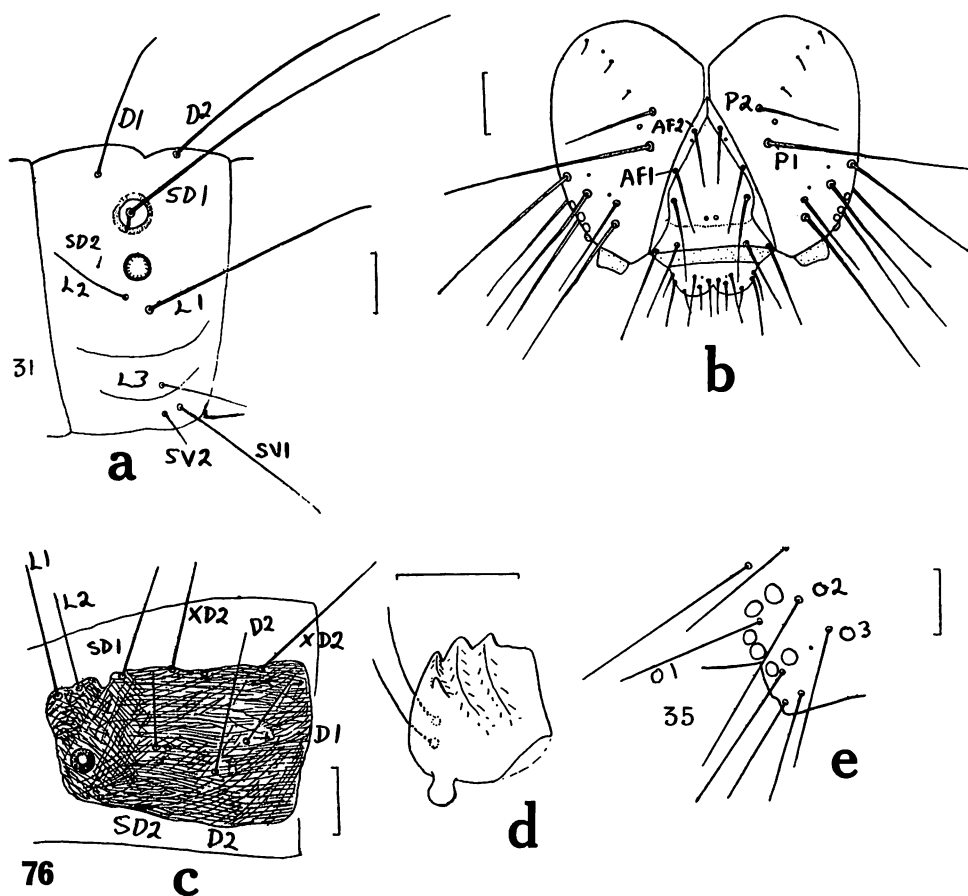


Figure 76—Details of the larvae of two species of Phycitinae. *a*, eighth abdominal segment of *Plodia interpunctella* (Hübner); *b*, front of head of same; *c*, sclerotization of the left part of the pronotum of *Cryptoblabes gnidiella* (Milliere); *d*, ventro-mesal aspect of the right mandible of same; *e*, ocellar area of same. The scale lines represent 0.20 mm. (Modified from Hinton, 1943.)

- 6(5). On Malvaceae.....7  
Not on Malvaceae.....8
- 7(6). Pinacula very conspicuous on abdominal segments  
1 to 8.....**Pectinophora scutigera** (Holdaway).  
Pinacula inconspicuous on abdominal segments 1  
to 8.....**Pectinophora gossypiella** (Saunders)
- 8(6). On *Gouldia* and *Hedyotis* in native forest; submentum  
lacking a medial impression.....**Aristoteliodes**.  
On many plants; a common species in lowland and  
cultivated areas; submentum with an ovate me-  
dial impression, usually pigmented.....  
.....**Blastobasis inana** (Butler).
- 9(1). Ventral prolegs with crochets uniordinal; on many  
kinds of forest plants.....**Carposina**.  
Ventral prolegs with bi- or triordinal crochets.....10
- 10(9). The SD1 setae surrounded by a pigmented ring  
outside of an unpigmented area around the bases  
of the setae on mesothorax and also on abdominal  
segment 8 and partially surrounded by pigmented  
dorsal crescents on abdominal segments 1 to 7;  
the D setae of the abdominal segments borne from  
conspicuous pinacula; head lacking a coronal  
suture; on many kinds of plants and common in  
the lowlands and cultivated areas.....  
.....**Ectomyelois ceratoniae** (Zeller).  
The SD1 setae, at least on mesothorax, without sur-  
rounding pigmented rings or crescents.....11
- 11(10). A common species in cultivated areas in bean pods  
of many kinds; larvae cream-colored with brown  
maculae; meso- and metanotum each with a pair  
of sclerotized areas near middle of caudal margins  
which contain no setae; prolegs elongated.....  
.....**Maruca testulalis** (Geyer).  
Larvae in *Erythrina* pods; scarce (not seen by me)  
(= *meticulosalis* of Volume 8:44, because of mis-  
identification).....**Terastia subjectalis** Lederer.

## SECTION P

## BORERS IN LIVING STEMS, TWIGGS, OR TUBERS

1. Prothoracic prespiracular L group of setae con-  
taining three setae.....2  
Prothorax with only two setae in the L group.....12

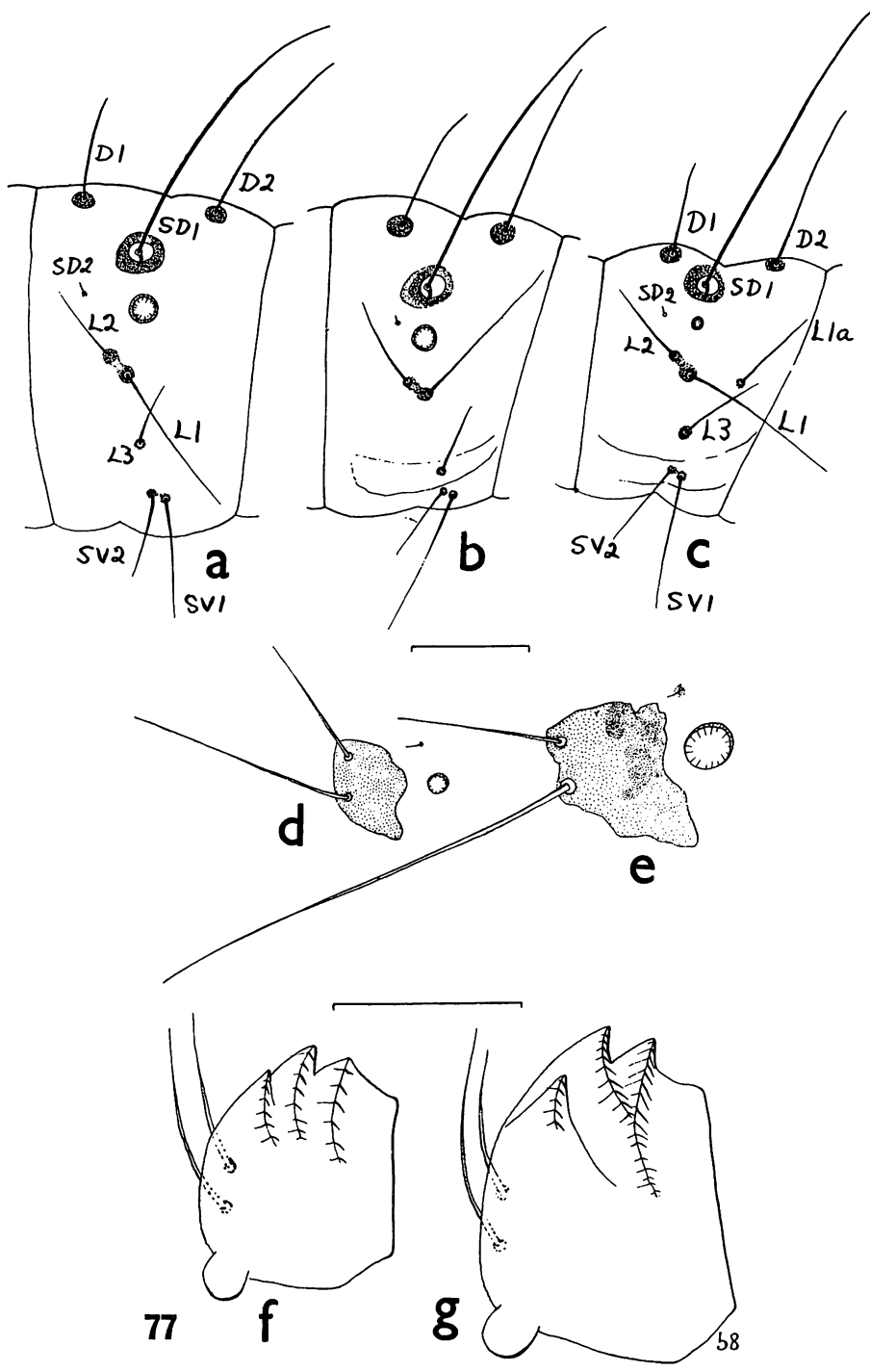


Figure 77—See legend on page 177.

- 2(1). Abdominal segment 8 with two setae in each SV group; most **Tortricidae**.....3  
 Eighth abdominal segment with only one seta in each SV group.....6
- 3(2). Anal fork strongly developed.....4  
 Anal fork absent (or feebly developed in some *Cryptophlebia*).....5
- 4(3). Common in *Lantana* (also occasionally in some other plants such as *Bignonia*, *Litchi* and *Tecoma*); a common species in the lowlands; as in figure 420.....**Epinotia lantana** (Busck).  
 On Malvaceae; common in *Abutilon* and *Sida* in the lowlands; in *Hibiscus* in the mountains.....**Crociosema**.  
 On various plants in the native forests but none known on Malvaceae; never on *Lantana* or other introduced plants.....**Spheterista**.
- 5(3). Borers in sedges.....**Bactra**.  
 On broad-leaved plants, never in sedges; common on many kinds of cultivated plants, including beans, *Litchi*, *Macadamia*, and, in the mountains, on *Acacia*.....**Cryptophlebia**.
- 6(2). Gall formers.....7  
 Not gall formers.....8
- 7(6). On *Schinus*.....**Crasimorpha infuscata** Hodges.  
 On *Hedyotis* (= *Gouldia*).....**Aristoteliodes**.
- 8(6). On solanaceous plants such as potato, tomato, egg-plant, etc.; larva as in figures 1286–1291.....**Phthorimaea operculella** (Zeller).  
 Not so.....9
- 9(8). In stems of sedges and grasses.....**Chedra**.  
 Not so.....10
- 10(9). Prothorax with the two anterior setae in the pre-spiracular L group arranged in a subvertical line.....**Hyposmocoma**.  
 Prespiracular L group of setae on prothorax arranged in a subhorizontal line.....11

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Figure 77—Details of *Anagasta* and *Ephestia* larvae; Pyralidae. *a*, *b*, *c*, left lateral aspects of the eighth abdominal segments of *Anagasta kühniella* (Zeller) *a*, *Ephestia cautella* (Walker) *b*, and *Ephestia elutella* (Hübner) *c* (the seta which I have labeled L1a may be present or absent on this species; Hinton called it "theta"). *d*, spiracle and prothoracic L group setae of *Ephestia elutella*; *e*, the same of *Anagasta kühniella*; *f*, ventro-mesal aspect of the right mandible of *Ephestia elutella*; *g*, the same of *Anagasta kühniella*. The scale lines represent 0.20 mm. (Modified from Hinton, 1943.)



- 11(10). Head with frons very short, not reaching middle of front of head and not reaching level of P1 setae; mandibles with a nearly straight internal cutting edge which is not conspicuously dentate. . . . . **Thyrocopa.**  
 Head with frons extending above middle of front of head to above level of P1 setae; mandibles with several conspicuous teeth on internal edges . . . **Cydia.**
- 12(1). Crochets of ventral prolegs uniordinal . . . . . 13  
 Crochets of ventral prolegs bi- or triordinal. . . . . 14
- 13(12). Head with frons short, extending dorsad only to about the level of the P1 setae. . . . . **Carposina.**  
 Head with frons extending above the level of setae P2 to near the dorsal triangle; on *Canthium*. . . . . **Alucita objurgatella** (Walsingham).
- 14(12). In *Lycopodium*. . . . . **Eudoria**  
 (= *Scoparia* of Volume 8) **lycopodiae** (Swezey).  
 Not so. . . . . 15
- 15(14). In rice or grasses . . . . . **Chilo suppressalis** (Walker).  
 In broad-leaved plants. . . . . 16
- 16(15). Mesothorax with seta SD1 enclosed by a pigmented ring which surrounds a pale area around base of seta . . . . . 17  
 Seta SD1 on mesothorax not enclosed by such a ring . . . . . 18
- 17(16). a. In *Argyroxiphium* on Haleakala, Maui. . . . . **Rhynchephestia rhabdotis** Hampson.  
 b. In *Wilkesia* (and other Compositae which have not been determined). . . . . **Homoeosoma alboparsum** (Butler).  
 c. In *Ageratum*, *Bidens*, *Dahlia*, *Tagetes* (marigold) . . . . . **Unadilla.**  
 d. In cactus; large orange or reddish larvae with large black maculae (see Volume 8: pp. 357–358, figures 293–B–293–C). . . . . **Cactoblastis cactorum** (Berg).
- 18(16). Common on cabbages, radishes, turnips, and cruciferous plants; less than 20 mm. long; abdomen whitish with pinkish brown vittae; head very dark, with ocellus I distinctly larger than II; prolegs slender . . . . . **Hellula undalis** (Fabricius).  
 Without such a combination of characters. . . . . 19

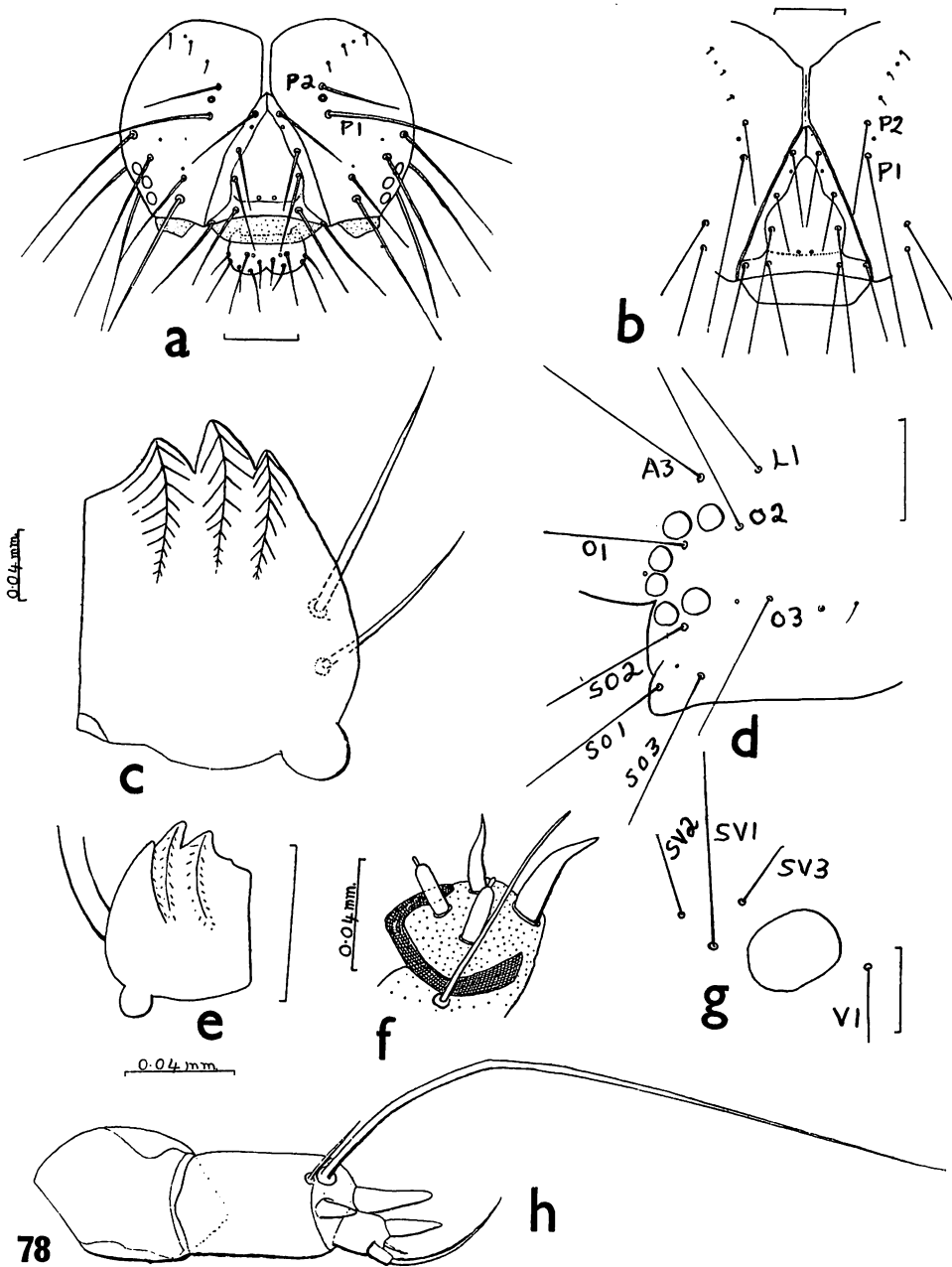


Figure 78—Details of the larvae of *Ephestia*; Pyralidae. *a*, front of head of *figulilella* Gregson; *b*, frons and associated parts of *cautella* (Walker); *c*, ventro-mesal aspect of left mandible of *figulilella*; *d*, ocellar area of *cautella*; *e*, ventro-mesal aspect of right mandible of *cautella*; *f*, dorso-lateral aspect of maxillary mala of *cautella*; *g*, subventral and ventral setae of the fourth abdominal segment of *cautella*; *h*, antenna of *figulilella*. The scale lines represent 0.20 mm, unless otherwise indicated. (Modified from Hinton, 1943.)

- 19(18). A common pest of sweetpotato, also on *Stictocardia* and perhaps on some other hostplants; mature larva about 25 to 30 mm. long, pale yellowish with large brown pinacula . . . . .  
 . . . . . ***Omphisa anastomosalis*** (Guenée).  
 A scarce species on *Erythrina*; larvae not seen by me (*meticulosalis* of Volume 8:44) . . . . .  
 . . . . . ***Terastia subjectalis*** Lederer.

## SECTION Q

LARVAE APPARENTLY SCAVENGERS IN PLANT DEBRIS OR ON THE SURFACES OF VARIOUS PLANT PARTS, DEAD OR LIVING, SUCH AS BARK, DEAD LEAVES, OR ON THE SURFACES OF FRUIT, AMONG DECAYING LEAVES, UNDER DEAD BARK, ETC.

1. Prespiracular L group of setae on prothorax with only two setae; ***Pyralidae*** . . . . .  
 . . . . . ***Cryptoblabes gnidiella*** (Millière).  
 Prothorax with three setae in the prespiracular L setal group . . . . . 2
- 2(1). Abdominal segments 1 to 8 with setae L1 and L2 widely separated; ***Tineidae*** . . . . . 3  
 Abdominal segments 1 to 8 with the L1 and L2 setae closely approximated and often on the same pinaculum . . . . . 8
- 3(2). Prolegs with a line or band of recurved spinelets on cephalic sides dorsad of the crochets . . . . . ***Opogona***.  
 Prolegs without such additional recurved spinelets . . . . 4
- 4(3). True leg tarsal segments unusual, very long, slender, and acuminate and, excluding the claw, the tarsus is about one-third longer than the tibia; ventral prolegs unusually long, at least twice as long as thick; head and pronotum dark brown; abdominal segments 1 to 8 with the D2 setae slightly more distantly separated than the D1 setae and with the SD1 setae about as distant from the spiracles as setae L1 or L2; pinacula prominent and most setae conspicuously long and dark; figures 160-A, 160-B . . . . .  
 . . . . . ***Choropleca terpsichorella*** (Busck).  
 True leg tarsi normally short and broad, not longer than tibiae; ventral prolegs not elongated; ab-

- dominal segments 1 to 8 with the D2 setae much more widely separated than the D1 setae and the SD1 setae only about one-half as far from spiracles as setae L1 or L2 or closer.....5
- 5(4). Abdominal segment 8, or segments 8 and 9, with the V setae much closer to each other and the distance between them subequal to or only a little greater than the distance between one of them and the nearest SV seta; pinacula infuscated on tergites; meso- and metanotum with conspicuous pigmented areas arranged as in figure 180; common on *Saccharum* (sugarcane) .....  
 ..... **Neodecadarchis flavistriata** (Walsingham).

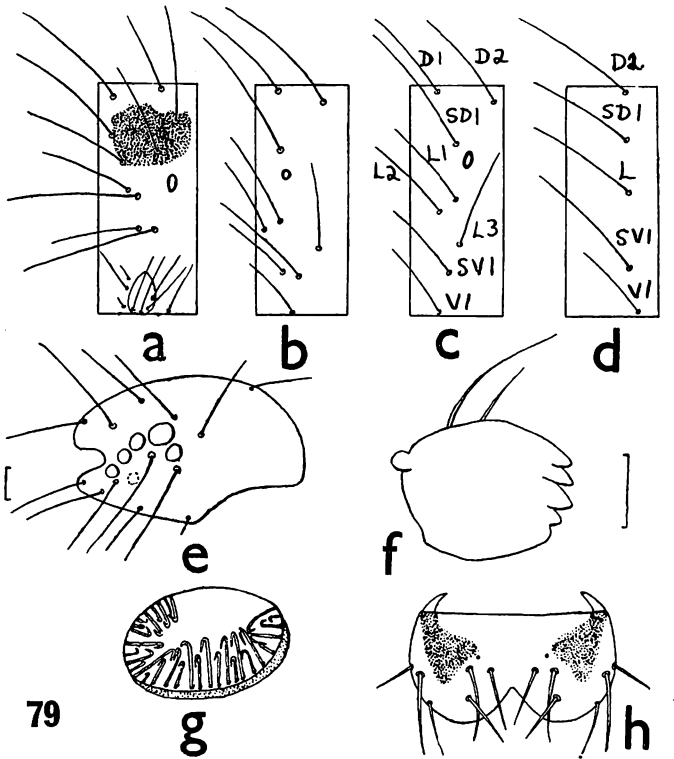


Figure 79—Details of the larva of *Euchromius ocellus* (Haworth); Pyralidae: Crambinae. (Modified from Hinton, 1943.) a, prothorax; b, c, d, seventh, eighth, and ninth abdominal segments; e, left side of head; f, ventro-mesal aspect of right mandible; g, diagram of crochets on fourth abdominal proleg; h, labrum. Scale lines represent 0.20 mm.

- Abdominal segment 8, or segments 8 and 9, with the V setae widely separated and the distance between them two, three, or more times as great as that between one of them and the nearest SV seta . . . . .6
- 6(5). Dark pigmented maculae distinct on all three thoracic segments; pattern of pigmentation as in figure 180; larvae about 20 to 30 mm. long; head with a distinct, elongate, impressed area with well-defined borders and a broadly rounded posterior end behind each antenna and including setae A1 and A2 and extending behind to a point above the most posterior ocellus . . . . .
- . . . . . **Decadarchis simulans** (Butler).
- Metathorax, or meso- and metathorax, lacking large, well-developed, pigmented areas; larvae smaller and head lacking such well-defined postantennal depressions (although *Decadarchis kerri* has a postantennal groove, it is ill-defined and is not a broad, flat-bottomed depression) . . . . .7
- 7(6). Larva appearing rather depressed; head broad, broadest near posterior lateral angles; vertical triangle forming an angle of about 90 degrees; spiracle of 8th abdominal segment ovate, about three times as long as that of 7th segment; prothoracic spiracle elongate-ovate, as long as distance between the two lowermost of the L setae; Leeward Island species . . . . .
- . . . . . **Decadarchis kerri** (Swezey).
- Larva not depressed; head broadest about middle; vertical triangle obviously more acute than 90 degrees; spiracle of 8th abdominal segment round and at most only about twice as large as that on the 7th segment; prothoracic spiracle round and much shorter than distance between the two lowermost of the L setae . . . . .
- . . . . . **Lepidobregma minuscula** (Walsingham).
- 8(2). Cephalic edge of pronotal shield with numerous secondary setae; a very elongate, slender larva . . . . .
- . . . . . **Stoeberhinus testaceus** Butler.
- Pronotum without secondary setae . . . . .9
- 9(8). Submentum with either a medial impression surrounded by a fine sclerotized line or with a medial, sclerotized or pigmented area, often sub-U-shaped . . 10
- Submentum lacking a medial impression or medial sclerotized or pigmented area . . . . .12

- 10(9). Head with seta P2 dorsolaterad of P1; mandible with three apical teeth. . . . . **Blastobasis inana** (Butler).  
 Head with seta P2 directly dorsad of P1; mandible, as seen from above, with only one blunt tooth visible and the inner edge behind the tooth forming a long, nearly straight, knifelike cutting edge. . . 11
- 11(10). Spiracles of abdominal segments 1 to 7 subequal in size to the SD1 setal sockets; head with seta O1 outside (toward mandible) of the row of only two ocelli, as in figure 636. . . . . **Endrosis sarcitrella** (Linnaeus).  
 Spiracles of abdominal segments 1 to 7 conspicuously larger than the SD1 setal sockets, about three times their size and the rims very thick; head with seta O1 inside the row of more numerous ocelli. . . . . **Thyrocopa**.  
 12(9). Head with only two ocelli developed on each side; as in figure 636 (this species is placed here also because the medial impression of the submentum is not always distinct). . . . . **Endrosis sarcitrella** (Linnaeus).  
 Head with more than two ocelli on each side. . . . . 13
- 13(12). Mandible, viewed from above, with a long, straight, knife-edge-like, internal cutting edge and only the dorsal apical tooth visible; abdominal segment 8 with seta SD1 dorsad of spiracle. . . . . **Autosticha pelodes** (Meyrick).  
 Mandible, viewed from above, with two to four sharp teeth distinctly visible and without a long, straight, internal cutting edge behind them; abdominal segment 8 with seta SD1 cephalad of the spiracle. . . . . 14
- 14(13). Abdominal segments 1 to 8 with setae L1 and L2 in a subvertical line; proleg crochets uniordinal; as in figures 743–744. . . . . **Anatrachyntis**.  
 Abdominal segments 1 to 8 with setae L1 and L2 in a subhorizontal line; proleg crochets biordinal at least on anterior rows (some species may have posterior rows uniordinal). . . . . **Hyposmocoma**.

## SECTION R

## LARVAE IN SOIL IN OR ABOUT THE ROOTS OF GRASS

Prespiracular L group on the prothorax with only two setae. Such larvae may be the unknown larvae of *Orthomecyna*, *Mestolobes*, *Tulla*, or *Tamsica* of the Pyralidae: Crambinae. See Volume 8:277.

## SECTION S

## LARVAE IN BEES' NESTS

1. Mature larvae less than 20 mm. long; head evidently lacking ocelli; abdomen with derm whitish and with the microscopical spicules pale, indistinct, and colored nearly as the derm; a line drawn between the two P1 setae on the head passes nearer the P2 setae than the AF2 setae; 8th abdominal segment with seta 12 dorsad of L1 (figure 75, *b*) . . . . . **Achroia grisella** (Fabricius).
2. Mature larvae longer than 20 mm.; head with six ocelli; abdomen mostly pale brownish, the dermal spicules dense, brownish; a line drawn between the P1 setae on the head passes nearer the AF2 setae than the P2 setae; 8th abdominal segment with seta L2 in front and only slightly dorsad of L1 (figure 75, *a, c, d*) . . . . .  
 . . . . . **Galleria mellionella** (Linnaeus).

## THE PUPA

In 1916, Edna Mosher published her distinguished doctoral thesis, *A Classification of the Lepidoptera Based on Characters of the Pupa*. In the Introduction to that work (pp. 17-18), she said:

It is within comparatively recent times that the immature stages of insects have been considered of any taxonomic value. The economic entomologist early realized the value of being able to recognize the immature stages, for in many orders of insects the larval stages alone were responsible for many ravages upon crops and orchards. Still the matter was not taken up by the systematists, and the workers in the field of economic entomology contented themselves by rearing the adult to determine the species, and then describing, perhaps all the stages, or more probably the larval and adult stages as being those of economic importance. Nowadays we are beginning to see that it is impossible to construct an adequate classification of any group of insects unless we use every bit of information obtainable on their life history and habits.

It is possible to multiply instances of the value of the larval stages in classification, so that one scarcely needs to cite examples; but the pupae have been less frequently used. There are cases, however, in which the only good taxonomic characters available are found in the pupal stage of the insect. Such instances are found among the nematocerosus Diptera, particularly in the family Chironomidae. Scudder ('89) was the first to attempt a classification of lepidopterous pupae, but his keys to the chrysalids were based, not on structural characters, but on the various projections from the body, the cuticular appendages, the coloration, and the mode of suspension.

Among the Lepidoptera a great deal of work has been done towards the classification of the larvae, but until 1893 nothing of importance had been done towards a study of the pupae. In this year Dr. T. A. Chapman, in a paper entitled "Some Neglected Points in the Pupae of Heterocerous Lepidoptera," called attention to the fact that the pupae possessed some remarkable taxonomic characters which might be used to clear up many of the disputed points in the classification of the order. This he endeavored to do for the groups in which material was available for study, and he has since published other articles as additional material was obtained. However, Dr. Chapman attempted no classification of the Lepidoptera on this basis, merely pointing out the pupal characters of the major groups and calling attention to instances in which a study of these characters would apparently alter the existing schemes of classification.

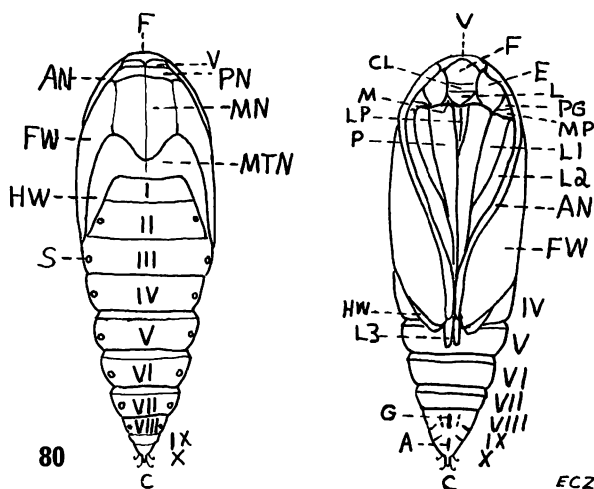


Figure 80—Pupa of a female of a small moth, dorsal and ventral aspects. *A*, anus; *AN*, antenna; *C*, cremaster; *CL*, clypeus; *E*, eye; *F*, frons; *FW*, forewing; *G*, genitalia; *HW*, hindwing; *L*, labrum; *LP*, labial palpi; *L1*, *L2*, *L3*, legs; *M*, mandible; *MN*, mesonotum; *MP*, maxillary palpus; *MTN*, metanotum; *P*, proboscis (maxillae); *PG*, postgena; *S*, spiracle; *V*, vertex; 1 to 10, abdominal segments.

There are great differences between the pupae of different species of moths—many have very distinct facies from the model shown here. The wings and/or the appendages may extend for greater or lesser distances caudad, and some may extend beyond the abdominal apex. Some parts concealed on one species may be exposed on another.



The attention of American entomologists was called to this subject by Dr. A. S. Packard ('95) in a paper entitled "Attempt at a New Classification of the Lepidoptera." He made a new grouping of the order based upon pupal characters and figured a large number of species. His determinations of the homology of the various parts of the pupae studied were far from correct, and this, of course, invalidated many of his conclusions.

Since that time nothing has been done in America towards a classification of the Lepidoptera based on pupal characters. The purpose of the present investigation is to present such a classification as far as material has been available for study. There is also an attempt to throw some light on the relationships existing between the different groups.

#### CHANGES PRECEDING PUPATION

The person who begins the study of pupae with the preconceived notion that the pupal stage is an interpolated one in the insect's life and that a pupa bears little or no resemblance to either larva or adult, will probably find abundant cause for a change of mind before his study is completed. In the case of Lepidoptera one is apt to think that no similarities could possibly exist between any of the three stages of the insect's development after it leaves the egg. After careful study, however, one is surprised with the resemblance between the stages, for it is of the highest importance in the study of any group to be able to homologize larval, pupal, and imaginal characters. This has been done to some extent in certain orders of insects, particularly in those groups where the resemblance between the larva and adult is more striking than in the case of the Lepidoptera. Attempts have been made, however, even in this order, to homologize the mouth-parts of the larva and adult, and some of the larval structures have been homologized with certain structures in the pupa; but apparently the idea that all three stages should be studied has been left for other minds to entertain.

The first striking difference between larva and pupa is that of size. This difference is easily explained by the great difference in the size of the alimentary canal. Another striking difference is that the pupa apparently lacks legs and prolegs. As will be shown later, the legs are always present, but folded and not in use, while the scars of all the prolegs remain to show their location and are very easily identified in the majority of cases. Many lepidopterous larvae possess striking tubercles and warts, and usually an abundance of setae. All larvae possess setae, but they are often inconspicuous. On the exposed portions of the body surface, in so far as observed, the pupa always retains the scars of these warts and tubercles, and the pupal body possesses setae arranged in most cases in the exact order in which they occurred in the larva. Many other structures of the larva can be easily identified in the pupa, . . .

In the case of insects with complete metamorphosis the name pupa is applied to the stage of the insect in which it is more or less quiescent while undergoing the changes which are necessary to fit it for its adult life. This word pupa, from the Latin meaning baby, was applied to this stage by Linnaeus from the resemblance of certain pupae to a baby which has been swathed or bound up, as was the custom in many parts of Europe at that time.

The pupae of Lepidoptera often display easily seen structures or characters that are of great assistance for purposes of identification and classification, but all too often we know little or nothing about the pupae of the moths we study. Some species are more easily distinguished by external, easily observable structures of the pupae than by features displayed by the adult moths. In spite of their importance, collections of moth pupae in most museums are astonishingly poor. Entomologists generally have neglected the study of pupae. Because of the lack of material, no detailed discussion of the pupae of Hawaiian moths is possible here.

Hinton (1946b:282) drew our attention to the fact that for nearly 200 years we accepted the classification proposed by Linnaeus in 1758. Linnaeus recognized three kinds of pupae: *pupae incompletae*, *pupae obtectae* and *pupae coarctatae*. Hinton demonstrated that the Linnean classification was not entirely satisfactory, and he divided insect pupae into two major groups: *pupae decticae* ("with mandibles that have a basal articulation and are capable of being moved by the imaginal muscles"), and *pupae apecticae* ("with fixed, non-functional mandibles"). Both major types occur in the Lepidoptera, but

only the *Dacnonypha* (which includes the primitive *Eriocraniidae* and *Mnesarchaeidae* which are not represented in Hawaii) have decticous pupae. All of the Hawaiian Lepidoptera of both the *Monotrysis* and *Ditrysis* have adecticous pupae. Adecticous pupae are further divided into *obtectate* and *exarate* groups. All of the adecticous lepidopterous pupae are also *obtectate*, because they have the appendages (wings, legs, antennae, and mouthparts) partly, mostly, or entirely fused to the body wall (as opposed to *exarate* pupae on which the appendages are free). Hence, the pupae of all of the moths known in Hawaii are *obtect adecticous*. "Obtect pupae have been evolved only once in the Lepidoptera. . . ." (Hinton, 1946*b*:325.)

The pupae of many moths are variously "ornamented" with spines, hooks, comblike processes, ridges, or other structures whose functions may appear enigmatical until one has carefully observed the living organism at various periods of its life. Chapman (1893, 1900*c*) was an early observer of the functions of these features of lepidopterous pupae, and Hinton (1946*b*), who expanded upon Chapman's studies, has given us a stimulating discussion. Although Hinton's paper was prepared more than a quarter of a century ago, no one has taken up the challenge of the opportunity for productive research in this field, and no recent comprehensive work on pupae has appeared.

Hinton has stated that there are no intermediate forms known between decticous and adecticous pupae, and he said (1946*b*:283-284):

There is usually no difficulty in deciding whether an adecticous pupa is exarate or obtect. For instance, the specialized obtect pupa of a hawk-moth is very different indeed from the exarate pupa of a blow-fly. But the feebly obtracted pupa of a *Nepticulid* or that of some of the *Orthorrhapha* might be mistaken for an exarate pupa. Although I have seen no adecticous pupae that do not clearly belong to one or the other of these categories, the degree of soldering of the appendages and hardening of the cuticle varies so considerably among the obtract pupae examined, that I have little doubt that every transition between exarate and obtract pupae will be found sooner or later amongst recent forms.

In order fully to appreciate the remarkable diversity of pupal types amongst insects, it is necessary to study pupal structures from a functional point of view. It is generally recognized that the pupal instar of the *Holometabola* is the most critical stage in the life of these insects. For a considerable time, which may be several days to many weeks, the insect is more or less immobile and helpless, and is, moreover, very susceptible to variations in humidity and other physical factors, and is easily damaged by any enemies it may have. This critical time is from the commencement of the pupal instar to, or nearly to, the emergence of the adult. During a part of this period extensive histolysis and histogenesis is taking place. The habit of the mature larva of making a cell in earth or wood, or a cocoon or case of some kind in which to pass its pupal and pharate adult stages, is a habit which must have been evolved more or less simultaneously with the appearance of a quiescent pupal instar; and this habit is well developed in the most primitive of recent *Holometabola*.

The evolution of a protective cell or cocoon for the pupal instar could hardly have taken place without the simultaneous development of a method of escape for the adult. And the various types of pupae are, so to speak, but reflections of the different ways in which the adult escapes from its cocoon or cell.

Hinton uses the word *pharate* to distinguish a phase of the adult holometabolous insect which generally has been ignored or not recognized by most entomologists. Hinton (1946*b*:325-326) said:

The *Holometabola* have two imaginal instars. The first of these is called the pupa and the second the imago. The pupa is a quiescent instar which is nearly always of very short duration. The second imaginal instar consists of two phases, the first enclosed in the cuticle of the pupa or first imaginal instar and the second beginning when the pupal cuticle is shed and ending when the imago dies. To avoid circumlocution, the first phase of the second imaginal instar is spoken of as the pharate adult. . . . The pharate adult is practically never distinguished by entomologists from the first imaginal instar or true pupal instar, and the activities—crawling, swimming, hibernating, etc.—attributed to the pupa are almost without exception activities of the pharate adult.

In his paper in *Nature* (1946c:553) Hinton said that "the term 'pharate' . . . is proposed to designate the phase of an instar which is enclosed within the cuticle of the previous instar." (He derived the name from the Greek word for "cloaked".) He draws attention to the fact that the records of wriggling, walking, and swimming by pupae are wrong, because it is the "pharate adult" within the unshed pupal cuticle that is wriggling, walking, or swimming. Hinton, however, did not mention in either of his above-quoted papers the fact that Edna Mosher, in her distinguished work on lepidopterous pupae (1916:21), had previously called this stage the *preimago*. She said:

During the life of the pupa the adult parts are developing, and before it is time for the imago to emerge, the cuticular parts of the adult are fully formed. In the generalized families previously mentioned and in some specialized forms where the pupal cuticle remains more or less transparent, one is able to see a part of the development taking place, especially in the case of the appendages. The scales appear on the legs and wings and the color pattern may often be easily traced on the latter several days before the emergence of the insect. This stage of the insect, after the cuticular parts are fully formed, and while it still retains its pupal skin, has been designated as the *preimago*.

Miss Mosher then stated in a footnote that "Packard applied the term *subimago* to the corresponding state in certain Hymenoptera. This is an unfortunate use of the term as *subimago* had already been applied to the first winged stage of the Ephemeridae."

The following quotations are taken from Hinton's account of the pupae of Lepidoptera (1946b:290-295):

Among the Lepidoptera, the Dacnonypha have a decticious pupa, but all families of the Monotrysia and Ditrysia have obtect adecticious pupae, the mandibles of which, when present, are reduced to no more than flat immovable plates of varying size. The number of different methods of escape from the cocoon and the corresponding morphological modifications exhibited by the pupae are much greater in the Lepidoptera than in any other order of insects except the Diptera.

The direction of evolution of the obtect pupae is unmistakably towards a greater and greater degree of solidification, and the fusion of the parts and the hardening of the cuticle becomes more complete from lower to higher forms almost without exception. In the Monotrysia and more primitive Ditrysia the abdomen of the pupa [pupal skin] is provided with series of posteriorly directed spines. When the adult is ready to emerge, it wriggles its abdomen so that the series of spines force the pupa forwards. On the head of the pupa there is usually a ridge or wedge-shaped tubercle which cuts through the fabric of the cocoon. This ridge or tubercle is known as the cocoon-cutter; and it is obviously the functional equivalent of the pupal mandibles of the Dacnonypha. After the pupa has protruded from the cocoon so that only a few of the posterior abdominal segments remain within, the adult emerges. . . . As is well known, the pupae of the Monotrysia and more primitive Ditrysia are normally never completely expelled from the cocoon. Many of these are retained within the cocoon by anteriorly directed hooks or spines . . . on the ninth or tenth [abdominal] segments or both. In many Tinacidae [*sic*] and primitive Psychidae there are two large anteriorly directed spines on the sternum of the tenth segment. The precise manner in which these spines are thrown out of action when the adult is moving forwards with the aid of the posteriorly directed pupal spines, and how they are later brought into play when the pupa has protruded the necessary distance out of the cocoon, still remains to be shown. Chapman (1900) has found that in some of the Tortricidae the pupa is held partly extruded from the cocoon by means of a silken cable attached to the bottom of the cocoon and to the cremastral hook of the pupa. This cremastral cable is just long enough to tighten at the right moment and prevent the pupa from falling out of the cocoon.

With the exception of the Hepialidae and a few others, the primitive Lepidoptera, which have a pupa which protrudes from the cocoon before the adult emerges, all pupate above ground in rotten wood, fungus, in bark, leaves, and so on. If the pupae of these were to fall out of the cocoon on to the ground before the adult emerged, they would obviously be exposed to additional hazards from which they are saved so long as the pupa remains attached to the cocoon. Experiments with a number of Tinacidae [*sic*] and Tortricidae suggest that there is a purely mechanical advantage gained by the pupal cuticle remaining fixed in the cocoon. The force necessary to pull the hind part of the adult out of the pupa is developed by the legs of the adult pushing against the pupal cuticle and pulling on the cocoon or the material in which the cocoon is imbedded. When the pupa is taken out of the cocoon and left loose on a flat surface, the emergence of the adult is sometimes sufficiently delayed so that the wings harden in a crumpled state and

cannot later be used for flying. The imago probably also relies to some extent on the force of gravity, which is ineffectual when it has to emerge on the ground. For example, locusts find it difficult to shed the nymphal skin unless they are able to crawl up some object and hang more or less upside-down. . . .

The more primitive obtect pupae are characterized by having at least three freely movable abdominal segments in the male and two in the female, usually a ridge or other kind of cocoon-cutter on the head, and nearly always some backwardly directed spines on the abdominal tergites. This kind of lepidopterous pupa is called a *pupa incompleta* by Chapman. The *pupa completa* of the higher Ditrysia, with few exceptions, have two or fewer movable segments in both males and females, no cocoon-cutters on the head, and usually no series of posteriorly directed spines on the abdomen. These pupae practically never protrude from the cocoon when the adult emerges. A further difference between the incompletae and completae of Chapman is that the fracture made in the pupal thorax, when the adult emerges, is regular in the former and frequently irregular in the latter, particularly among the more specialized forms. . . .

Chapman (1900) has already drawn attention to the fact that at least three developments were necessary if the pupa was to remain entirely within the cocoon. First, the cocoon had to be flimsy enough for the moth to break through or else had to be provided with an anterior valve or lid which could be easily pushed open. Secondly, the pupal cuticle of the head and thorax had to be sufficiently rigid to be held back by the narrower opening in the cocoon and thus prevent the emerging adult from dragging out the pupa with itself. In some instances a cremastral cable would prevent the pupa from being pulled out if the cuticle of the head and thorax were not sufficiently rigid. And, thirdly, the pupal cuticle had to be rigid enough to form a base from which the moth could force its way out. This rigidity of the pupal cuticle is attained not only by hardening the cuticle itself but also by decreasing the number of movable abdominal segments, so that it finally becomes rigid enough to transmit to the base of the cocoon the thrust necessary for the moth to open it. Chapman has shown that in some Notodontids the cocoon so closely embraces the pupa that the moth can take the necessary thrust from the base of the cocoon. In some Agrotids and Lymantrids the pupal cuticle more or less collapses, and the moth makes its escape by the aid of its legs alone.

A few of the most highly specialized Lepidoptera, e.g. some Notodontidae and Sphingidae which pupate in cells in the ground, use their pupae to propel themselves to the surface. This habit and the structures that make it possible have been acquired *de novo* and are not, of course, evidence of a direct connection with forms possessing a pupa incompleta. According to Packard (1895), the species of *Datana* (Notodontidae) propel themselves to the surface of the ground with the aid of the pupal cremaster. Among the Sphingidae this habit appears to be fairly widespread, but in this family the locomotor organs are lateral ridges or flanges on the prespiracular region of the abdomen. . . .

Many of the tougher cocoons of the higher Lepidoptera are equipped with an anterior valve constructed somewhat like a lobster-trap, so that the moth can push out easily and other insects are unable to enter. Species with this kind of cocoon usually do not possess any other special device for escaping. If the valve is badly constructed, the moth is unable to escape and dies within the cocoon. . . . In the Megalopygidae, Eucleidae, and some others, a hinged lid or trap-door is constructed at the anterior end of the cocoon. These lids may be held in place by a loose and easily broken outer webbing or by silk strands fastened internally.

A number of highly specialized Macroheterocera which strengthen their cocoons very considerably have evolved an oral secretion which softens the cocoon fabric. This cocoon-softening fluid is secreted by the moth a short time before it pushes its way out of the cocoon. . . .

## SEXUAL DIFFERENCES IN PUPAE

It is usually not difficult to distinguish the sexes of pupae when one gains a modest knowledge. In species whose adults have strongly sexually dimorphic antennae one may usually see the differences on the antennae of the pupae. Usually, however, one must examine abdominal sternites 8 and 9 to observe the nature of the indications of the sexual parts, and there is a considerable variety of characters displayed in this area. In many species the genitalia of the female are indicated by a medial sulcus which extends along sternite 9 and invades sternite 8, thus dividing the caudal margin of sternite 8, and it lacks callosities on either side. The male has the gonopore indication confined to the 9th sternum and it is flanked on each side by a callosity or low nodule. Edna Mosher (1916:28-29) had the following to say regarding the features of the caudal end of the abdomen:

*Genital Openings.*—In the male the genital opening is situated on the ventro-meson of the ninth abdominal segment. It is usually either a mere slit-like opening . . . , without any adjacent elevations, or it has a distinctly elevated tubercle on each side . . . , and occasionally is situated in a slight depression. In the females there are two openings which may or may not become confluent. These may be mere rounded pores or slit-like openings, and are associated apparently with the eighth and ninth segments. The boundary lines between segments 8 and 9, and 9 and 10 are rarely distinct on the meson, and where they are distinct it seems as if the caudal opening were associated with the tenth segment. In the more specialized pupae the caudal margins of the eighth and ninth segments are more strongly curved cephalad near the meson than in the male . . . and the segments are dovetailed together. The presence of the two openings apparently represents the more generalized condition. . . .

*Anal Opening.*—This is always situated on the meson near the caudal margin of the tenth segment. It sometimes shows as a circular opening . . . but is usually slit-like. . . . It is usually surrounded on each side with several prominent wrinkles or folds.

*Anal Rise.*—The anal opening is frequently situated on the summit of a mound-like elevation known as the anal rise. The setae on this rise are very conspicuous in certain families of the Tortricioidea. . . .

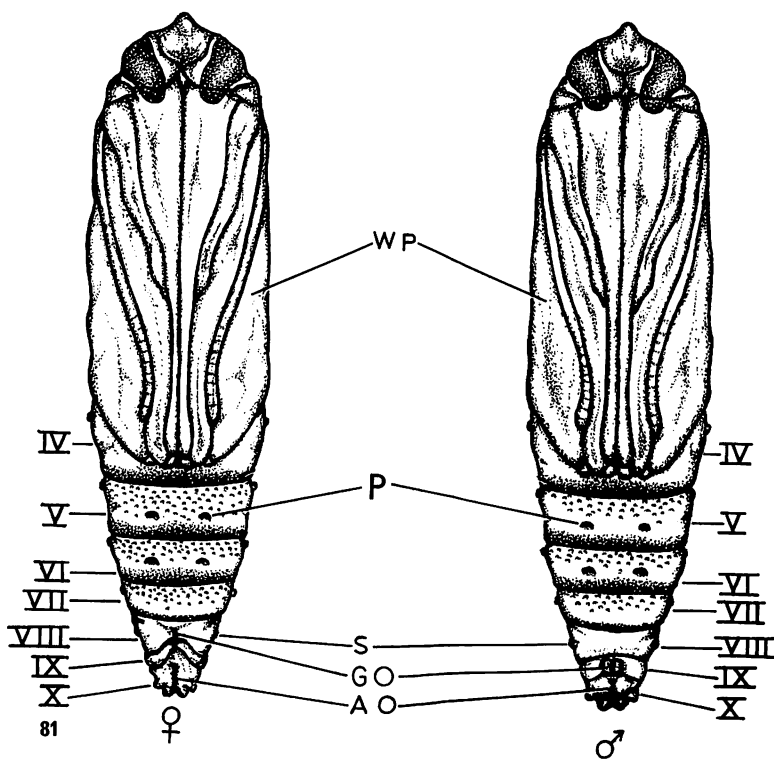


Figure 81—Female and male pupae of a moth (*Vogtia malloi* Pastrana, Phycitinae; not Hawaiian), in ventral aspect, to demonstrate sexual differences. Note that the genital opening of the female extends into both the eighth and ninth sterna, whereas on the male it is confined to the ninth sternum and has a rounded protuberance or pustulelike process on either side. (Modified from D. M. Maddox, 1969:1212, who kindly supplied a copy of his original figure.) AO, anal opening; GO, genital opening; P, proleg scars; S, the caudal spiracle on the eighth abdominal segment; WP, forewing pad or case. There is much variation in appearance of the caudal area of the pupae of various species. The reader should not expect to find any species he examines to have a similar appearance, but modifications of the general characters displayed here will be recognizable in most species. Compare figure 80.

*Abdominal Spiracles.*—Spiracles are always present on abdominal segments 1–8. The spiracles of the first segment are covered, so far as observed, by the wings, except in the superfamily Eucleoidea and the family Nepticulidae. The spiracles of the eighth segment are never functional and show no distinct opening. . . .

*Cremaster.*—The cremaster is a prolongation of the tenth segment and is not found in the more generalized pupae. It was homologized by C. V. Riley with the suranal plate of the larva. It is of various lengths and shapes and often bears setae at the distal end.

Jackson, at an early date, developed techniques of sexing pupae, and he observed the following characteristics of butterflies and larger moths (1890:167):

#### THE EXTERNAL ANATOMICAL CHARACTERS DISTINCTIVE OF SEX IN THE CHRYSALIS

1. The male chrysalis is characterized by a linear depression in the ninth sternal region.

The female chrysalis is characterized in one of the following ways:—

- (i) By two linear depressions, one in the eighth sternal region, the other in the ninth.
- (ii) By a longitudinal furrow crossing the posterior third of the eighth sternal region, and a similar complete furrow crossing the ninth.
- (iii) By a continuous longitudinal furrow crossing the eighth and ninth sternal regions.
- (iv) By a triangular forward extension of the sternal region of the ninth somite invading the sternal region of the eighth, together with *either* (a) a linear depression in the eighth sternal region and another at the apex of the triangular extension, or (b) a single depression close to or in the apex of the triangular extension and produced by a confluence of the two depressions before mentioned.

For additional details of general nature regarding pupae, see Chapman, 1900c:88–100, and Tutt's extensive discussions in the same book (pp. 38–88). For other discussions on the sexing of pupae, see Butt and Cantu, 1962, Solomon, 1962; and Maddox, 1969.

It is most regrettable that my plans for the preparation of a detailed, illustrated key to as many pupae of Hawaiian Lepidoptera as could be assembled have been frustrated by my being forced to discontinue work on this text when I was in the midst of my studies of the larvae and pupae. I can, therefore, present only a partial manuscript key upon which I had been working. This is a great loss, and it will handicap workers in the future. It would have been a worthy service to my readers had I been able to give here a key which would have enabled them to identify, at least to genus, almost any lepidopterous pupa which they might collect in Hawaii. Moreover, it would have been an especially valuable contribution had all of the pupae of the Lepidoptera of economic importance in Hawaii been well illustrated and incorporated in the key. The blame for these faults rests on others—not on the author whose plans and desires have been thwarted.

#### KEY TO THE PUPAE OF SOME HAWAIIAN MICROLEPIDOPTERA AND PYRALIDAE

- 1. Coxae of all three pairs of legs widely exposed;  
head with eyes concealed by huge antennal  
eyecaps, as in figure 104; very small pupae  
from larvae mining leaves of *Pelea* (but not  
pupating in the mines) . . . . . **Opostegidae.**  
Not so. . . . . 2

- 2(1). At least abdominal tergites 5 and 6 with spinose, dentiform processes or with distinct, multitudinous, small dentiform spines or transverse rows of denticles (most abdominal tergites may be armed) and always with more than a single pair of medial denticles. . . . . 3
- Abdominal tergites 5 and 6 lacking spinose processes, multitudinous spines or denticles (some other tergites may be spinose), at most with a single pair of medial denticles on tergites 4 to 7 in *Schreckensteinia*. . . . . 17
- 3(2). Some or all coxae visible. . . . . 3-A
- All coxae concealed. . . . . 13
- 3-A(3). Labial palpi rudimentary or absent [do not confuse the short maxillae (proboscis) with labial palpi]; maxillary palpi absent; pupae tightly enclosed in a boat-shaped cocoon of longitudinally ribbed white silk on leaves of *Gossypium* (cotton); figure 481-F. . . . .
- . . . . . **Bucculatrix thurberiella** Busck.
- Labial and maxillary palpi visible. . . . . 4
- 4(3). Coxae 2 and 3 or 1, 2, and 3 visible, and/or maxillary palpi very large and extending mesad from antenna between eye and leg 1 to or nearly to proboscis or nearly to labrum (maxillary and labial palpi large and conspicuous on most species); proboscis often shorter than labial palpi. . . . . **Tineidae.**
- Only the metacoxae visible; maxillary palpi usually small, lateral, and visible only between leg 1 and the antennae; proboscis always longer than labial palpi; Tortricidae. . . . . 5
- 5(4). Abdominal tergites 2 to 7 or 8 each with one or two subbasal foveae, as in figures 302-A, *e* and 327. . . . . 6
- Abdominal tergites without such pits. . . . . 7
- 6(5). Abdominal tergites 2 to 7 each with two subbasal pits, as on figure 302-A, *c-e*. . . . . **Panaphelix.**
- Abdominal tergites 2 to 8 each with a single medial subbasal pit, as on figure 327. . . . . **Amorbia.**
- 7(5). Cauda expanded as in figure 224; associated with *Rubus* (blackberry). . . . . **Croesia.**
- Not so. . . . . 8

- 8(7). Cauda lacking subtriangular denticles and usually obviously produced caudad, as in figures 232, 233, 272, 302-A. . . . .9  
 Cauda with subtriangular denticles, as in figures 346, 364, 376, 416, 417-A, 426, and/or not produced caudad as described above. . . .11
- 9(8). Pupa as in figure 272. . . . .**Epiphyas**.  
 Not so. . . . .10
- 10(9). As in figures 232, 233, *a-f*. . . . .**Spheterista**.  
 As in figures 233, *g-i*. . . . .**Pararrhaptica**.  
 As in figures 302-A, *a-b*. . . . .**Bradleyella**.
- 11(8). Antennae hidden at a point only slightly caudad of the mesocoxae; pupa as in figure 346. . . . .**Bactra**.  
 Not so, antennae extending to near apices of mesotarsi. . . . .12
- 12(11). [I have not had adequate material to enable a definitive key to be prepared for the several genera of Olethreutinae which belong here, and I have been unable to compare various characters in the genera.]  
 As in figure 346 (note that the proboscis does not reach the apices of the profemora). . . . .**Cryptophlebia**.  
 As in figure 426 (note that the proboscis reaches the mesocoxae and note the large number of denticles on the dorsum of the base of the cauda). . . . .**Episimus**.  
 As in figure 376. . . . .**Cydia**.  
 As in figure 416. . . . .**Crociosema**.  
 As in figure 417-A, *a-e*. . . . .**Eccoptocera**.  
 As in figure 417-A, *d-f*. . . . .**Strepsicrates**.  
 As in figure 417-A, *g-i*. . . . .**Epinotia**.
- 13(3). Pro-, meso- and metanota and most abdominal tergites conspicuously asperate and with a conspicuous, narrow, medial linelike crest running caudad to at least tergite 8; part of Pyralidae: Galleriinae. . . . .13-A  
 Not so. . . . .13-B
- 13-A(13). Metatarsi extending far beyond wings; cauda when viewed from directly behind appearing to be armed with four large, broad, lateral,



- subhorizontal, dentiform processes, the dorsal pair largest and contiguous or nearly so on the midline and directed caudolaterad and not dorsad, but the lower pair lateral and well-separated, and there are no midventral denticles; associated with bees.....**Galleria.**
- Metatarsi at most slightly exceeding apices of wings; cauda when viewed from directly behind seen to have four dorsal, denticulate processes, the upper pair of which are more mesad and not above the lower pair which are laterad; the upper pair is directed dorsad, and, in addition to these, there are about six ventral dentiform processes of which the midventral pair is largest (but these are smaller than the dorsal processes); associated with stored grains and nuts.....**Aphomia.**
- 13-B(13). Labial palpi concealed; parts of legs 1 and 2 extending cephalad between eyes and antennae.....14
- 14(13-B). Labial palpi conspicuously exposed.....15
- Very small pupae with "earlike," protuberant, mesothoracic spiracles, as in figure 498; legs not unusually long.....**Bedellia.**
- Moderate-sized pupae with unusually long legs; abdomen often armed with peculiar spinose processes.....**Pterophoridae.**
- 15(13-B). Maxillary palpi unusually large, extending mesad and impinging upon the proboscis; abdominal tergites with singularly large, heavy denticles and processes; associated with *Yucca* ..... **Prodoxinae.**
- Maxillary palpi concealed; abdominal tergites with multitudinous, small-to-minute denticles; not associated with *Yucca*; Gracilariidae.....16
- 16(15). Antennae not reaching apex of abdomen; head produced into an acute point between antennae (thorax and abdomen lacking processes or flangelike elevations such as those found on *Bedellia*); the most prominent denticles on abdominal tergites arranged in basal bands several denticles broad; commonly found in *Lantana* leaves; as in figure 430.....**Cremastobombycia.**

- Antennae extending much beyond apex of abdomen, often distally recurved over dorsum; head rounded between antennae; denticles of abdominal tergites all small, multitudinous, and extensively distributed; leaf miners in many plants but not in *Lantana* ..... **Philodoria.**
- 17(2). Two pairs of coxae conspicuously exposed caudad of the large, broad-tipped labial palpi; maxillary palpi very large and broad, and extending from the antennae to broad contact with the mandibles; as in figure 160-C; Tineidae: Dryadaulinae... **Choropleca.**  
Not so..... 17-A
- 17-A(17). Cauda with a conspicuous, mid-lateral, longitudinal sulcus with sclerotized margins on each side; Pyralidae..... **Crambinae.**  
Cauda lacking such lateral sulci..... 17-B
- 17-B(17-A). Labrum far anterodorsad of a line drawn between the ventrolateral margins of the eyes; Pyralidae..... **Pyraustinae.**  
Labrum near a line drawn between the ventral margins of the eyes..... 17-C
- 17-C(17-B). Labial palpi exposed..... 18  
Labial palpi concealed except for, at most, a small part at extreme base adjacent to labrum..... 26
- 18(17-B). Profemora concealed; figure 610; Scythrididae..... **Mapsidius.**  
Profemora slightly to extensively exposed..... 19
- 19(18). Abdominal tergites 4 to 7 each with a medial pair of denticles; figure 536; Schreckensteiniidae.. ..... **Schreckensteinia.**  
Abdominal tergites lacking such denticles..... 20
- 20(19). Ventrocaudal margin of cauda with either a medial process that bears a prominent cluster of hooked setae on either side or with two processes (one on either side of the medial line), each of which bears a cluster of hooked setae; very small pupae associated with grasses, sedges, or ferns; Momphinae... 20-A  
Not so..... 20-C

- 20-A(20). Antennae extending far beyond apex of abdomen, as in figure 708*a*; in stems of *Eragrostis* .....an undetermined *Chedra*-like species.  
Antennae reaching about to or very slightly beyond apex of abdomen, more as in figures 708*b-c* .....20-B
- 20-B(20-A). Mesothoracic spiracles with the exposed pilose parts broad and conspicuous, semicircular in outline and extending caudad over the mesonotum; antennae touching each other at extreme apices; cauda with a separated pair of ventrocaudal processes each of which bears a prominent cluster of about six hooked setae; associated with grasses and sedges...  
.....**Chedra.**
- Mesothoracic spiracles with the exposed pilose parts long and narrow and appearing attached to the pronotum; antennae entirely separated from each other for their entire lengths; cauda with a medial ventrocaudal process (evidently two processes fused) which bears on either side a prominent cluster of about six long, mostly hooked bristles which radiate laterad; associated with fern sporangia .....**Batrachedrodes.**
- 20-C(20). Maxillary palpi concealed .....21  
Maxillary palpi exposed .....23
- 21(20-C). Proboscis only moderately longer than labial palpi which are unusually large; cauda lacking hooked setae; abdominal tergites with numerous fine erect hairs strangely arranged in ellipses; pupa in a dense white silk cocoon; associated with *Melastoma* (Indian rhododendron); Nolidae. ....**Selca.**
- Proboscis more than three times as long as labial palpi; cauda with conspicuous hooked setae ..22
- 22(21). On foliage of crucifers, abundant in lowland and cultivated areas; wings not extending caudad of fifth abdominal segment; details as on figure 511; Yponomeutidae. ....**Plutella.**
- On *Pelea* (= *Platydesma*) and *Fagara* (= *Xanthoxylum*) in the native forests; wings extending to near or beyond apex of sixth abdominal segment; details as on figure 503; Yponomeutidae .....**Prays.**

- 23(20-C). Mesothoracic spiracles transverse, not tubular, not protuberant, not conspicuous; abdominal spiracles not strongly protuberant; Carposinidae . . . . . **Carposina**.  
 Mesothoracic spiracles tubular, protuberant; abdominal spiracles obviously protuberant . . . 24
- 24(23). Associated with *Nothoestrum* in the mountain forests; apex of abdomen drawn out into two thick caudal processes; figures 525–526; Yponomeutidae . . . . . endemic **Acrolepia**.  
 Cauda without such processes; usually on cultivated or introduced plants . . . . . 25
- 25(24). In onion (*Allium*) and related cultivated plants; cauda with more than 10 strong hooked setae, some dorsal, some ventral, and some directly caudad; wings extending onto 4th abdominal ventrite; figures 521–522; Yponomeutidae . . . . . **Acrolepia assectella** (Zeller).  
 On cruciferous plants, endemic and introduced; cauda with not more than 10 heavy, hooked setae and all directly caudad and all below the dorsal margin; wings extending onto 5th abdominal sternum; figure 511; Yponomeutidae . . . . . **Plutella**.
- 26(17-C). Profemora exposed . . . . . 27  
 Profemora concealed . . . . . 32
- 27(26). Maxillary palpi concealed . . . . . 28  
 Maxillary palpi exposed . . . . . 30
- 28(27). Antennae distinctly separated from each other throughout their lengths . . . . . **Alucitidae**.  
 Antennae closely approximated or touching each other at some point caudad . . . . . 29
- 29(28). Derm conspicuously microgranular overall; a small miner in *Lonicera* leaves; as in figure 632 of *Swezeyula* . . . . . **Cynodiidae**.  
 Not so (see the discussion under the species heading in the main text for additional details); Blastobasinae . . . . . **Blastobasis**.
- 30(27). Proboscis extending only a little farther caudad than apices of profemora; antennae extending not quite to wing apices and well separated throughout their lengths by the middle legs which extend to near the wing

- apices; abdominal tergites 1 to 7 inclusive each with a short, but elongated, medial, slightly elevated, more heavily sclerotized and pigmented process which, because of the arrangement of the pigmentation, resembles = = = = marks down the dorsum; associated with grains and dried food; part of Pyralidae: Galleriinae. . . . . **Corcyra.**
- Without such a combination of characters. . . . 30-A
- 30-A(30). Cauda armed with one or more slender-tipped, spinelike processes and derm of dorsum often extensively sculptured; see figure 649; Gelechiidae: Xyloryctinae. . . . . **Thyrocopa.**
- Cauda drawn out into a single, long, heavy, medial process; as in figures 1342, 1345, 1350. . . 31
- 31(30-A). Pupa as in figure 1345; Gelechiinae. . . **Autosticha.**
- Pupa as in figure 1350; Gelechiinae. . . . . **Stoeberhinus.**
- 32(26). Abdomen with an unusual pair of heavy ventrocaudal processes directed cephalad, as in figures 625, 643. . . . . 33
- Abdomen lacking such ventrocaudal processes; Gelechiidae. . . . . 34
- 33(32). Antennae reaching to about apex of abdomen; as in figure 625; on Palmae. . . **Agonoxenidae.**
- Antennae not passing 6th abdominal sternum; as in figure 643; on *Cordia*; Gelechiidae. . . . . **Ethmiinae.**
- 34(32). Abdominal tergites 1 to 4 with peculiar spinose areas as on figure 1267. . . . . 35
- Abdominal tergites without such spinose areas. . . . . 36
- 35(34). Abdominal tergites 5, 6, and 7 each with a medial, basal fossa, as in figure 1271; Gelechiinae. . . . . **Trichotaphe.**
- Abdominal tergites 5, 6, and 7 lacking such dorsal pits; Gelechiinae. . . . . **Dichomeris.**
- 36(34). Cauda with a large, conspicuous, ventral mat of setae and pupa as in figure 1275; Gelechiinae. . . . . **Crasimorpha.**
- Not so. . . . . 37

- 37(36). Antennae divergent at apices and exposing the apices of metatarsi, as in figures 1282, 1292, 1297, 1304.....38  
 Antennae contiguous to or nearly to apices and concealing metatarsi, as in figures 731, 744, 753, 804, 1337.....41
- 38(37). Derm densely pilose, as in figure 1304; in Malvaceae; Gelechiinae.....**Pectinophora**.  
 Derm not pilose, mostly smooth and bare, excepting for the usual setae.....39
- 39(38). Associated with seeds, cereals, grains, or feeding stuff; as in figure 1297; Gelechiinae...**Sitotroga**.  
 Not so; associated with solanaceous plants.....40
- 40(39). Pupa more than 5 mm. long; as in figure 1282; Gelechiinae.....**Phthorimaea**.  
 Pupa less than 5 mm. long; as in figure 1292; Gelechiinae.....**Keiferia**.
- 41(37). Antennae extending nearly to, to, or beyond apex of abdomen; as in figure 1337 (but see discussion in the text under *Aristoteliodes*); Gelechiinae.....**Aristoteliodes**.  
 Antennae not reaching apex of abdomen.....42
- 42(41). Pupal skin retained in the portable case of the larva, or, in *Trissodoris*, in a case made of an ovate section of *Pandanus* leaf.....43  
 Pupae not in such cases.....44
- 43(42). Pupa as in figure 731, in an ovate case made of a section of *Pandanus* leaf as in figure 727; Cosmopteriginae.....**Trissodoris**.  
 Case not made of a *Pandanus* leaf but built of silk into which is incorporated various materials; details of cauda more as in figure 805; Cosmopteriginae.....  
 .....**Hyposmocoma** sensu stricto.
- 44(42). Pupa as in figure 705; maxillary palpi evidently concealed; cauda rounded and lacking long hooked setae; associated with *Prosopis*; Chrysosopeleiinae.....**Ithome**.  
 Not so; maxillary palpi exposed; cauda always with long hooked setae.....45
- 45(44). Dorsal setae of abdominal segments 5 to 8 with hooked apices; pupa as in figure 744; Cosmopteriginae.....**Anatrachyntis**.

Dorsal setae of abdomen straight (excepting those on the cauda which are hooked); Cosmopteriginae .....46  
46(45). As in figure 753.....**Asymphorodes.**  
As in figures 804, 806.....  
.....**Hyposmocomma (Euperissus).**  
(The key differences between these genera remain to be determined. Although material available for study has been too limited to determine reliable differences, the genera appear to be generally similar.)

## SOME OBSERVATIONS ON THE CLASSIFICATION OF LEPIDOPTERA

In the first of my volumes on the Hawaiian Lepidoptera (1958a:32), I said:

Chaos reigns in the classification of the Lepidoptera, and it is difficult to find any two authors who accept the same arrangement of the families or recognize all of the same families. . . . The taxonomy of the Lepidoptera has suffered greatly because of much superficial work largely at the hands of dilettanti. More than any other order, Lepidoptera has attracted workers whose scientific foundations have not been broad enough to enable them to apply proper principles in their studies. Much poor work continues at the present time and really belongs in the realm of stamp-collecting or similar hobbies and wears false colors under the guise of science.

After several years' further study I am convinced even more that the taxonomy of the Lepidoptera is largely chaos. It is the most confused and unsatisfactory of any order of insects.

It is astonishing to see large works continuing to be published by recognized "authorities" who appear to lack a basic knowledge of a proper classification of the organisms about which they write. Why, for example, should one today publish a monograph in which members of the Monotrysia are placed in the Ditrysia? Should a coleopterist commit a similar error by including a member of the Adephaga in the Polyphaga, or a dipterist place a nematocerous fly in the Brachycera, or a hymenopterist include a sawfly in the Apocrita, each would stand condemned as an incompetent in the eyes of his colleagues. Yet, over and over one sees similar errors made by lepidopterists. Family names are used by authors who are unable to define the groups the names are supposed to represent. Family-group names are used without the users being able to tell us where and by whom such names were proposed. Supposedly new genera and species are described without their authors being sure to what families they should be assigned. One does not find coleopterists describing Oedermeridae and assigning them to the Cerambycidae, for example, but equivalent errors are made not infrequently by lepidopterists. The situation is astonishing.

The taxonomy of the Lepidoptera, particularly the Microlepidoptera, is an "inflated" one in which many groups are called "families" which more appropriately should be relegated to tribal or even subtribal status. It is illogical to consider that the Lepidoptera should have levels of taxonomic groupings which are not consistent, for example, with those of the Coleoptera, Diptera, and Hymenoptera. There are those lepidopterists who insist upon continuing to use family names for groups of moths, whose character differences surely are not of family significance, even after it has been demonstrated by careful study, including study of the immature stages, that they are not different families. This kind of "inflation" serves only to confuse and to weaken taxonomy and to obfuscate affinity and evolutionary sequence. An experienced coleopterist can recognize cryptorhynchid and barid weevils, and he can define the groups to which they belong. He would not think of calling them separate families, and thereby remove them from meaningful association within the family Curculionidae, simply because he can recognize them easily by constant characters. The ease or difficulty that one may experience in separating one group from another is not necessarily the criterion for their recognition. It



is fundamental morphological, physiological, and genetic distinctions which are important. Upon observing superficially that sphinx moths may possibly appear difficult to distinguish from hummingbirds—each has an extraordinarily rapid wingbeat, each is able to hover, each is able to fly backward, each is clothed in modified scales, each has a long beak or proboscis, and each feeds upon nectar—one still does not class them together, because there are fundamental characters of much greater importance which demonstrate the distinctiveness of the groups. Character differences must be properly evaluated before a workable and meaningful taxonomy can be developed. Some lepidopterists appear to believe that if they can demonstrate a character by which one of their favored groups can “usually” be separated from another, they are then justified in treating them as different *families*. This is, of course, absurd. A family is a major unit of taxonomy, and it should not be treated lightly or devalued. Kiriakoff (1948a: 139) was also strong in his criticism when he said:

More generally speaking, it is my opinion that there has been too much unnecessary splitting of families, especially in the *Lepidoptera*, mostly on insufficient ground, i.e. based on characters of little value, worth at most to be used for differentiation in intrafamilial categories such as subfamily, infrafamily, supertribe, tribe or even subtribe. As some authors have pointed out (vide for instance the excellent discussion in Simpson 1945), splitters generally use a minimum of taxonomic categories and prefer to create numerous units placed on the same hierarchic level. This results in a lack of uniform value of differentiating characters and consequently in bringing into existence of groups having an equal taxonomic status but a very unequal taxonomic value. Of course, an ideal arrangement is practically impossible, i.e. an arrangement in groups exactly equal as to their taxonomic value; but surely some balance could be achieved. So, if for instance a group within a family presents some obvious characters peculiar to it, most of the authors would at once make a new family of this group instead of creating, say, a subfamily including this particular group.

To illustrate the work done by splitters, let us take for instance the classification of Brues and Melander 1932, which is a relatively recent one: we find that these authors recognize not less than 145 Lepidopterous families. This is obviously an exaggeration, especially if compared with the 31 families of Handlirsch 1926. Handlirsch's classification may be too synthetic and many of his subfamilies are worth the familial rank; nevertheless, it seems to me that some 60 or 70 families would do. The family should be considered as one of the capital units in classification (as also should the genus) and not appropriated to be cut into pieces at the least provocation. There are intermediate categories in sufficient number to be used in the cases of minor differentiations.

The unsatisfactory state of the taxonomy of Lepidoptera is a consequence of several factors, including incompetent, poorly or narrowly trained workers, disinterest in problems above the species level, lack of skilled observation, lack of familiarity with other groups, lack of basic studies of comparative anatomy, the overwhelming mass of tens of thousands of species confused by a plethora of poor writing, and by the extraordinary, confusing organisms themselves.

Historically, lepidopterists have, in general, studied, described, and discussed only a few external parts of Lepidoptera. Many appear to have forgotten that there are important characters beneath the squamae of the head and thorax. How often does one see the structures of the descaled head, thorax, legs, or antennae of a moth described? (It should be noted here that I intended to have illustrations of such parts for as many genera as possible in the Hawaiian fauna, and a number of microscope preparations were made for this purpose. I was, however, not allowed the opportunity to complete this study or to prepare the planned illustrations. This I very much regret. I have seen many significant details in the dissections made.) Excluding wing venation (most of which was examined superficially and all too often erroneously) and, comparatively recently, the genitalia, most of the structure which lies beneath

the squamae of moths has been ignored by too many workers, and this has had disastrous results on the taxonomy. Competent workers realize that too much reliance has been placed on wing venation in the past, and that, unless this factor is used with caution gained through experience, it may often cause incorrect conclusions to be drawn. Until the *whole* organisms are studied adequately, it is impossible to develop meaningful classifications. One often wonders if many students of Lepidoptera realize how much lies beneath the pretty scale patterns and varied shapes of the insects they study. It is astonishing that year after year passes with little evidence that professors or institutions give students or specialists major assignments on any comprehensive work on the comparative morphology of the Lepidoptera with the purpose of developing a new and sensible taxonomy. Here and there we sometimes see a glimmer of hope when we learn of some study being made, contemplated, or published, but, with modest exceptions, little of fundamental or revolutionary importance appears to be forthcoming. We do, however, find enlightenment, stimulation, and encouragement from the monographs of such workers as Börner, Kristensen, Ehrlich, Hinton, Kiriakoff, MacKay, Michener, Sharplin, Shepard, Stekol'nikov, and others who have pointed the way for more basic studies of morphology and taxonomy. The classification of Lepidoptera has been and continues to be out of balance with most of the remainder of the classification of insects, and the sooner lepidopterists become aware of this fact, the better it will be for all.

There remains a highly significant fact, however, which frequently escapes the notice of the critics of lepidopterists; that is, that the bulk of the Lepidoptera are geologically a young group which continues today in an explosive state of evolution, diversification, and expansion. Much of the modern evolution appears random, opportunistic, and often confusing. Large numbers of "intermediate" forms persist to confuse the taxonomist. Tens of thousands of new species and probably thousands of unknown genera remain to be recorded. The number of highly competent, professionally trained workers employed to study this vast and confusing array is far too small adequately to cope with the multitude of problems involved. Because of their fragile nature and the fact that their sclerites and sutures are concealed beneath dense masses of squamae and hairs, Lepidoptera are often really difficult objects with which to work. The proper study of this order requires more time and effort in the careful preparation of specimens than is necessary for most other orders of insects, and this makes their study tedious, laborious, and time-consuming. These facts are frequently ignored or misunderstood by administrators and not infrequently by other entomologists who work on more easily studied material. As one who has had some experience with the study of various orders of insects, I am perhaps modestly qualified to say that Lepidoptera are an innately difficult group to study. I hasten to add, however, that a new approach to their study is required, and lepidopterists must begin to look at the whole animals, and (dare I say it?) perhaps to begin seriously to study whole specimens preserved fresh in fluid.

I can, of course, be criticized for not doing more detailed studies than I have for these texts and for not practicing more of what I have been preaching, but it is not the purpose or intent of *Insects of Hawaii* to prepare a new classifica-

tion of Lepidoptera. I am an "outsider" trying only to present a manual to assist workers toward a better understanding of the Hawaiian fauna and to assist them in identifying the known species. It is beyond the scope of my task to carry the work much farther. Yet I deplore the fact that I have not had the time, the opportunity, or the support required to enter more deeply into the study of the organisms upon which I have begun to work, and, if I may say so, forced to treat them far too superficially. No one can be more aware than I of the inadequacy of my own work on the Hawaiian Lepidoptera, but I am aware of the faults and wish to plead that other lepidopterists look with critical eyes upon the published work in their field and endeavor to set new standards and to take new approaches in future studies of the extraordinary organisms they study.

### THE CLASSIFICATION ADOPTED FOR THIS VOLUME

As implied in the foregoing discussion, no satisfactory classification of the Microlepidoptera exists. This situation renders the preparation of a work such as this exceedingly difficult. One must either adopt some published system, modify an existing scheme, or erect a new one. If one's experience demonstrates that all the published systems he has seen are unacceptable, then he must choose an alternate course, but when one attempts such a change one immediately is confronted by formidable obstacles. I have studied the major classifications proposed by many experienced entomologists, and I have found them all to be unsatisfactory. None of the systems proposed agree, as a comparison of the accompanying abstracts demonstrates (figures 83-90). Börner (1939) examined many characters generally overlooked or ignored by most workers, and he made a bold attempt to establish a revolutionary new classification. Börner, however, did not examine enough material, and he fell into many pitfalls. He did not realize that the various character differences he found in the limited number of species he studied were variable within allied groups of species. If one were to follow his system it would mean the separation into different families of allied groups of species. Börner's work is stimulating, but his conclusions and his proposed classification contain major faults. Although Börner's system cannot be accepted, his methods of approach to the major problems and much of what he had to say are worthy of close study.

Kiriakoff has made more recent attempts to establish a meaningful taxonomy, and his work is stimulating and worthy of serious consideration. In his study (1948a), *A Classification of the Lepidoptera and Related Groups with Some Remarks on Taxonomy*, he attempted a reclassification based upon his own new studies in the light of the work of Karsch, Börner, Handlirsch, Hinton, and others. This led him to propose a radical new arrangement for the higher categories within, and related to, the Lepidoptera which, as will be seen below, he considered a suborder of the Amphiesmenoptera.

Superordo PANORPAEFORMIA  
Ordo MECOPTERA  
Ordo AMPHIESMENOPTERA  
Subordo ZEUGLOPTERA  
Subordo TRICHOPTERA

## Subordo LEPIDOPTERA

Supercohors HOPLOSTOMATOPTERA (= Eriocraniids)

Supercohors APLOSTOMATOPTERA (= Hepialids)

Supercohors NANNOLEPIDOPTERA (= Nepticulids)

Supercohors EULEPIDOPTERA

Cohors STEMMATONCOPODA

Subcohors INCURVARIIFORMES

Subcohors TINEIFORMES

Subcohors GELECHIFORMES

Subcohors PYRALIDIFORMES

Cohors HARMONCOPODA

Subcohors PAPILIONIFORMES

Subcohors SPHINGIFORMES

Subcohors NOCTUIFORMES

This is an interesting approach to many difficult problems, and we should like to see Kiriakoff's work continued down to the family level after detailed study of many genera. The major divisions Stemmatoncopoda and Harmoncopoda were used in 1898 by Karsch in his then-advanced system which has not received the attention it deserves. These terms apply to the different structures of the larval prolegs, and Karsch demonstrated that there is a major difference between the usual "crown" or modified "crown" of crochets on the prolegs of the larvae of the Microlepidoptera and Pyralidae and the mesoserries of the Macrolepidoptera, including the butterflies (but excluding the Hesperiiidae which Karsch removed from the Rhopalocera and placed adjacent to the Thyrididae in the Stemmatoncopoda or microlepidopterous series).

Although the fauna of Hawaii lacks many families of Lepidoptera and is thus comparatively simple, I find it most difficult to propose a meaningful arrangement of the families in the light of the present state of our knowledge (or ignorance). We have to consider only the Opostegidae and Incurvariidae in the Monotrysia, and we can easily set these families aside. In the Ditrysia we have to treat the tineoids, tortricoids, gracillarioids, yponomeutoids, pterophoroids, alucitoids, and gelechioids. The pyraloids, geometroids, noctuoids, sphingoids, and the butterflies have already been discussed in Volumes 7 and 8.

One of the distinctive features of the gelechioids, a feature which sets them apart from the tineoids, tortricoids, yponomeutoids, pterophoroids, and alucitoids, is their densely squamose proboscides. Gelechioids share the squamose character of the proboscis only with the pyraloids. (I do not believe that the pterophorids and thyridids belong with the pyraloids with which they are placed in most classifications. Börner placed the pterophorids with the yponomeutoids, which he included in his Gelechioidea in his 1959 arrangement, and he placed the thyridids nearer the sphingids. Kiriakoff, 1948a: 140, said that "the *Pterophoridae* should be removed from the *Gelechioidea* and placed, together with the *Hesperiiidae* and the *Thyrididae*, in the superfamily Hesperioidea. . . .") If the nature of the vestiture of the proboscis has any important significance, then, in taxonomic arrangement, those Microlepidoptera whose proboscides

are "naked" (really minutely pilose) instead of imbricated squamose should be placed before the gelechioids and not separated by them. (There are said to be a few exceptions among non-Hawaiian Yponomeutidae which are supposed to have some squamae at the base of the proboscis. These reports are probably based upon errors of observation or other errors such as that committed by Forbes, 1923:35, who erroneously stated that the proboscis is squamose in the Tineidae.) In many classifications the tortricoids are placed in a more advanced position than the gelechioids and between them and the pyraloids, but this appears untenable. Various workers have emphasized the resemblances between the tortricids and the cossids. Ian Common places the tortricids adjacent to the cossids and before the tineoids in his 1970 scheme. It would appear, however, that the tineoids are less advanced than the tortricoids, and, in a linear arrangement, it appears better to place the tortricoids above the tineoids. Significantly, the tortricids have the facial scaling in agreement with the cossids and some tineids (the squamae on the lower part of the face are directed dorsad instead of ventrad as they are on the other groups, and this curious detail has been heretofore overlooked). Also, the wing venation, including the retention of the chorda in the forewings of many tortricids, and various features of the larvae are shared with the cossids (and some other groups). Many tortricid larvae which roll or tie leaves have the peculiar structure known as the anal fork as, strangely, have some leaf-tying Gelechiinae which are unrelated to tortricids, and I do not know of any other group which shares this unusual character. It is an interesting parallelism which may also be expected to be developed in groups with similar larval habits such as the Pyraustinae of the Pyralidae. Some tineoids have also preserved the chorda in the forewings, but the more primitive, long, folded, five-segmented, maxillary palpi of many of them are unlike anything found in the tortricoids. The tineoids greatly resemble the monotrysian incurvariids in many characters. I shall, therefore, place the tortricoids after the tineoids. The yponomeutoids cannot be far removed from the gelechioids, but where should we place the pterophorids, carposinids, and alucitids which have caused taxonomists so much difficulty? The carposinids were long placed in the Tortricoidea (where they do not belong) or associated with the gelechioids (where also they do not belong). The Alucitidae (= Orneodidae) have been placed in the Pyraloidea where they do not belong. The Pterophoridae have been considered to be derivatives of the pyralids, but that appears unlikely when all characters are considered. They have naked proboscides and lack tympana which typical pyralids have. As noted above, Kiriakoff places them near the Thyrididae. Here again we meet the difficulty of attempting to arrange the groups in a straight line where a "tree" would better serve our purpose. Arbitrary decisions must be made at least for convenience if definitive arrangements cannot now be attained.

I have decided upon the following tentative arrangement for the Hawaiian Microlepidoptera:

## MONOTRYZIA

## NEPTICULOIDEA

Opostegidae

## ADELOIDEA

Incurvariidae

## DITRYZIA

## TINEOIDEA

Tineidae

## TORTRICOIDEA

Tortricidae

## GRACILLARIOIDEA

Gracillariidae

Bucculatricidae

Lyonetiidae

## YPONOMEUTOIDEA

Yponomeutidae

Schreckensteiniidae

## PTEROPHOROIDEA

Pterophoridae

## ALUCITOIDEA

Carposinidae

Alucitidae

## GELECHIOIDEA

Scythrididae

Agonoxenidae

Cynodiidae

Gelechiidae (including Oecophorinae, Ethmiinae, Xyloryctinae, Blastobasinae, Chrysopeleiinae, Momphinae, Cosmopteriginae, and Gelechiinae).

## PYRALOIDEA

Pyralidae

I am not satisfied with various aspects of this arrangement. Hence, I refer to it as a "tentative" system. There are numerous questions which experienced workers can raise concerning it. To criticize it is easier than to reconstruct it, and simple, positive characterizations of the groups are exceedingly difficult to prepare.

The Gracillariidae and Lyonetiidae constitute major problems. Some workers place them both in the Tineoidea, as does Common in his recent 1970 work. These two families are, however, considerably more derived forms than are the true tineids, and I cannot see how they can logically be grouped closely within the Tineoidea unless the definition of that superfamily is con-

	ADULT					LARVA					PUPA																
	PROBOSCIS  CHAETOSEMATA  TYMPANA					PROTHORACIC L SETAE  2					ANAL FORK  ABDOMINAL SETAE  L1 AND L2					ABDOMINAL TERGITES MULTISPINOSE OR MULTIDENTICULATE  ONE OR MORE EXPOSED COXAE  ALL CONCEALED FULLY EXPOSED LABIAL PALPI  MOSTLY CONCEALED* EXPOSED CONCEALED PROFEMORA  ENTIRELY SEPARATED ON ABDOMEN CONTIGUOUS ON ABDOMEN  ANTENNAE  PILIFERS UNUSUALLY LARGE & SEPARATING LABRUM FROM LABIAL PALPI OR MAXILLAE  PILIFERS SMALL OR CONCEALED & LABRUM CONTIGUOUS TO LABIAL PALPI OR MAXILLAE											
SQUAMOSE <sup>1</sup>	"NAKED" <sup>1,2</sup>	PRESENT	ABSENT	PRESENT	ABSENT	PRESENT	ABSENT	REMOTE	ADJACENT	ABDOMINAL TERGITES MULTISPINOSE OR MULTIDENTICULATE	ONE OR MORE EXPOSED	COXAE	ALL CONCEALED	FULLY EXPOSED	MOSTLY CONCEALED*	EXPOSED	CONCEALED	PROFEMORA	ENTIRELY SEPARATED ON ABDOMEN	CONTIGUOUS ON ABDOMEN	PILIFERS UNUSUALLY LARGE & SEPARATING LABRUM FROM LABIAL PALPI OR MAXILLAE	PILIFERS SMALL OR CONCEALED & LABRUM CONTIGUOUS TO LABIAL PALPI OR MAXILLAE					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23					
TINEIDAE		x			x	x					x	x		x	x	x	x		x			x					
TORTRICIDAE		x	x			x	x			x		x		x		x	x		x			x					
GRACILLARIIDAE		x		x		x	x			x	x		x		x		x		x			x					
BUCCULATRIGIDAE		x		x		x	x			x	x		x		x		x		x			x					
LYONETIIDAE		x		x		x	x			x	x		x		x		x			x		x					
YPONOMEUTIDAE		x		x		x	x			x	x		x		x		x		x			x					
SCHRECKENSTEINIIDAE		x		x		x	x			x	x			x		x		x		x		x					
PTEROPHORIDAE		x		x		x	x			x	x		x		x		x		x		x						
CARPOSINIDAE		x		x			x			x	x		x		x		x		x			x					
ALUCITIDAE		x		x				x		x	x		x		x		x		x			x					
SCYTHRIDIDAE	x			x		x	x			x	x		x		x		x		x			x					
AGONOXENIDAE	x			x		x	x			x	x		x		x		x			x		x					
CYCNOTIIDAE	x			x		x	x			x	x		x		x		x			x		x					
GELECHIIDAE <sup>5</sup>	x			x		x	x		x <sup>4</sup>	x	x		x		x		x			x		x					
PYRALIDAE	x		x					x		x	x		x		x		x		x		x						

<sup>1</sup>Densely clothed basad with imbricated squamae.  
<sup>2</sup>Really minutely pilose, but usually called "naked".  
<sup>3</sup>Sometimes shortly exposed at extreme base only.  
<sup>4</sup>Only on some Gelechiinae.  
<sup>5</sup>Including Oecophorinae, Ethmiinae, Xyloryctinae, Blastobasinae, Momphinae, Chrysopeleiinae, Cosmopteriginae, Gelechiinae.

Figure 82—A tabular comparison of some characters of the adults, larvae, and pupae of the ditrysian families of Microlepidoptera and the Pyralidae of Hawaii. Many characters of the adults are too variable to be used with profit in such a simple tabulation. For example, ocelli may be absent, weak, or strong within one genus. Maxillary palpi may have one to four segments in the members of a single genus. Labial palpi may be small to very large within a genus. Wing venation often varies greatly within a family or even within a genus. There is great range of structure in the genitalia within some families, and various organs may be present or absent within single genera.

siderably enlarged. I am not satisfied that the Gracillariidae and Lyonetiidae should be placed, as I have listed them here, in the same superfamily. Fracker (1915), in his study of the larvae, placed the Lyonetiidae in the Tineoidea and the Gracillariidae in the Yponomeutidae, whereas Mosher, in her study of the pupae, placed them together in the Gracillarioidea. Some authors have become misled because they have wrongly placed tineids such as *Opogona* and the *Ereunetis*-like groups in the Lyonetiidae, thus making a confusingly compound group. I leave these tiny leaf miners, the Gracillariidae and Lyonetiidae, together in the Gracillarioidea as a matter of present convenience and as an expression of my ignorance of how better to account for them. The pupae of the Gracillariidae have spinose abdominal tergites, but the Lyonetiidae do not. The antennae of the gracillariid pupae, as on various tineids and yponomeutids, are entirely separated on the abdomen, but on the lyonetiid and the advanced gelechioid pupae the antennae are contiguous. The labial palpi on the gracillariid pupae are exposed, a more primitive arrangement than that found on the Lyonetiidae and the typical gelechioids where the labial palpi are concealed (the Scythrididae have exposed labial palpi, but that family is an aberrant one). In spite of these characteristics, some workers place the lyonetiids below the gracillariids in taxonomic series. The peculiar larvae of the gracillariids show them to be a highly modified group specialized for their leaf-mining habit.

The genus *Schreckensteinia* is variously placed in the Schreckensteiniidae, Heliodinidae, Epermeniidae, or Yponomeutidae. The larvae are distinctive, because they combine features of the Gelechioidea and Yponomeutidae. As in the Gelechioidea, the abdominal setae L1 and L2 are adjacent; this is a most unusual feature for a member of the Yponomeutoidea. The pupae, however, are similar to those of the yponomeutoids as are the peculiar silk network cocoons.

The Scythrididae are peculiar in various ways. The multiplication of the setae on various primary setal pinacula of the larvae is highly unusual in the Microlepidoptera, and larvae and pupae are more yponomeutoid than gelechioid. Confusingly, the proboscis of the adult is squamose, as it is in the typical gelechioids, so the family combines both gelechioid and yponomeutoid characters.

The division of the gelechioids has long been the subject of much difference of opinion. In some restricted faunas differences between various subgroups may appear to be clear, but when one studies other faunas one finds intermediate forms that blend one group with another. The characters usually used to separate the Oecophorinae from the Gelechiinae in Europe and America, for example, break down when subjected to close examination; and it is surprising that so many authors appear to cling with almost desperation to their desire to maintain these two closely allied groups as full families. The oecophorids and gelechiids simply are not separate families in the sense of families of other orders of insects. Perhaps it would be better to treat them as tribes. Various authors rightly have shown the close relationship between the Momphinae, Chrysopeleinae, and Cosmopteriginae, and it may be best to treat the latter two groups as tribes of the Momphinae (the family-group name



Momphinae is the oldest name in the cluster, and it must be used in the senior sense and not the name Cosmopteriginae, which is wrongly used by some authors). More remains to be said about these groups, and I prefer to treat them as subfamilies for the present.

After several years of trying to understand the evolution of the Lepidoptera and endeavoring to develop a logical taxonomy, I must admit frustration and defeat. I am not convinced that a definitive classification can be developed soon. Lepidoptera have been in a state of extraordinary "explosive" evolutionary flowering since the Cretaceous, and this dynamic surge of evolutionary potential appears to be proceeding without cessation. This means that there are vast numbers of living "intermediate" forms, and this creates extraordinary difficulties for taxonomists. The development of many structures is surprisingly variable in the Lepidoptera. There is, for example, possibly more variability in the development of the maxillary palpi within a single genus of moths than there is in tens of thousands of species of curculionid beetles.

One of the most unusual characteristics of the Lepidoptera is the astonishing development and variety of the genitalia and external sexual structures. One can only contemplate with wonder why there has been such an extraordinary concentration on sexual apparatus in the Lepidoptera. One may see more remarkable structural development in the genitalia of one group of small moths than can be found in the entire beetle family Carabidae, with its more than 25,000 species, or the Cerambycidae, which may contain as many species and whose genitalia are so simple and so similar that they are rarely examined by cerambycid taxonomists and are rarely used in classification.

If one attempts to base a classification of the Lepidoptera on wing venation, he may arrive at conclusions greatly different from a scheme based upon genitalia. A classification based upon larvae will result in yet another arrangement, and a classification based upon pupae will not agree with the others. The more one studies the Lepidoptera the more one becomes confused, frustrated, and mentally exhausted. It is exceedingly difficult now to see a logical order of evolution in the Lepidoptera, and the interpretation of this order and the development of a meaningful taxonomy will occupy systematists for generations to come.

Long after this book was submitted for publication Ian Common's excellent review entitled *Evolution and Classification of the Lepidoptera* was published (Common, 1975: 183–203). I regret that I did not have the assistance of that carefully prepared, helpful article when my text was being written. I recommend the Common survey to all serious students of Lepidoptera.

It will be of interest, as examples of variability of treatment, to trace two genera through the various systems to see how they have been classified by different authors.

First, let us examine the placement of the monotrysian *Opostega*:

Fracker: Aculeata, Nepticulidae  
 Forbes: Tineoidea, Opostegidae  
 Handlirsch: Tineidae, Oposteginae  
 Meyrick: Hyponomeutoidea, Lyonetiidae  
 McDunnough: Tineoidea, Opostegidae  
 Comstock: Microfrenatae, Opostegidae  
 Turner: Tineidae, Oposteginae  
 Costa Lima: Tineoidea, Opostegidae  
 Bourgogne: Monotrysia, Stigmellidoidea, Stigmellidae  
 Imms: Monotrysia, Stigmellidoidea, Opostegidae  
 Börner: Monotrysia, Nepticulidae  
 Obenberger: Nepticuloidea, Opostegidae  
 Common: Monotrysia, Nepticuloidea, Opostegidae

Next, let us examine the placement of the ditrysian *Scythris* (to which the Hawaiian *Mapsidius* is allied):

Fracker: Yponomeutidae, Scythridinae  
 Mosher: Gelechioidea, Scythrididae  
 Forbes: Yponomeutidae  
 Handlirsch: Tineidae, Hyponomeutinae, Scythridini  
 Meyrick: Hyponomeutoidea, Scythridae  
 McDunnough: Hyponomeutoidea, Scythridae  
 Comstock: Specialized Microfrenatae, Scythrididae  
 Turner: Elachistidae, Scythrinae  
 Costa Lima: Yponomeutoidea, Scythrididae  
 Bourgogne: Tineoidea, Scythrididae  
 Imms: Tineoidea, Scythridae  
 Börner: Gelechioidea, Scythrididae  
 Obenberger: Hyponomeutoidea, Scythrididae  
 Common: Gelechioidea, Scythridae

Mosher did not study the Opostegidae, and Fracker placed the family in the Nepticulidae. Fracker treated the scythridids as a subfamily of the Yponomeutidae, whereas they are considered a family of the Gelechioidea by Mosher. Fracker's arrangement is somewhat confusing, because he was inconsistent in his use of superfamily names. As can be seen from the arrangement, he treated the Gracillariidae, Tortricidae, Elachistidae, and Nolidae at superfamily level, but he did not use superfamily names for them as he did for other groups. Fracker's study of larvae led him to place the Lyonetiidae and Gracillariidae in different superfamilies, whereas Mosher's study of the pupae led her to place them within the same superfamily. These authors appear

to have allowed the then current classification of Dyar to over-rule some of their independently derived conclusions based upon their studies of the immature stages. Moreover, Heinrich and Busck, then active at the U.S. National Museum, may have strongly influenced them. Mosher said that she could find no reasons for dividing the Tortricidae into three families, but nevertheless she used three family names for them. No doubt the pioneering papers of Fracker and Mosher reflect in some parts the thinking of their professors and Heinrich and Busck. One must use their doctoral theses with caution, because some of their material was incorrectly identified, and they examined representatives of only a limited number of species. One can, therefore, be led astray by following their reports too closely. Their general approach to the difficult problems they attacked was advanced and commendable, and their monographs are excellent guides when one understands some of their faults. It has always surprised me that they did not stimulate much more advanced work on the immature stages of the Lepidoptera.

One cannot avoid being astonished by the varied opinions held by the various authors who have prepared classifications of the Lepidoptera as thus exemplified, and if one will examine in detail the outlines of the various systems proposed for the classifications which are given below one will become further bewildered. It should be noted that the various systems quoted here have all been proposed within about the last half century and when "modern" methods of investigation were available for use. Yet, none of the authors of these classifications has incorporated a comparative study of the genitalia and all have ignored large parts of the body areas of the moths. It is of particular interest to compare the larval system of Fracker, the pupal system of Mosher, the unusual system of Turner, the unacceptable system of Obenberger and the modern system of Common, a professional specialist on the Lepidoptera.

In the comparative tabulations assembled as figures 83 to 90, I have included only those groups which contain species known to Hawaii, and I have not given the total classifications of the various authors. Some authors did not include in their classifications some of the families now recognized in Hawaii. Hence, it is not possible to follow through all the systems the names of some families.

FRACKER, 1915 (Based upon larvae)	MOSHER, 1916 (Based upon pupae)
FRENATAE	TINEOIDEA
MICROLEPIDOPTERA	Tineidae
ACULEATA	Prodoxidae
Nepticulidae	TORTRICOIDEA
Prodoxidae	Olethreutidae
NON-ACULEATA	Tortricidae
TINEOID SERIES	Sparganothidae
TINEOIDEA	GRACILARIOIDEA
Tineidae	Bucculatricidae
Lyonetiidae	Lyonetiidae
YPONOMEUTOIDEA	Gracilariidae
Yponomeutidae	PYRALOIDEA
Gracillariidae	Pterophoridae
Tortricidae	Pyralidae
Elachistidae	PAPILIONOIDEA
GELECHIOIDEA	Lycaenidae
Ethmiidae	Pieridae
Gelechiidae	Nymphalidae
Oecophoridae	GELECHIOIDEA
Blastobasidae	Scythrididae
Cosmopterygidae	Gelechiidae
PYRALI-ZYGAENOID SERIES	Chrysopeleidae
PYRALOIDEA	Oecophoridae
Pyralidae	Cosmopterygidae
Orneodidae	Elachistidae
Pterophoridae	NOCTUOIDEA
Nolidae	Noctuidae
MACROHETEROCERA	Arctiidae
BOMBYCOIDEA	NOTODONTOIDEA
Geometridae	Geometridae
Noctuidae	SPHINGOIDEA
SPHINGOIDEA	Sphingidae
Sphingidae	
RHOPALOCERA	
LYCAENOIDEA	
Lycaenidae	
NYMPHALOIDEA	
Nymphalidae	
PAPILIONOIDEA	
Pieridae	

Figure 83—A comparison of two schemes of classification applied to the Hawaiian Lepidoptera according to the methods proposed by Fracker, 1915, who studied the larvae, and Mosher, 1916, who studied the pupae.

FORBES, 1923	HANDLIRSCH, 1924
FRENATAE	FRENATAE
INCURVARIOIDEA	TINEOIDEA
Incurvariidae	TINEIDAE
TINEOIDEA	TINEIDAE ACULEATAE
Tineidae	Prodoxinae
Lyonetiidae	Opoteginae
(including Bucculatrigidae)	ACANTHOPLEONA
Opotegidae	Tineinae
Gracillariidae	Tineini
CYCNODIOIDEA	Acrolepini
Cycnodiidae	Monopinae
GELECHIOIDEA	Gracillariinae
Oecophoridae	Bucculatrigini
Xyloryctidae	Oenophilini
Gelechiidae	Gracillariini
Blastobasidae	Hyponomeutinae
Lavernidae	Scythridini
YPONOMEUTOIDEA	Epermeniini
Yponomeutidae	Plutellinae
TORTRICOIDEA	Gelechiinae
Tortricidae	Gelechiini
Carposinidae	Oecophorini
PYRALOIDEA	Cosmopterygini
Pyralidae	Lyonetiini
Pterophoridae	Elachistinae
Orneodidae	Tineidae incertae sedis
GEOMETROIDEA	Xyloryctinae
Geometridae	Hypsmocomminae
SPHINGOIDEA	Chrysopeleiinae
Sphingidae	TORTRICIDAE
NOCTUOIDEA	Tortricinae
Noctuidae	? Carposininae
Nolidae	PYRALIDINA
RHOPALOCERA	PYRALIDIDAE
PAPILIONOIDEA	PTEROPHORIDAE
Pieridae	ORNEODIDAE
Lycaenidae	MACROFRENATAE
Nymphalidae	SPHINGIDAE
	NOCTUIDAE
	ARCTIIDAE
	GEOMETRIDAE
	PHOPALOCERA
	PAPILIONIDAE
	Pieridinae
	Lycaeninae
	Nymphalinae

Figure 84—A comparison of methods of classifying the Hawaiian Lepidoptera according to the systems of Forbes and Handlirsch.

TILLYARD, 1926	MEYRICK, 1928
HETERONEURA	Phylum 1: CARADRININA
HETEROCERA	Caradrinidae
TINEOIDEA	Plusiadae
Tineidae	Nolidae
(including <i>Bucculatrix</i> )	Phylum 2: NOTODONTINA
Plutellidae	Hydriomenidae
Gracilariidae	Selidosemidae
Hyponomeutidae	Sphingidae
Oecophoridae	Phylum 3: PAPILIONINA
Xyloryctidae	Nymphalidae
Gelechiidae	Lycaenidae
Elachistidae	Pieridae
Eucosmidae	Phylum 6: PYRALIDINA
Tortricidae	Phycitidae
Carposinidae	Galleriidae
PTEROPHOROIDEA	Crambidae
Pterophoridae	Pyraustidae
Orneodidae	Pyralidae
PYRALOIDEA	Pterophoridae
Pyraustidae	Phylum 9: TORTRICINA
Pyralidae	Tortricidae
Crambidae	Eucosmidae
Galleriidae	Phylum 10: TINEINA
Phycitidae	Tribe 1: GELECHIOIDEA
NOCTUOIDEA	Xyloryctidae
Noctuidae	Gelechiidae
Nolidae	Cosmopterygidae
NOTODONTOIDEA	Blastobasidae
Sphingidae	Oecophoridae
Boarmiidae	Tribe 2: COPROMORPHOIDEA
Larentiidae	Orneodidae
RHOPALOCERA	Carposinidae
PAPILIONOIDEA	Tribe 3: GLYPHIPTERYGOIDEA
Nymphalidae	Heliodinidae
Pieridae	Tribe 4: HYPONOMEUTOIDEA
Lycaenidae	Elachistidae
	Scythridae
	Hyponomeutidae
	Gracilariidae
	Plutellidae
	Lyonetiidae
	(including <i>Opostega</i> and <i>Bucculatrix</i> )
	Tineidae
	Lamproniidae

Figure 85—A comparison of possible methods of classifying the Hawaiian Lepidoptera according to the Tillyard and Meyrick systems.

McDUNNOUGH, 1938-39

## PAPILIONOIDEA

Pieridae  
 Danaidae  
 Nymphalidae  
 Lycaenidae

## SPHINGOIDEA

Sphingidae

## NOCTUOIDEA

Nolidae  
 Phalaenidae

## GEOMETROIDEA

Geometridae

## PYRALIDOIDEA

Pyralidae  
 Pterophoridae  
 Alucitidae

## TORTRICOIDEA

Olethreutidae  
 Tortricidae  
 Carposinidae

## GELECHIOIDEA

Cosmopterygidae  
 Gelechiidae  
 Oecophoridae  
 Blastobasidae  
 Ethmiidae

## YPONOMEUTOIDEA

Heliodinidae  
 Plutellidae  
 Yponomeutidae  
 Scythridae

## CYCNODIOIDEA

Elachistidae

## TINEOIDEA

Gracillariidae  
 Opostegidae  
 Lyonetiidae  
 (including *Bucculatrix*)  
 Tineidae

## INCURVARIOIDEA

Prodoxidae

COMSTOCK, 1940

## FRENATAE

## GENERALIZED FRENATAE

Incurvariidae

## SPECIALIZED FRENATAE

## SPECIALIZED MICROFRENATAE

Tineidae  
 Lyonetiidae  
 (including *Bucculatrix*)

Opostegidae  
 Gracillariidae  
 Elachistidae  
 Oecophoridae  
 Ethmiidae  
 Gelechiidae  
 Blastobasidae  
 Cosmopterygidae  
 Scythrididae  
 Yponomeutidae  
 Plutellidae

## TORTRICOIDEA

Olethreutidae  
 Tortricidae  
 Carposinidae

## PYRALIDOIDEA

Pyralidae  
 Pterophoridae  
 Orneodidae

## SPECIALIZED MACROFRENATAE

## FRENULUM-CONSERVERS

Sphingidae

## GEOMETROIDEA

Geometridae

## THE NOCTUIDS &amp; ALLIES

Noctuidae  
 Arctiidae

## FRENULUM-LOSERS

Pieridae  
 Nymphalidae  
 Lycaenidae

Figure 86—A comparison of methods of classifying the Hawaiian Lepidoptera according to the systems of McDunnough and Comstock.

TURNER, 1947	COSTA LIMA, 1945, 1949
HETERONEURA	FRENATAE
ASTHENOCHORDA	HETEROCERA
RHOPALOCERA	INCURVARIOIDEA
NYMPHALOIDEA	Prodoxidae
Nymphalidae	TINEOIDEA
Pieridae	Lyonetiidae (including <i>Bucculatrix</i> )
Lycaenidae	Oinophilidae
MICROPTILA	Opostegidae
Elachistidae	Tineidae
Scythrinae	ELACHISTOIDEA
Elachistinae	Elachistidae
Cosmopteryginae	GELECHIOIDEA
Gelechiidae	Agonoxenidae
Hyponomeutinae	Blastobasidae
Oecophorinae	Cryptophasidae
Blastobasinae	Ethmiidae
Gelechianae	Hyposmocomidae
Xyloryctinae	Lavernidae
Tortricidae	Oecophoridae
Eucosminae	YPONOMEUTOIDEA
Tortricinae	Acrolepiidae
Copromorphidae	Plutellidae
Carposinae	Scythrididae
Plutellidae	Yponomeutidae
Plutellinae	TORTRICOIDEA
Gracilariinae	Tortricidae
Tineidae	Grapholitidae
Adelinae	Carposinidae
Tineinae	PTEROPHOROIDEA
Lyonetianae	Pterophoridae
Oposteginae	Orneodidae
PTEROPHOROIDEA	PYRALOIDEA
Orneodidae	Pyraustidae
Pterophoridae	Pyralidae
PYRALOIDEA	Galleriidae
Phycitidae	Crambidae
Galleriidae	Phycitidae
Crambidae	SPHINGOIDEA
Pyralidae	Sphingidae
Pyraustidae	GEOMETROIDEA
STHENOCHORDA	Geometridae
NOCTUOIDEA	NOCTUOIDEA
Noctuidae	Noctuidae
Nolidae	Nolidae
SPHINGOIDEA	RHOPALOCERA
Sphingidae	NYMPHALOIDEA
GEOMETROIDEA	Danaidae
Boarmiidae	Lycaenidae
Larentiidae	Nymphalidae
	Pieridae

Figure 87—A comparison of the Turner and Costa Lima methods of classification as applied to the Hawaiian Lepidoptera. Turner's 1947 work contains innovations based upon studies of characters often overlooked, and it should be consulted by specialists in search of stimulating discussion.



BOURGOGNE, 1951	HENNIG, 1953
HETERONEURA	Order AMPHIESMENOPTERA
MONOTRYZIA	(Suborder TRICHOPTERA)
STIGMELLOIDEA	Suborder LEPIDOPTERA
Stigmellidae	TINEOIDEA
INCURVARIOIDEA	Prodoxidae
Incurvariidae	Agonoxenidae
DITRYZIA	Gelechiidae
TINEOIDEA	Plutellidae
Tineidae	Gracilariidae
Lyonetiidae (including	Hyponomeutidae
<i>Bucculatrix</i> )	Heliodinidae
Lithocolletidae	Oecophoridae
Hyponomeutidae	PTEROPHOROIDEA
Scythrididae	Orneodidae
Elachistidae	Pterophoridae
Heliodinidae	TORTRICOIDEA
Orneodidae	Carposinidae
Cryptophasidae	Tortricidae
Blastobasidae	PYRALOIDEA
Oecophoridae	Pyalidae
Momphidae	GEOMETROIDEA
Agonoxenidae	Geometridae
Gelechiidae	PHALAENOIDEA
TORTRICOIDEA	Arctiidae
Tortricidae	Noctuidae
Carposinidae	SPHINGOIDEA
PYRALIDOIDEA	Sphingidae
Pterophoridae	NYMPHALOIDEA
Pyalidae	Nymphalidae
GEOMETROIDEA	DANAIOIDEA
Geometridae	Danaidae
NOCTUOIDEA	PAPILIONOIDEA
Noctuidae	Pieridae
Arctiidae	
SPHINGOIDEA	
Sphingidae	
RHOPALOCERA	
PAPILIONOIDEA	
Pieridae	
Lycaenidae	
Nymphalidae	

Figure 88—A comparison of the Bourgogne and Hennig systems of classification as applied to the Hawaiian Lepidoptera. Note the extreme differences in these two systems. Note also the innovation of accepting Kiriakoff's Amphiesmenoptera in which the Trichoptera and Lepidoptera are combined in one order. Hennig ignored the significant difference between the Monotrysia and Ditrysia.

IMMS, 1957  
(Revised by Richards &  
Davies)

MONOTRYSIA  
STIGMELLOIDEA  
    Opostegidae  
INCURVARIOIDEA  
    Incurvariidae  
DITRYSIA  
TINAEOIDEA  
TINAEINA  
    Gelechiidae  
    Cosmopterygidae  
    Oecophoridae  
    Xyloryctidae  
    Yponomeutidae  
    Elachistidae  
    Scythridae  
    Gracillariidae  
    Plutellidae  
    Tinaeidae  
    Orneodidae  
TORTRICOIDEA  
    Eucosmidae  
    Tortricidae  
    Carposinidae  
PYRALIDOIDEA  
PYRALIDINA  
    Galleriidae  
    Crambidae  
    Phycitidae  
    Pyralidae  
    Pyraustidae  
    Pterophoridae  
PAPILIONOIDEA  
    Nymphalidae  
    Lycaenidae  
    Pieridae  
GEOMETROIDEA  
    Geometridae  
SPHINGOIDEA  
    Sphingidae  
NOCTUOIDEA  
    Arctiidae  
    Noctuidae

BÖRNER, 1959

MONOTRYSIA  
    Nepticulidae  
    Incurvariidae  
DITRYSIA  
HETEROCERA  
TINEOIDEA  
    Tineidae  
    Gracillariidae  
    Tortricidae  
GELECHIOIDEA  
    Hyponomeutidae  
    Epermeniidae  
    Orneodidae  
    Pterophoridae  
    Gelechiidae  
    Scythrididae  
PYRALOIDEA  
    Pyralidae  
    Geometridae  
NOCTUOIDEA  
    Noctuidae  
BOMBYCOIDEA  
    Arctiidae  
    Sphingidae  
RHOPALOCERA  
    Pieridae  
    Nymphalidae  
    Lycaenidae

Figure 89—A comparison of the Imms and Börner systems when used to classify the Hawaiian Lepidoptera.

OBERBERGER, 1964	COMMON, 1970
HETERONEURA	MONOTRYSLA
HETEROCERA	NEPTICULOIDEA
INCURVARIOIDEA	Opotegidae
Prodoxidae	INCURVARIOIDEA
NEPTICULOIDEA	Prodoxidae
Opotegidae	DITRYSLA
Pyraultidae	TORTRICOIDEA
Pyrallidae	Tortricidae
Galleriidae	TINEOIDEA
Phycitidae	Tineidae
SPHINGOIDEA	Lyonetiidae (including
Sphingidae	<i>Bucculatrix</i> )
TINEOIDEA	Gracillariidae
Oenophilidae	YPONOMEUTOIDEA
Tineidae	Heliodinidae
Lyonetiidae	Yponomeutidae
Plutellidae	GELECHIOIDEA
Cosmopterygidae	Agonoxenidae
Gracillariidae (including	Elachistidae
Bucculatrigenae)	Scythridae
Hypomocomididae	Oecophoridae
PTEROPHOROIDEA	Ethmiidae
Pterophoridae	Cosmopterigidae
Orneodidae	Blastobasidae
TORTRICOIDEA	Xyloryctidae
Carposinidae	Gelechiidae
Olethreutidae	COPROMORPHOIDEA
Tortricidae	Alucitidae
HYPONOMEUTOIDEA	Carposinidae
Acrolepiidae	PYRALOIDEA
Xyloryctidae	Pyrallidae
Scythrididae	PTEROPHOROIDEA
GELECHIOIDEA	Pterophoridae
Blastobasidae	PAPILIONOIDEA
Agonoxenidae	Pieridae
Gelechiidae	Nymphalidae
Ethmiidae	Lycaenidae
Oecophoridae	GEOMETROIDEA
Epermeniidae	Geometridae
Elachistidae	SPHINGOIDEA
NOCTUOIDEA	Sphingidae
Plusiidae	NOCTUOIDEA
Noctuidae	Nolidae
Nolidae	Noctuidae
GEOMETROIDEA	
Boarmiidae	
Larentiidae	
RHOPALOCERA	
PAPILIONOIDEA	
Pieridae	
Danaididae	
Nymphalidae	
Lycaenidae	

Figure 90—A comparison of the Obenberger and Common methods of classification as applied to the Hawaiian Lepidoptera. The Common system is the most logical of the systems thus far proposed. The Obenberger system contains many faults and is best ignored.

## KEY TO THE MAJOR GROUPS OF HETEROCERA IN HAWAII

The Rhopalocera, or butterflies, have already been treated in Volume 7. After further study, I believe that the Pterophoridae and Alucitidae do not belong to the Pyraloidea. These groups have already been discussed in Volume 8, but a revised section on the Alucitidae is included here. The Pterophoridae and Alucitidae have "naked" proboscides, and the larvae I have studied have three setae in the prespiracular L group on the prothorax (but some larvae of Pterophoridae are said to have only two prespiracular L setae). The true pyralids have squamose proboscides and only two prothoracic L setae. A representative of the family Nolidae (a family not previously known in Hawaii) has been purposely introduced to Hawaii since Volume 7 was published, and details concerning it will be included in a proposed supplement to the Lepidoptera volumes of this series.

1. Wings divided longitudinally into lobes or plumes;  
see the key to the Microlepidoptera . . . . .  
. . . . . **Pterophoridae** and **Alucitidae**.  
Wings entire . . . . . 2
- 2(1). Hindwings with vein 8 usually closely parallel or partly  
fused with anterior (radial) margin of cell and fused  
for a greater or lesser distance with vein 7 beyond  
apex of cell (closely approximated to vein 7 beyond  
cell but not actually fused with it only in Pyralinae  
in Hawaii); hindwings with all three branches of  
vein 1 usually well-developed; tympanal organs in  
base of abdomen; proboscis squamose . . . . .  
. . . . . **Pyralidae**, see Volume 8.  
Hindwings with vein 8 either free from the cell or arising  
from it before its apex, usually arising from near  
base of cell, and never fused for a distance with vein  
7 beyond the cell apex; hindwings with one to three  
branches of vein 1 developed; abdomen with or  
without tympana; proboscis "naked" (pilose) or  
squamose . . . . . 3
- 3(2). Hindwings with one to three branches of vein 1  
developed, but if fewer than three branches are  
present, at least near wing margin, then always  
small or very small species with narrow hindwings  
whose fringes are at least one-half as long as the  
breadth of the hindwing; venation often reduced;  
tympana absent; proboscis "naked" or squamose  
. . . . . **Microlepidoptera**, see following key.

- Hindwings with at most only two branches of vein 1 developed; hindwings always broad, usually broader than forewings and with fringes much less than one-half as long as the breadth of the hindwing; tympana in metathorax or base of abdomen or absent (in the Sphingidae which are very large species); proboscis "naked" .....4
- 4(3). Tympana absent; hindwings with vein 8 separated from anterior margin of cell and subparallel to it from near base to beyond cell apex and with a crossvein connecting vein 8 to anterior margin of cell near or before its middle; very large, heavy-bodied species with comparatively long, narrow forewings.....**Sphingidae**, see Volume 7.
- Tympana present either in the caudal part of the metathorax or in base of abdomen; vein 8 in hindwing either touching or fused with anterior margin of cell at a point before middle of cell, but strongly diverging from that point and without a crossvein between vein 8 and cell .....5
- 5(4). Tympana in base of abdomen; forewing with vein 5 arising from cell near its middle or nearer to the origin of vein 6 than to 4; hindwing with vein 8 free of anterior margin of cell at extreme base and then fusing with anterior margin of cell or very closely approximated to the margin for a short distance before middle and then free to apex.....
- .....**Geometridae**, see Volume 7.
- Tympana in caudal part of metathorax; forewing with vein 5 arising from cell nearer base of vein 4 than to 6; hindwing with vein 8 fused with anterior margin of cell at extreme base and for a variable distance beyond, then free to apex.....6
- 6(5). Vein 8 in hindwing fused with anterior margin of cell only near base; forewing with all 12 veins and hindwing with all eight veins developed.....
- .....**Noctuidae**, see Volume 7.
- Vein 8 in hindwing fused with anterior margin of cell for about one-half its length; forewing with only 11 veins and hindwing with only seven veins in our species; labial palpi large, beaklike, not upturned .....**Nolidae**.

For a key to the families of Microlepidoptera of the world, see Durrant, in Hampson, 1918*b*:388.

## KEY TO THE FAMILIES OF MICROLEPIDOPTERA IN HAWAII

(Adapted for use on the Hawaiian fauna only.)

1. Wings each longitudinally cleft into lobes or plumes .....2  
     Wings entire.....3
- 2(1). Forewings divided into two lobes and hindwings  
         with three lobes . . . . **Pterophoridae**, see Volume 8.  
     Fore- and hindwings each deeply cleft into six  
         slender plumes, as in figure 604 . . . . . **Alucitidae**.
- 3(1). First antennal segment greatly expanded, concave  
         beneath, and highly modified to form a huge  
         eye-cap which covers, or nearly covers, the entire  
         eye, as in figure 91 of *Opostega*, or not so expanded  
         but with an unusually large pecten of squamae  
         and hairs which covers part of the eye, as in  
         figures 481-A of *Bucculatrix* and 482 of *Bedellia*;  
         **Monotrysia** and part of **Ditrysia** . . . . .4  
     First antennal segment not more than moderately  
         expanded and with pecten usually consisting of  
         a few hairs, long squamae or setae, or absent,  
         but if pecten is well-developed (as in *Bucculatrix*,  
         *Bedellia* and *Swezeyula*), then only partly con-  
         cealing the eye and first antennal segment never  
         much expanded beneath the vestiture; **Ditrysia**  
         . . . . .6
- 4(3). First antennal segment greatly expanded, the  
         sclerite itself almost semi-cup-shaped, most  
         unusual, and forming a huge eye-cap (this  
         character of the sclerite itself to be seen from  
         beneath the raised antenna or by abrading the  
         vestiture; do not mistake the large pectens of  
         *Bucculatrix*, *Bedellia* or *Swezeyula* for this struc-  
         ture); wing venation greatly reduced, cells  
         absent, as in figure 91; frenulum a row of many  
         bristles; females with only one sex opening;  
         minute leaf miners on *Pelea*; **Monotrysia** . . . . .  
         . . . . . **Opostegidae**.  
     First antennal segment not greatly expanded  
         beneath the vestiture, but with a large, dense  
         pecten of hairs and squamae (one may have to  
         abrade the scales to see the true character of the  
         narrow antennal segment); wing venation more

- complete, as in figures 482, 628; frenulum with not more than three setae; female with two sex openings (three families are entered at this point in the key for convenience only, because the large antennal pectens of *Bucculatrix*, *Bedellia* and *Swezeyula* might be confused with the eye-caps of *Opostega* by a person unfamiliar with the structure of the moths; they are not allied to the Opostegidae); **Ditrysia**, in part . . . . . 5
- 5(4). Labial palpi greatly reduced, inconspicuous, pendant, not extending beyond the apex of the long, pointed face which extends distinctly below the level of the lower margins of the eyes, as in figure 481—A of *Bucculatrix* . . . **Bucculatrigenidae**.  
Labial palpi well-developed and extending conspicuously beyond the apically rounded or truncated face which is not produced below the ventral ocular margins . . . . . 5a
- 5a(5). Proboscis not squamose basad; wings very narrow, venation greatly reduced, as in figure 482; frenulum of female trisetose; *Bedellia* of the . . . . . **Lyonetiidae**.  
Proboscis squamose basad; wings not unusually narrow, forewing with 11 veins and hindwing with seven veins in the species in Hawaii, as in figure 628; frenulum of female bisetose; *Swezeyula* of the . . . . . **Cynodiidae**.
- 6(3). Proboscis absent . . . . . 7  
Proboscis present . . . . . 8
- 7(6). Labial palpi with some long, stiff, projecting bristles which are differentiated from the main squamose vestiture (examine both palpi, because the setae appear to be lost on some specimens); details as in figures 201, 205 of *Lindera* and *Setomorpha* . . . . . part of **Tineidae**.  
Labial palpi without any erect, stiff, specialized setae protruding from the scaling; wing venation and other details as in figure 1260 of *Oecia* . . . . . part of **Gelechiidae**.
- 8(6). Proboscis "naked" (minutely pilose but not squamose) . . . . . 9  
Proboscis clothed basad with imbricated squamae . . . . . 17

- 9(8). Head with chaetosemata (see figure 8 for drawing of a chaetosema); depressed squamae on lower part of face directed dorsad or dorsad and mesad; (ocelli present in all known species in Hawaii except in *Amorbia*; hindwings as broad or broader than forewings; vein 7, when present, runs to termen, not to costa).....**Tortricidae.**  
 Head lacking chaetosemata; squamae on lower part of face directed ventrad toward proboscis; other characters mentioned in parentheses above variable.....10
- 10(9). Wings with venation as in figures 537–538 of *Carposina*, and vein 7 in forewing runs to termen, not to costa; hindwings broader than forewings and with only six veins (only four veins arise from cell, as in figure 537) and with “pectens” of long hair on posterior basal margin of cell and on anal area; labial palpi porrect, sexually dimorphic and longer in the female than in the male (figure 537); antennae of male with conspicuous, very long hair beneath; many, but not all, species with conspicuous patches of raised squamae on forewings.....**Carposinidae.**  
 Without such a combination of characters.....11
- 11(10). Labial palpi with some long, stiff, projecting setae which are differentiated from the main prostrate squamae clothing the palpi (figures 113, 117, for example).....**Tineidae.**  
 Labial palpi without such erect, specialized, stiff bristles.....12
- 12(11). First antennal segment with a large, conspicuous mass or pecten of squamae and hairs which partly conceals the eye, as in figures 481–A (*Bucculatrix*) and 482 (*Bedellia*).....12a  
 First antennal segment without such a mass of squamae and hairs, at most with a pecten of only a few stiff bristles.....13
- 12a(12). Face pointed and produced distinctly below ventral margins of eyes; labial palpi greatly reduced, mostly hidden beneath sides of face and not extending beyond apex of face; metatibia conspicuously clothed with much long hair and that on upper surface extending



- conspicuously far beyond apex of tibia (some of the dorsal hairs reaching or exceeding the apex of the first metatarsal segment) . . . . .
- . . . . . **Bucculatrigenidae.**
- Face not extending below ventral margins of eyes, its apex broadly subtruncate; labial palpi conspicuously exposed beyond apex of face; metatibia not clothed with long hair . . . . . **Lyonetiidae.**
- 13(12). Metatibia with conspicuous, slanting erect, stiff, dorsal bristles and with a distinct whorl of stiff bristles at apex, as in figure 530; wings of unusual shape, as in figure 528; a leaf skeletonizer on *Rubus* . . . . . **Schreckensteiniidae.**
- Metatibia not so armed; wings different . . . . . 14
- 14(13). Antennae unusually long, as long or longer than forewings; wing venation as in figures 427, 432; small or very small leaf miners, many with submetallic colors, and forewings with beautiful color patterns . . . . . **Gracillariidae.**
- Antennae shorter than forewings . . . . . 15
- 15(14). Wings very narrow; hindwings with greatly reduced venation and cell not developed, as in figure 427 of *Cremastobombycia*; a very small leaf miner on *Lantana*, etc. . . . . part of **Gracillariidae.**
- Wings comparatively broad or broad; hindwings with seven or eight veins; cells well-developed in both pairs of wings . . . . . 16
- 16(15). Head clothed with "rough" erect or suberect hair and without squamae; maxillary palpi very long and folded (female with a peculiar, long tentacle from the first segment); wing membrane with very numerous, distinct aculeae (minute spinose processes of the derm and usually easily seen between the squamae on the hindwings, especially in the males which have a peculiar "loose" kind of scaling); neither pair of wings with any veins from the cells forked; ovipositor heavily sclerotized, serrated, and modified for piercing plant tissues; yucca moths . . . . .
- . . . . . **Incurvariidae.**
- Head mostly squamose; maxillary palpi reduced; wing membrane lacking aculeae; at least hindwings with a forked vein from cell . . . . .
- . . . . . **Yponomeutidae.**

- 17(8). Face strongly retreating ventrocaudad, subhorizontal; antennae appearing to be inserted in front of eyes (and held stretched out in front of head when at rest); distal segment of labial palpus compressed, very thin, rather bladelike, concave externally; wing venation as in figure 621; forewings with veins 2, 3, and 4 arising from posterior margin of cell instead of 3 and 4 arising from apex of cell; hindwing with anterior margin of cell submedial; female frenulum with only two setae; one small, yellow, leaf eater on palms  
 ..... **Agonoxenidae.**  
 Not so.....18
- 18(17). Anterior margin of cell in hindwing submedial; frenulum of female with only two setae; labial palpi drooping or porrect; a small leaf miner in *Lonicera*; as in figures 628–629. .... **Cynodiidae.**  
 Not so; labial palpi usually strongly curved dorsad.....19
- 19(18). Forewing with vein 11 short, only about as long or shorter than vein 10 and arising distad of middle of wing, venation as in figures 608–609; frenulum of female with only two setae.....  
 ..... **Scythrididae.**  
 Forewing with vein 11 normally long, usually arising distinctly basad of middle of wing and usually obviously longer than vein 10; frenulum of female with three setae..... **Gelechiidae.**

### A SUMMARY OF SOME CHARACTERS WHICH MAY BE OF FURTHER ASSISTANCE FOR THE DETERMINATION OF SMALL HAWAIIAN MOTHS

1. If the proboscis is absent, see some of the Pyralidae (Galleriinae), *Acrapex* in the Noctuidae, some of the Tineidae, and *Oecia* in the Gelechiinae.
2. If the proboscis is densely clothed basad with imbricated squamae, see the Pyralidae, Scythrididae, Agonoxenidae, Cynodiidae, and Gelechiidae.
3. If there are tympanal organs in the base of the abdomen, see the Geometridae if the proboscis is "naked" and the Pyralidae if the proboscis is squamose.
4. If there are tympanal organs in the caudal part of the metathorax, see the Noctuidae and Nolidae.
5. If the head bears chaetosemata and the base of the abdomen lacks tympana, see the Tortricidae. If chaetosemata are present and there are tympanal organs in the base of the abdomen, see some Pyralidae if the proboscis is squamose and the Geometridae if the proboscis is "naked".

6. If the labial palpi are rather drooping, see some Yponomeutidae and Cynodiidae, and if very small and mostly hidden beneath the sides of a sharply pointed, prolonged face, see the Bucculatricidae.

7. If the antennae have an abundance of very long, rather shaggy hair beneath, see male Carposinidae.

8. If the antennae have long pectinations, see the Geometridae, Noctuidae, Nolidae, and Tortricidae.

9. If the squamae on the lower part of the face above the base of the proboscis are directed dorsad or dorsomesad, see the Tortricidae if chaetosemata are present and some Tineidae if chaetosemata are absent.

10. If the moth is very small (usually with striking color pattern), has a smooth head, and the antennae are as long or longer than the forewings, see the Gracillariidae.

11. If the head, including the front, is clothed with rough masses of erect hair and slender squamae, see the Incurvariidae, Tineidae, *Acrapex* in the Noctuidae, and the Nolidae.

12. If the labial palpi have some long, stiff, erect bristles projecting from the squamae, see the Tineidae.

13. If the termen of the hindwing is concave, see the Gelechiinae.

14. If the forewings have clusters of raised squamae, see the Carposinidae, Tortricidae, *Stictoptera* (large species) in the Noctuidae, and the Nolidae if the proboscis is "naked," or the Cosmopteriginae of the Gelechiidae if the proboscis is squamose.

15. If the first antennal segment is widely expanded or bears a large mass of squamae and hairs which partly or largely conceals the eyes, see the Opostegidae, Bucculatricidae, Lyonetiidae, and Cynodiidae.

16. If the moth is very small and has long antennae and the mesotibiae are evidently swollen or more thickened than the other tibiae, see *Caloptilia* of the Gracillariidae.

17. If the metatibia has a conspicuous apical whorl of long, stiff, slanting-erect bristles, see the Schreckensteiniidae.

18. If the head has a distinct "browridge" between the antennae, see *Opogona* of the Tineidae.

19. If the head has the face strongly receding and subhorizontal and the moth is a small, slender species found on palm leaves with its antennae extended out in front of its head, see the Agonoxenidae.

20. If the labial palpi are porrect and longer in the female than in the male, and the male antennae are clothed with long hair, see the Carposinidae.

21. A tiny moth which spins, gyrates and "dances" rapidly on the surface on which it lands will probably be the "dancing moth", *Choropleca terpsichorella* (Busck), in the Tineidae. It is common in the lowlands and is frequently attracted to lights.

22. A very small moth commonly attracted to lights and, when at rest, appears brown with a broad white vitta down its back and which rests with its antennae stretched straight out in front of its head is *Asymphorodes dimorpha* (Busck) in the Cosmopteriginae (compare 37).

23. A moth which is very commonly attracted to light and which has extraordinarily long labial palpi which curve up over the back and end in a tuft of hair will probably be male *Stoeberhinus testaceus* Butler in the Gelechiinae.

24. If the tips of the closed forewings are conspicuously turned outward or recurved and appear almost as "earlike" caudal lobes, see the Erechthiinae of the Tineidae.

25. If the moth (very small species) appears to "sit on its tail" with the cephalic end raised conspicuously at an angle from the substratum, see the Gracillariidae.

26. A small, narrow-winged moth found on blackberry flowers or leaves and which holds its hind legs obliquely elevated when at rest will be *Schreckensteinia*.

27. If the moth is very small, slender, and appears to have a speckled pepper-and-salt pattern on the forewings and a heavy pecten on the basal antennal segment, see *Bedellia* in the Lyonetiidae.

28. Very small, slender, straw-colored moths which have only about three small, dark, dotlike maculae on the forewings belong to *Chedra* in the Momphinae.

29. A medium-sized moth usually found on *Cordia* which has a very striking color pattern—pinkish grey forewings marked with numerous black spots and yellow hindwings with black tips—is *Ethmia*.

30. A minute, white or nearly white moth found on *Pelea* leaves will probably belong to *Opostega*.

31. A medium-sized, mostly white moth found on yucca flowers will probably belong to *Tegeticula*.

32. A moth that appears bell-shaped when at rest will probably belong to the Tortricidae.

33. If the abdominal tergites of the moth are armed with bands or rows of numerous spinules (usually to be seen after abrasion of the squamae and often appearing golden in color), see the Xyloryctinae, Oecophorinae, and Blastobasinae if the bands of spines are arranged transversely and the Momphinae if they are arranged longitudinally.

34. If the wings of the moth are split into lobes: see the Alucitidae if there are six plumes in both pairs of wings; see the Pterophoridae if there are only two lobes in the forewings and three in the hindwings, and the moth has very long legs.

35. Dull-colored moths found in houses or on woolens, furs, and feathers and whose heads bristle with "rough" erect hair will probably belong to *Tinea* or *Tineola* in the Tineinae.

36. A rough-headed moth with creamy-white forewings and with a large, conspicuous, dark-brown, basal area, and found on fur, will probably belong to *Trichophaga* in the Tineinae.

37. A small moth which at rest extends its antennae out in front of the head, which displays on the closed forewings a common pale medial vitta bordered on either side by a dark vitta, and which is found on cabbage and related plants will probably belong to *Plutella*.

38. Moths found associated with stored grain, flour, cereals, and feeding stuff will probably belong to *Ephestia*, *Plodia*, and *Anagasta* of the Phycitinae (Pyralidae), or to *Euchromius* in the Crambinae (Pyralidae), or to *Sitotroga* (basal antennal segment with a pecten) in the Gelechiinae, or to *Nemapogon* in the Tineidae (if it has a rough-haired head; all other species in this group have "smooth-scaled" heads). Occasionally, a small, slender species with

considerable color in the forewing pattern may be found on such food, and such a species may be *Anatrachyntis rileyi* in the Cosmopteriginae.

39. A very small, dark-colored moth found on *Prosopis* blossoms or on *Acacia* blossoms may be *Ithome* in the Chrysopeleiinae.

40. A drab-colored moth found on cotton fruits may belong to *Pectinophora* in the Gelechiinae if the proboscis is squamose and the first antennal segment bears a pecten.

41. A drab-colored moth associated with stored potatoes may be *Phthorimaea* in the Gelechiinae.

42. A small "rough-headed" moth associated with dried mushrooms may be *Nemapogon* in the Tineinae.

43. A small, black and white moth found on cotton and which has a strong, white hairtuft on the crown of the head and which has a pointed, receding face will probably be *Bucculatrix*.

## Suborder **MONOTRYZIA** Börner

*Monotrysia* Börner, 1939:1422. Hinton, 1946a:4.

The moths of this primitive suborder are unusual, because the females have only one external sex opening instead of two. This fact often has been overlooked. The males of many species of *Monotrysia* lack sclerotized aedeagi, but the males of other species have sclerotized aedeagi. Some literature would lead one to conclude that the lack of a sclerotized aedeagus is a characteristic feature of the suborder, but this is only partly true. Most (or all?) of the species are said to have aculeae (fixed spicules of the wing membrane, aculei, microtrichia), but, whereas they are conspicuous on some species, they are few in number and difficult to see on other species. The aculeae appear to be absent or mostly absent from the general wing membrane in the Hawaiian *Opostega*, but they are very conspicuous, especially on the hindwings, of the introduced *Tegeticula*. On many species these minute structures can be seen only by examining the descaled wings under high magnification. Forbes, speaking of the American *Opostega* (1923:160), said "Aculeae present but abnormal, pointing costad; arranged in regular rows, and confined to a small area about the base of the wing." I have failed to observe such an arrangement in the Hawaiian specimens I have examined. I have illustrated aculeae on a wing of the European *Opostega salaciella* (Treitschke) as seen with an electron microscope (figure 93).

Only two families of *Monotrysia*, the *Opostegidae* and an introduced member of the *Incurvariidae*, are now represented in Hawaii. The members of the *Ditrysia*, to which all other Hawaiian moths belong, do not have generally dispersed, wing-membrane aculeae, and all of them have two external sexual openings in the females (see figure 33). However, a condensed cluster of microtrichia (often difficult to see) is present at the base of the forewing costa on many *Ditrysia*, and another larger, elongate, often conspicuous zone usually may be seen adjacent to the margin on the anal curve of the forewing on most ditrysiian moths. These specialized clusters of microtrichia are quite distinct from the wing membrane aculeae of the *Monotrysia*, and they are involved in locking the closed wings to the body. Börner, 1939, and Common, 1969, have discussed some of these structures.

## Superfamily **NEPTICULOIDEA** (Stainton)

*Nepticulidae* Stainton, 1854:295.

The superfamily *Nepticuloidea* is now generally considered to be composed of two families of very small moths, the *Nepticulidae* and the *Opostegidae*. The family *Nepticulidae* is much the more numerous group, but it never became established in Hawaii where only the *Opostegidae* represent the superfamily.

Family **OPOSTEGIDAE** Meyrick

*Opostegides* Meyrick, 1893 (1892):478.

*Nepticulidae*, *Oposteginae*: Spuler, 1901–1910, vol. 2:482.

*Opostegidae*: Busck, 1914a, pl. 2. Heinrich, 1918:27. Forbes, 1923:160. Eyer, 1964.

*Tineidae*, *Oposteginae*: Tillyard, 1926:421.

Entomologists have long been confused regarding the status of this group as a family, and its position is perhaps not yet fully determined. Some authors have placed the moths with the tineids, but they surely do not belong there. Meyrick (1895, 1927*b*), in his *Handbook of British Lepidoptera*, placed *Opostega* near *Nepticula* in his expanded conception of the Tineidae. Spuler (1901–1910, vol. 2:482) listed the group as a subfamily of the Nepticulidae. Heinrich, in his paper on *Opostega* and its larva (1918:27–34), considered the Opostegidae to be an advanced family that split off from the ancestral stem of the Nepticulidae. Imms (1951), in his textbook, included *Opostega* in the Adelidae. Forbes (1923:160), in his arrangement of the Tineoidea, placed the group between the Lyonetiidae and Gracillariidae and noted that “the relationships are quite obscure.” He appears to have overlooked the fact that the moths belong to the Monotrysia. McDunnough (1939:100), possibly following

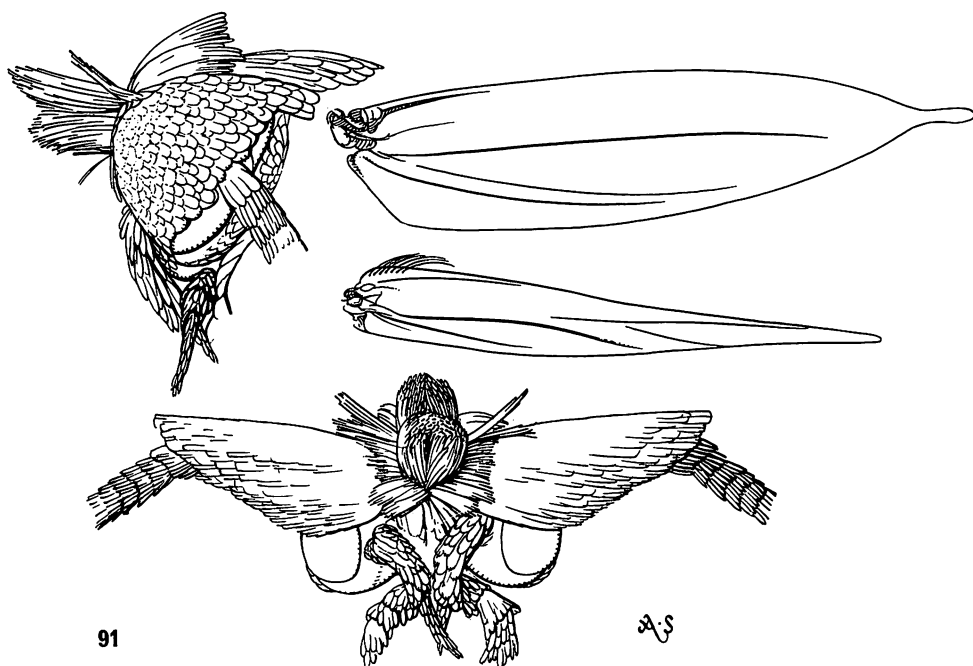


Figure 91—Details of *Opostega*. Wing venation of the female holotype of *Opostega maculata* Walsingham (B.M. slide 3990). Lateral and frontal aspects of the head of a paratype of *Opostega dives* Walsingham.

Forbes into error, placed the family between the Gracillariidae and Lyonetiidae in his *Checklist of the Lepidoptera of Canada and the United States of America*, and he listed only six species from all of America north of Mexico (more than six species occur in Hawaii). Eyer (1924), in his *Comparative Morphology of the Male Genitalia of the Primitive Lepidoptera*, considered the group worthy of full family rank, and he concluded that it is allied to the Heliozelidae and Nepticulidae. Eyer later (1964) published a paper on the five species he then recognized from North America, and he continued to consider the group as a distinct family. These peculiar little moths appear to deserve full family status.

Here belong the smallest of the Hawaiian Lepidoptera; some of the species have a wing expanse of only 6.0 mm. As figures 91–92 demonstrate, the wing venation is greatly reduced and the first antennal segment is expanded into a huge, concave eye-cap which covers the eye and extends over the base of the wing. The larvae of all of the known Hawaiian species are leaf miners in *Pelea* (Rutaceae). Our knowledge of the group the world over is meager, and much of interest remains to be recorded. The entire family requires revision, and it is not known how many genera are represented in the small complex of included species.

### Genus **OPOSTEGA** Zeller

*Opostega* Zeller, 1839:214; 1853:504, footnote on the derivation of the generic name. Type-species: *Elachista salaciella* Treitschke (figs. 92, wing venation; 93, wing aculeae; 97, male genitalia).

Meyrick, 1893:605; 1895:728.

Heinrich, 1918:27, larvae and relationships.

Swezey, 1921b:531, review of the genus in Hawaii.

Eyer, 1964, North American species.

Although it appears from the literature that *Opostega* is spread widely over the world, not many species have been described. The group rests largely in a confused state of taxonomy, and many of the species now assigned to *Opostega* do not belong to it. The Hawaiian species may not be true *Opostega*, but we shall have to wait an adequate study of the family as a whole before a conclusion can be reached regarding the status of our group. Heinrich long ago (1918:30)

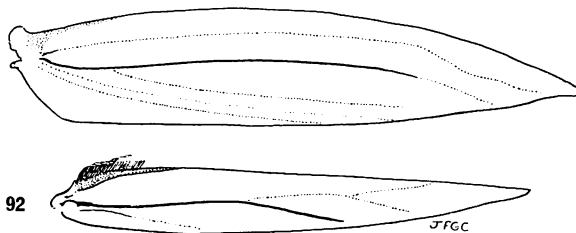
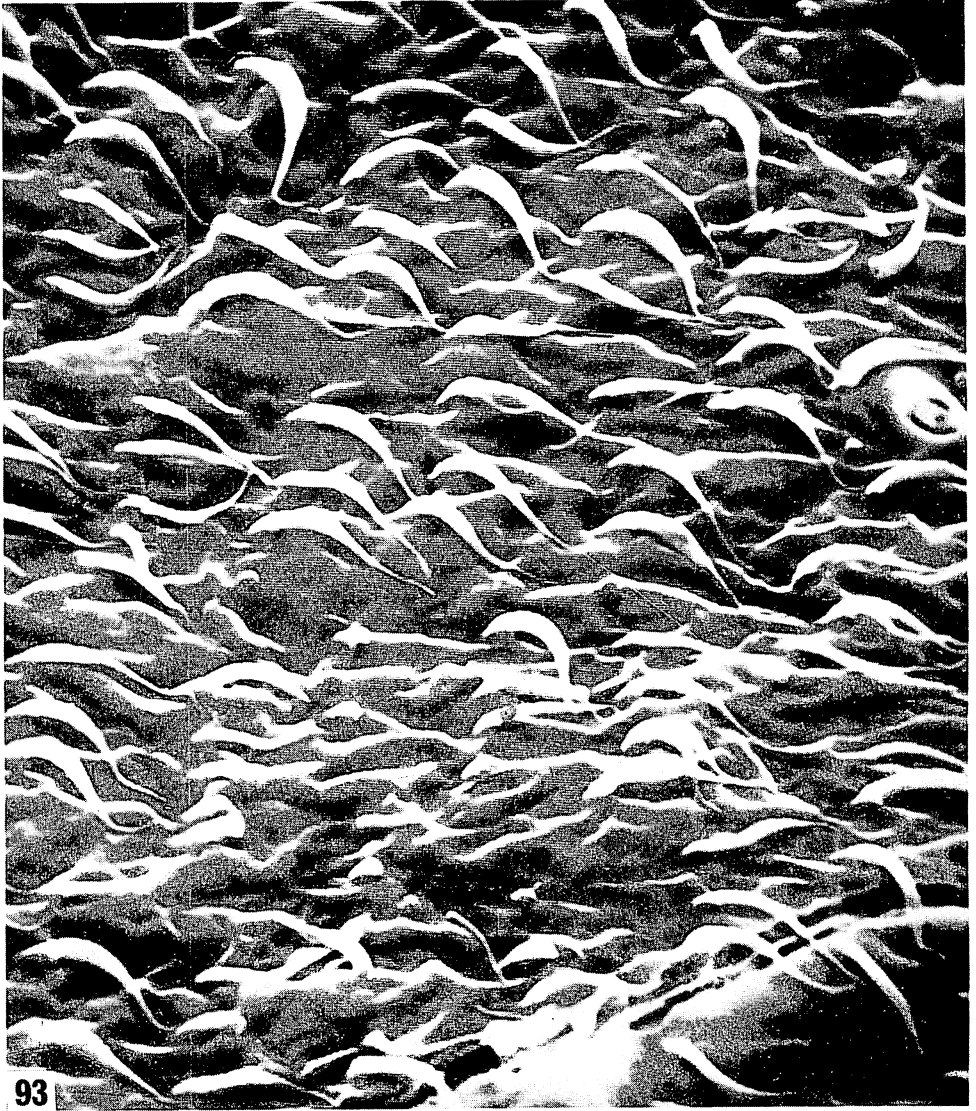


Figure 92—Wing venation of *Opostega salaciella* (Treitschke), the type-species of *Opostega*.





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Figure 93—Aculeae on the ventral surface of the forewing of *Opostega salaciella* (Treitschke). Approximately 2,500 times magnification. [“Stereoscan” electron microscope photograph most kindly prepared for this text by the British Museum (Nat. Hist.)]

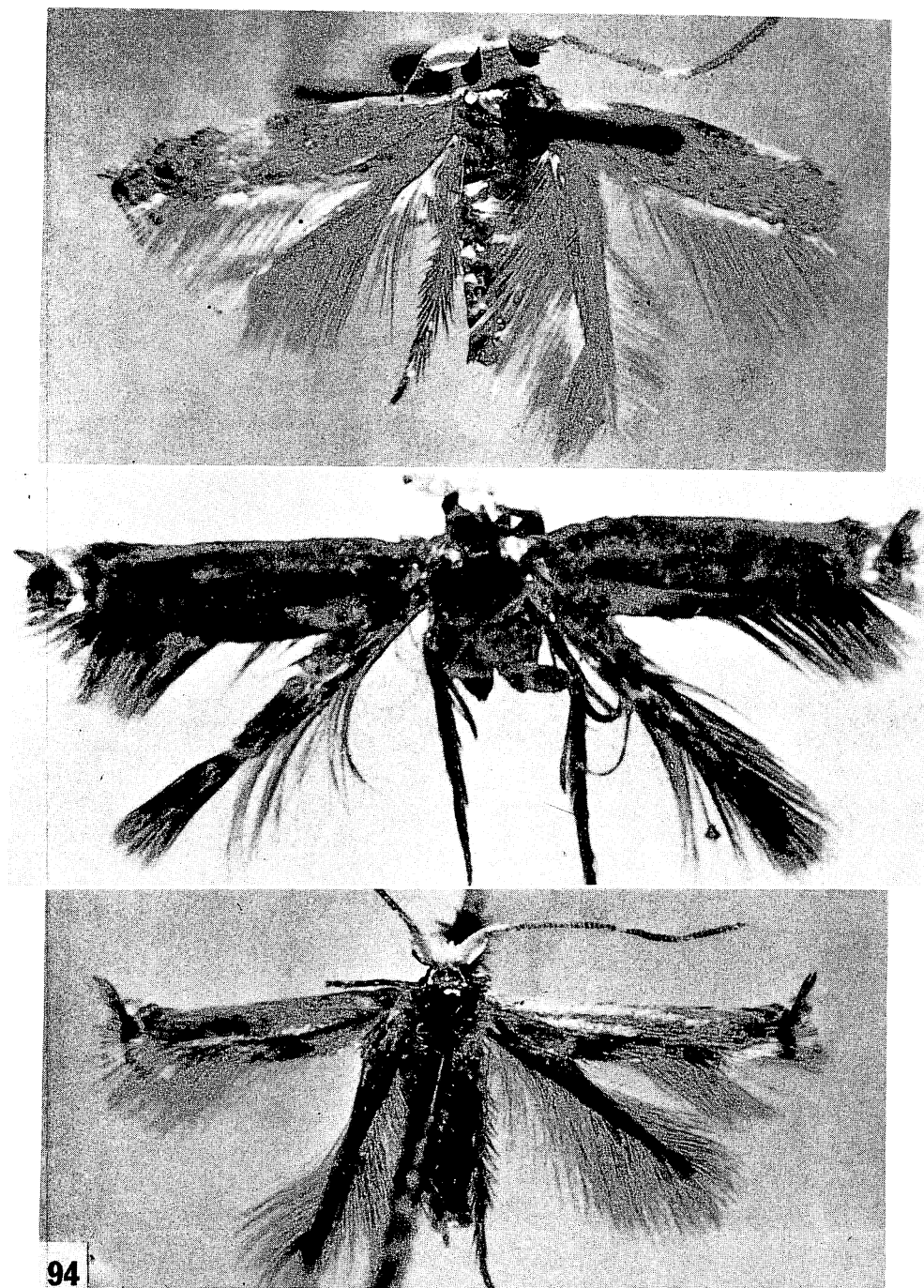


Figure 94—*Opostega*. Top, *callosa* Swezey, holotype male (slide Z-XII-31-65-C); Waialae Nui, Oahu; forewing 3.0 mm. Middle, *dives* Walsingham, holotype female (BM slide 2040); Halemanu, Kauai; forewing 5.0 mm. Bottom, *filiforma* Swezey? (determined by Swezey), female, Mt. Olympus, Oahu; forewing 2.75 mm. (the holotype is from Kauai, and this specimen may not be identical).

called attention to differences in the larvae between an Hawaiian species and an American species which may indicate that two genera are involved.

The proboscis is rudimentary; the labial palpi are small, slender, and drooping; and the maxillary palpi are long, slender, and folded. The antennae are about as long as the forewings. The area between the antennal bases is densely clothed with erect, shaggy, hair-like scales with bifid apices, but the

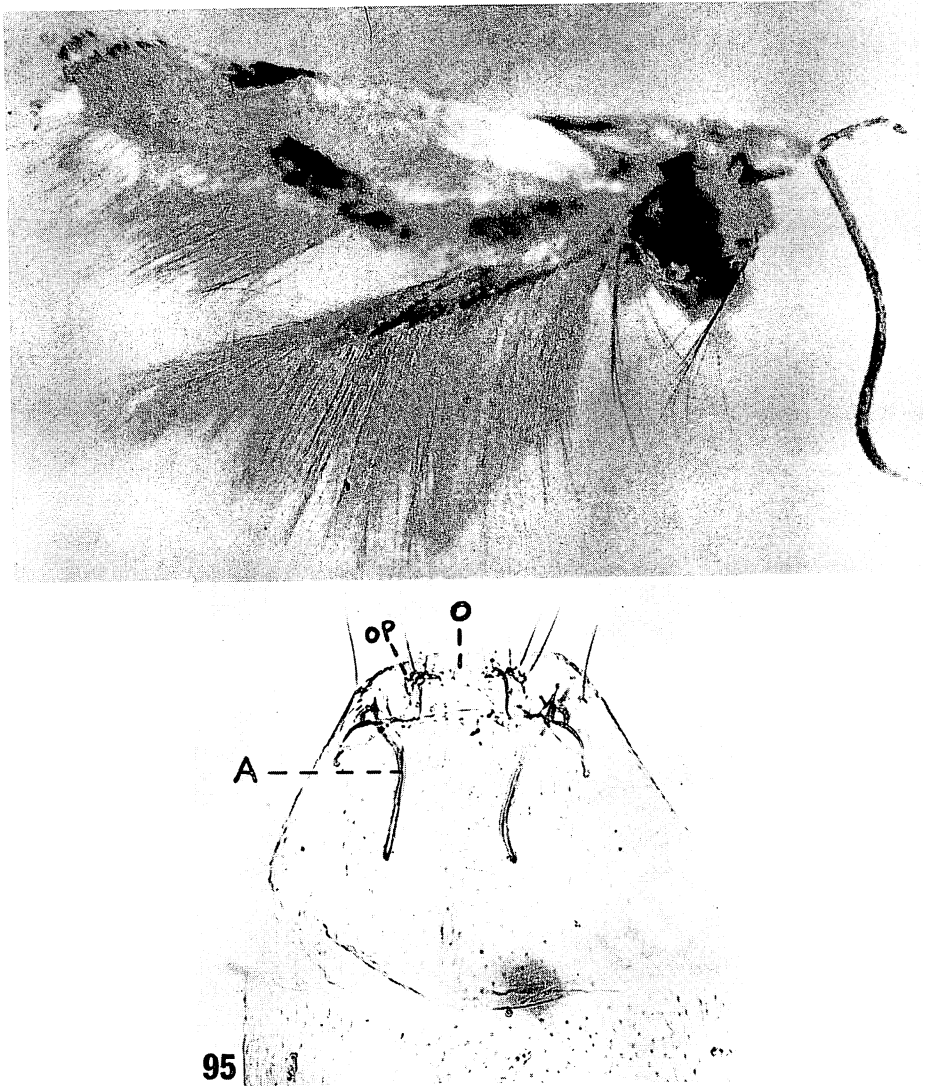
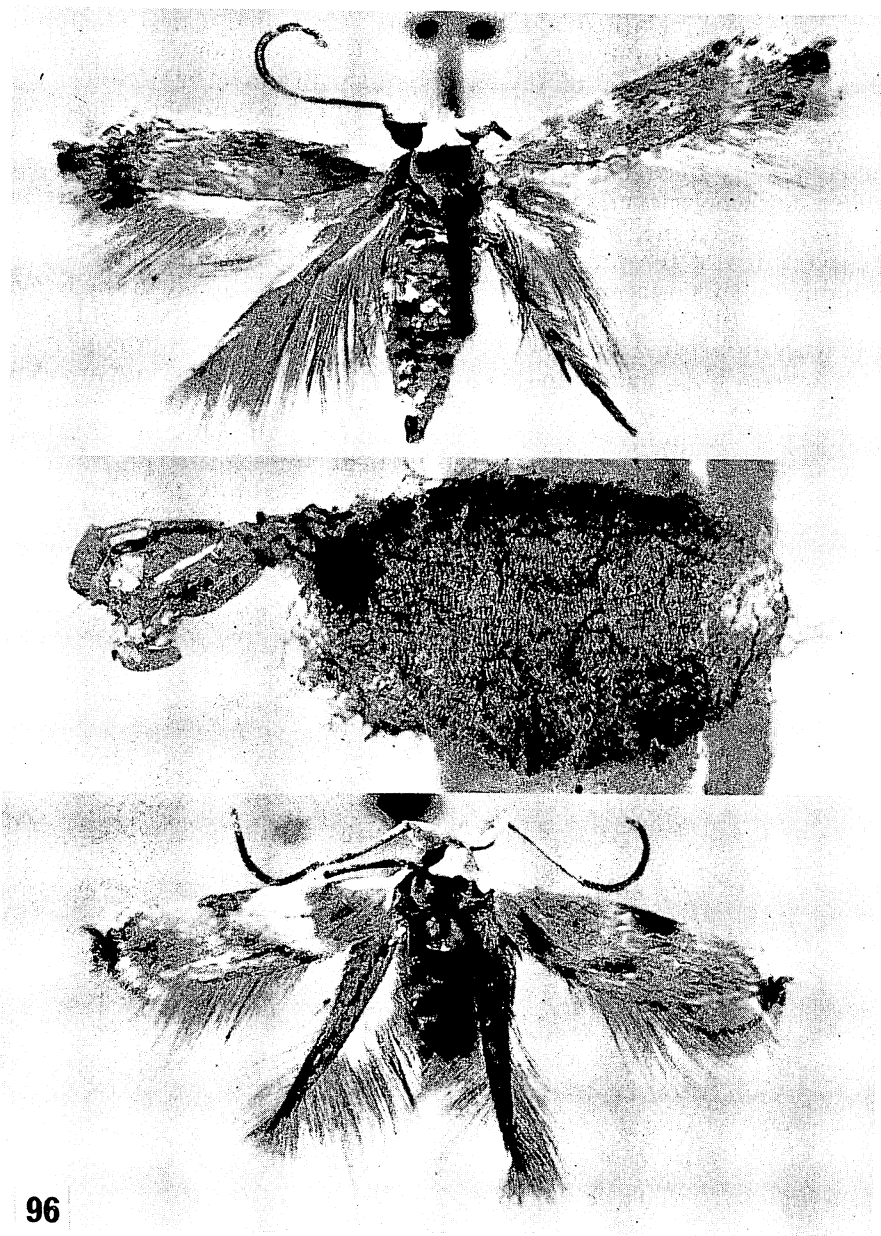


Figure 95—*Opostega maculata* Walsingham, holotype female, from over 3,000 feet on Molokai, and its genitalia (BM slide 3990); forewing 3.0 mm. A, apophysis; O, position of the single genital opening; OP, "ostium pad".



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Figure 96—*Opostega*. Top, *peleana* Swezey, holotype female (slide Z-XII-31-65-B); Mt. Olympus, Oahu; forewing 3.5 mm. Middle, straw-brown cocoon of same with pupal skin protruding. Bottom, *serpentina* Swezey, holotype female (slide Z-XII-31-65-D); Mt. Olympus, Oahu; forewing 3.0 mm.

crown of the head is clothed with broad, flat, imbricated scales. The forewings are turned upward at the tips, and this recalls the form of wing tip in species of the *Erechthiinae* complex of our *Tineidae*. Braun (1924:240) said: "In *Opostega* there is no functional frenulum in either sex and the wing-coupling apparatus in both sexes consists only of the series of costal spines and their retinacula. The fourteen or fifteen strongly curved costal spines lie close together, the whole forming a strong hook which catches onto a curve in the base of cubitus clothed with obliquely forward projecting scales into which the curved tips of the individual spines hook. In addition there is a slight overfolding of subcosta under which the costal spines slip when the wings are folded." The tibiae and first tarsal segments of the midlegs and hindlegs bristle with numerous, long spines. One wonders why the enormous eye-caps were evolved. They completely conceal the eyes when the antennae are at rest. I do not know in what position the antennae are held when the moths are walking or are in flight. If they are not held together and directed forward on the median line, or held near the vertical, the eyes would be rendered virtually useless. I regret that I have had no opportunity to study the living animals in nature.

Although six species of *Opostega* have been described from Hawaii, we do not know how many species exist there. Undescribed species are known in the Islands. Five species are recognized in America north of Mexico, and four species are listed in the British Isles.

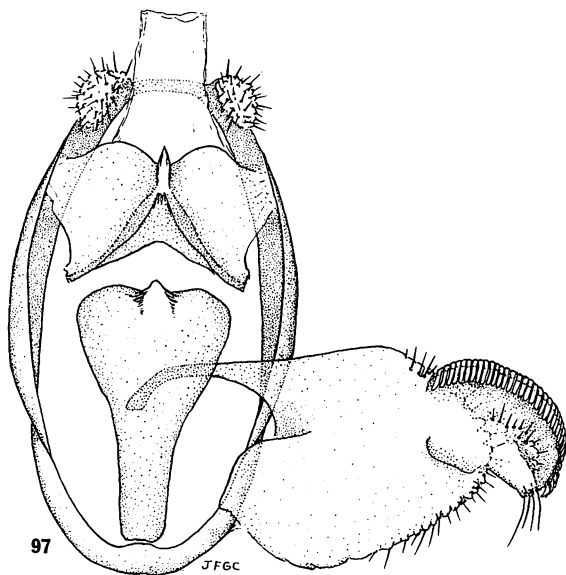


Figure 97—Male genitalia of *Opostega salaciella* (Treitschke), the type-species of *Opostega*.

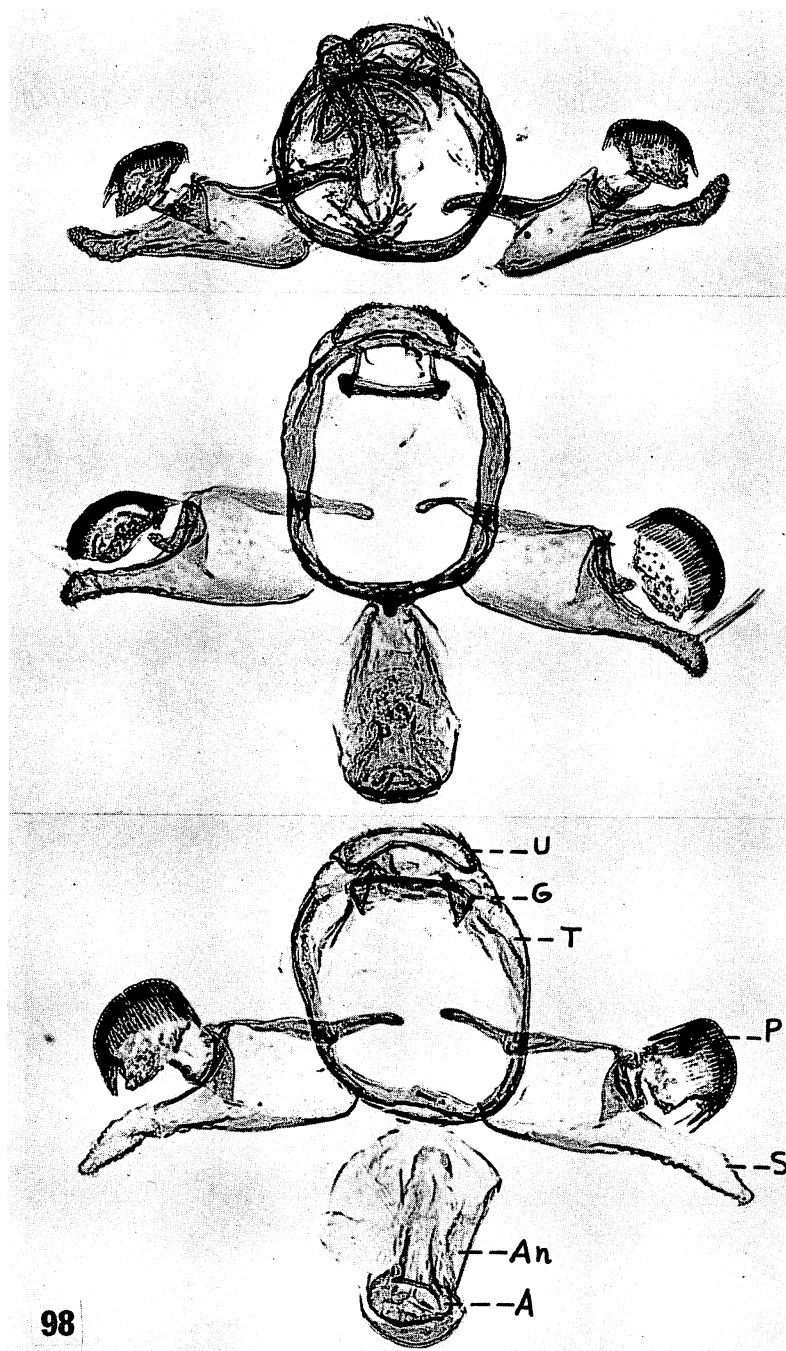


Figure 98—Male genitalia of *Opostega*. Top, *callosa* Swezey, holotype (slide Z-XII-31-65-C); Waialae Nui, Oahu. Middle (slide Z-V-9-66-B) and bottom (slide Z-XI-16-65), two specimens of an unidentified species from Mt. Kaala, Oahu, 4,000 feet, J. W. Beardsley. In the two lower figures, I have cut the anellus loose and pulled it down to obtain a better view of the inner structure; the membranous aedeagus adheres to its inner surface. *A*, membranous aedeagus; *An*, anellus; *G*, gnathus; *P*, pectinifer of valva; *S*, sacculus of valva; *T*, tegumen; *U*, uncus.



All of the species known in Hawaii (including some undescribed species) mine the leaves of *Pelea* (Rutaceae). The adult moths have rarely been collected in Hawaii, but their mines are not uncommon in *Pelea* leaves. Perkins (1913: clxix) said that the adults "are probably difficult to collect." He found adults of *Opostega dives* running on *Pelea* leaves in sunshine.

The larvae are known to be attacked by chalcidoid parasites, but little information on parasitism has been assembled. Perkins (1913:clxix) said:

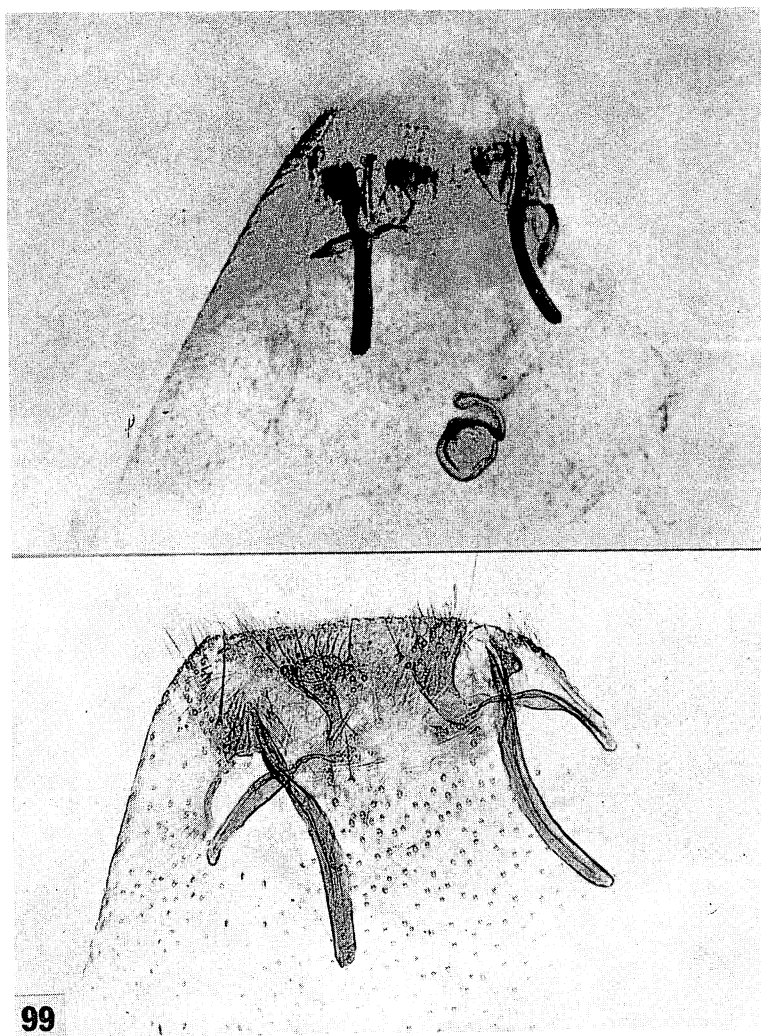


Figure 99—*Opostega dives* Walsingham, female genitalia. Top, the holotype from Halemanu, Kauai (BM slide 2040); the specimen is somewhat folded, but is similar to the bottom specimen. Bottom, paratype of same (BM slide 2034). The species was described from these two female specimens which Walsingham wrongly determined to be males.

"From these mines one generally breeds only Eulophid parasites." Swezey (1921*b*:536) said "Sometimes more parasites issue than moth larvae from the mined leaves brought in [to the laboratory]." The eulophid *Euderus metallicus* (Ashmead) was reared from the mines of an unidentified, probably new *Opostega* collected on Maui in 1965 by J. W. Beardsley, and the eulophid *Pauahiana lineata* Yoshimoto was reared by Dr. Swezey from the larvae of two species of *Opostega*.

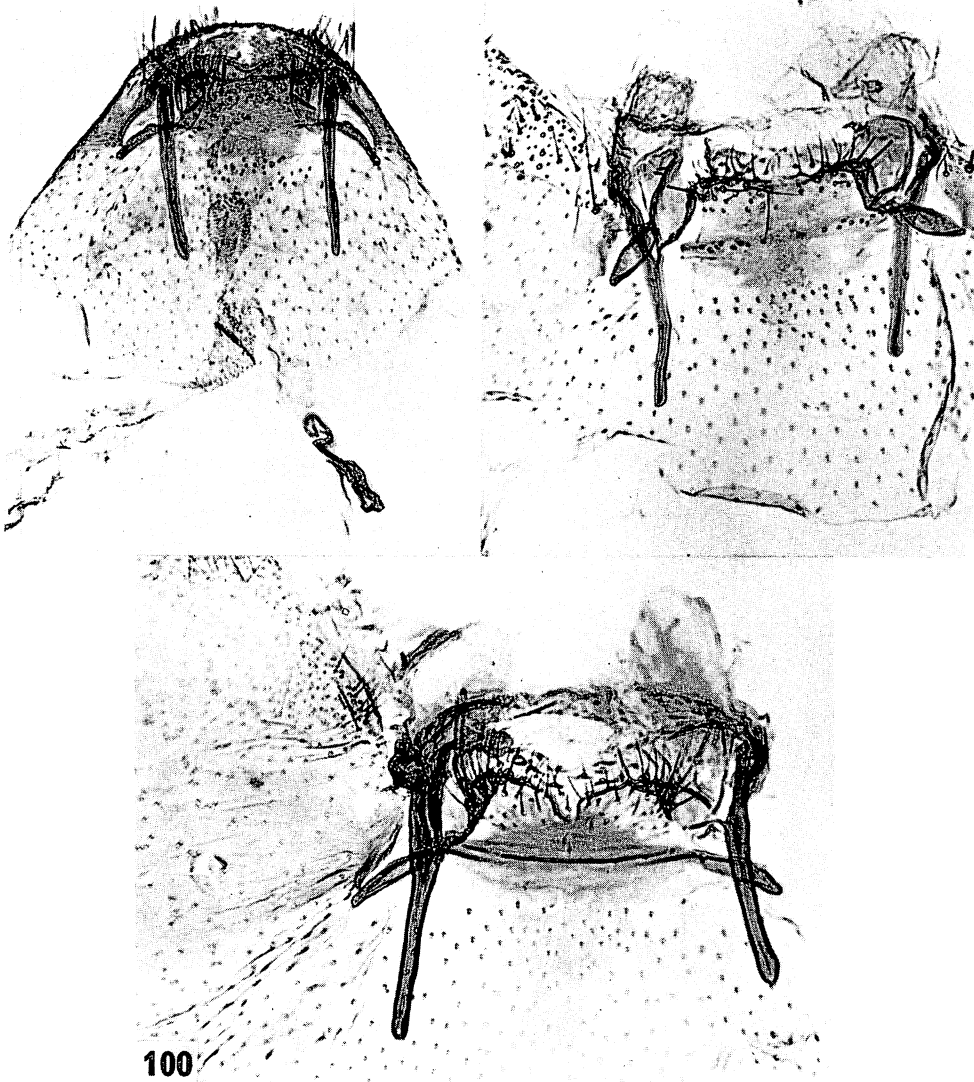


Figure 100—*Opostega* female genitalia, ventral aspects. Top left, *filiforma* Swezey, holotype (slide Z-V-9-66-A); Mt. Kaala, Oahu. Top right, supposedly the same species from a specimen from Mt. Olympus, Oahu (slide Z-I-2-65-A). Bottom, *serpentina* Swezey, holotype (slide Z-XII-31-65-D); Mt. Olympus, Oahu; the abdomen is cut open and the caudal tergite is at the left.



The larvae of *Opostega* (figure 103) are among the most unusual lepidopterous larvae that I have seen. They are highly divergent, and their chaetotaxy is reduced and peculiar. True legs and prolegs are obsolete. The head is greatly modified, and the frons expands caudad instead of being attenuated. I have not had the opportunity to study Hawaiian specimens in detail.

It would appear that Forbes' descriptive notes (1923:160) require partial modification, unless the material to which he refers is quite different from the Hawaiian species. The mandibles of the Hawaiian *Opostega* are toothed and appear to be of the biting type.

Dr. Swezey supplied larvae of an unidentified Hawaiian *Opostega* to Carl Heinrich who figured the head structure in his 1918 report, and the reader is referred to that paper for additional details. See figure 103 for Heinrich's illustrations.

It has proved difficult to rear these moths in the laboratory. Although the larvae in abundantly mined leaves may appear to mature and may leave the mines with an apparent intention to pupate, few, in fact, go on to this stage. These difficulties probably could be overcome by use of "controlled climate" chambers.

We owe our knowledge of these interesting little moths in Hawaii largely to Dr. Swezey, and I believe that the introductory remarks to his report on the genus in Hawaii (1921*b*:531-532) are worthy of inclusion here:

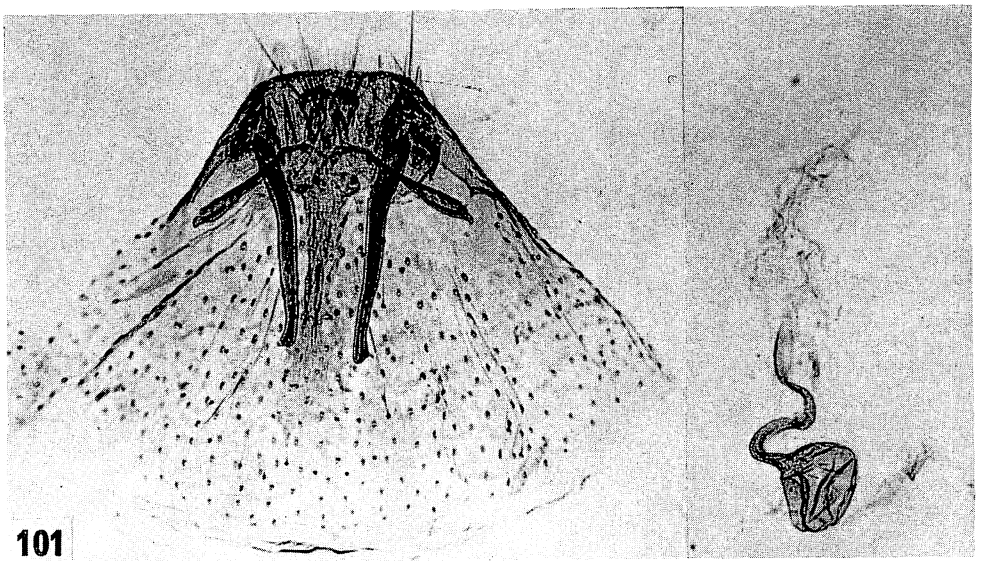


Figure 101—Female genitalia of the holotype of *Opostega peleana* Swezey (slide Z-XII-31-65-B); Mt. Olympus, Oahu. Ventral aspect; the spermatheca is at right.

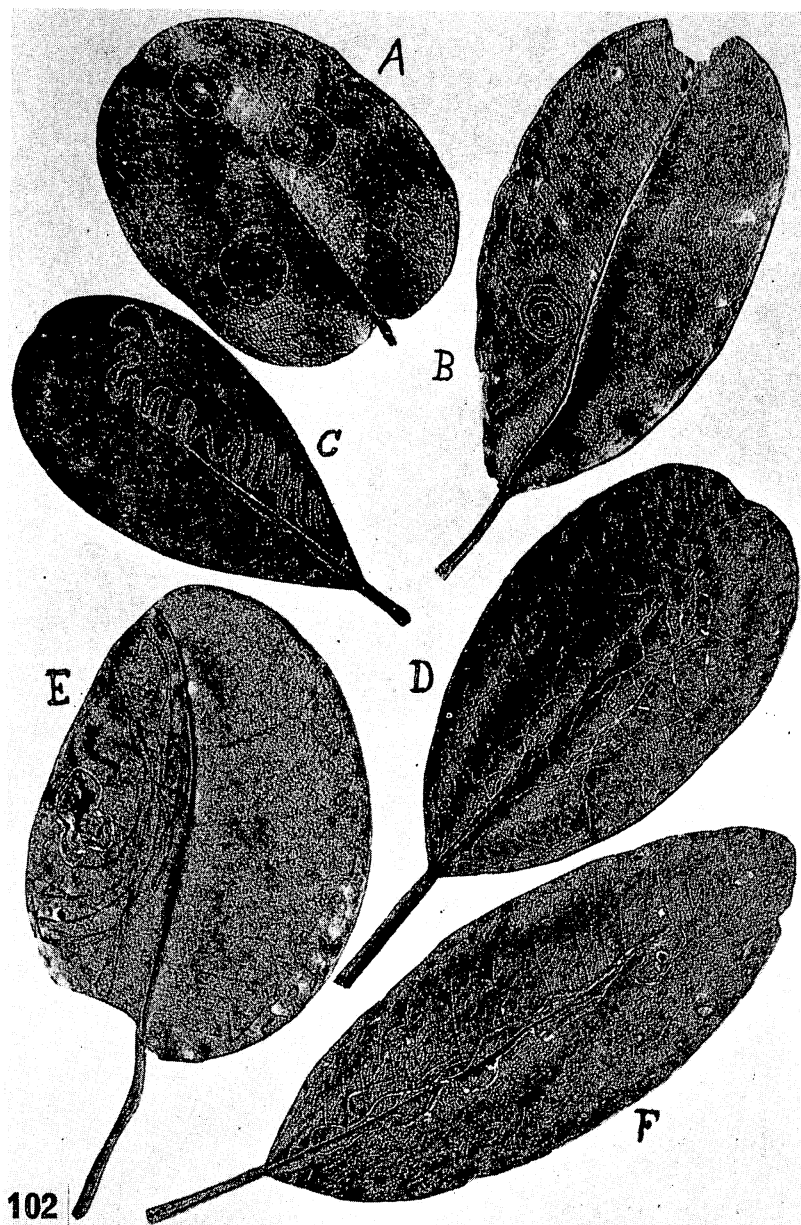
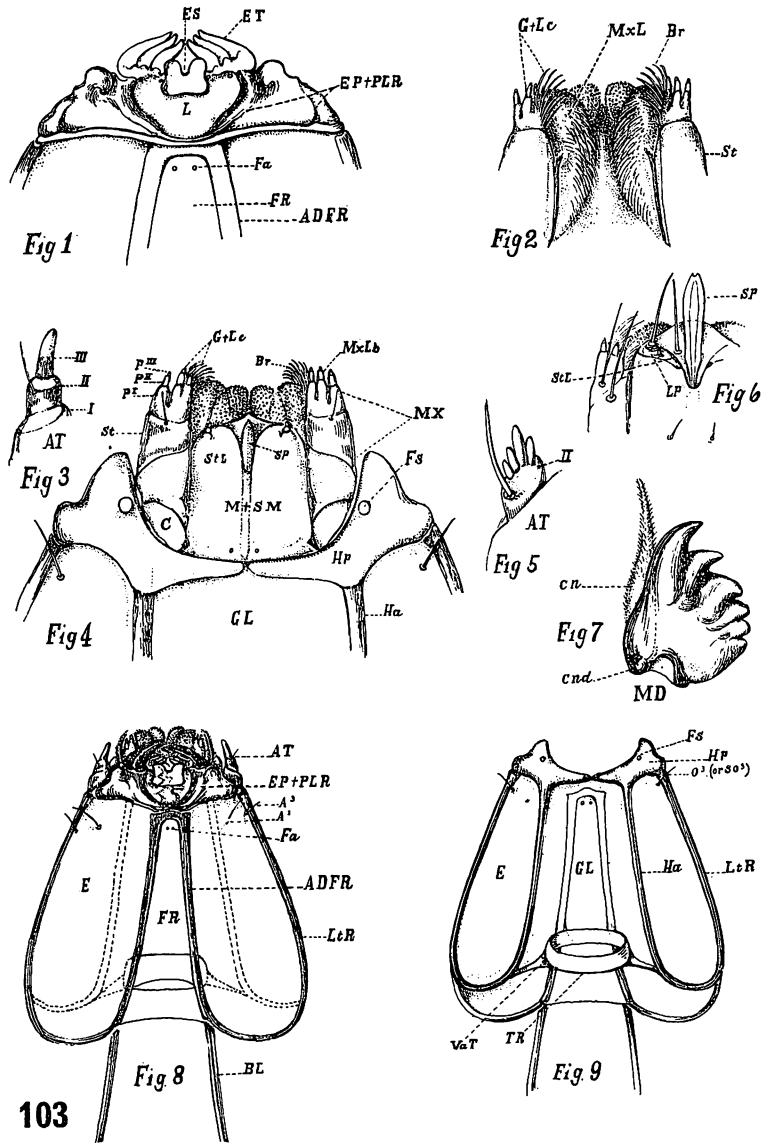


Figure 102—*Opostega* larval mines in the leaves of various species of *Pelea*. A, *callosa* Swezey in *Pelea rotundifolia* on Oahu. B, *maculata* Walsingham, as determined by Swezey, in *Pelea oblongifolia* on Oahu and Molokai. C, *serpentina* Swezey, in *Pelea elliptica* on Oahu. D, *filiforma* Swezey, in *Pelea clusiiifolia* on Oahu. E, *peleana* Swezey, in *Pelea sandwicensis* on Oahu. F, an undetermined species from Kaholuamano, Kauai, either *dives* Walsingham or a new species. (After Swezey, 1921.)



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Figure 103—Details of the highly modified heads of *Opotege* larvae (after Heinrich, 1918). Figures 5 and 6 are of the American *nonstrigella* Chambers, but all the other figures are of an undetermined Hawaiian species which was collected by Swezey and probably is one of the Oahu species.

1. Labrum and anterior dorsal region of the head capsule of the Hawaiian species (ADFR, adfrontal ridge; EP+PLR, epistoma and pleurostoma; ES, epipharyngeal shield; ET, epipharyngeal setae or "teeth"; Fa, frontal pores; FR, frons).

2. Maxillae, hypopharynx, and maxillae of the Hawaiian species (Br, brush of spines on lacinia; G+Lc, galea and lacinia; MxL, maxillulae; St, maxillary stipes).

(Continued at bottom of page 245.)

In the "Fauna Hawaiiensis," two species of this genus were described and figured: *maculata* Walsm. and *dives* Walsm. The former on a single specimen from Molokai, and the latter on two specimens from Halemanu, Kauai. These are very small moths, and in all of my collecting in the Hawaiian forests I have only once collected a specimen of this genus. It was on the summit of Mt. Kaala of the Waianae Range, Oahu, and was not either one of the described species. I have, however, reared four different species from mines in the leaves of various species of *Pelea*, from various localities on Oahu.

Peculiar mines were discovered in the leaves of *Pelea* a long time ago, but the insect producing them was not ascertained. Finally larvae were found in some of the mines, but at first it could not be determined to what order of insects they belonged. The larvae are very slender, and the head structure very peculiar. In 1910, when I was at the National Museum at Washington, D.C., Mr. Busck showed me some larvae which he had recently received of a species of *Opostega* which is a cambium-miner in *Ribes*. I at once noted the similarity of these larvae to those found in the mines in *Pelea* leaves, and, hence, since then considered that these mines were produced by *Opostega* larvae.

I have repeatedly brought in *Pelea* leaves with mines and attempted to rear moths from the larvae in them. Many times these have resulted in failure, but occasionally I have secured a moth, and these have proved to be of the genus *Opostega*. There are six different types of the mines in *Pelea* leaves, and probably others not yet known may occur in some of the regions not yet fully explored. The moths that I have reared from these mines are very closely related, but I consider that those from each of the different kinds of mines are different species respectively. Four new species are described herewith.

Some of the mines seem to occur only in certain species of *Pelea*, and sometimes as many as two kinds of mines are found in the same leaf. As far as my observations go, five of the species occur quite generally throughout Oahu. Often I have found these five on the same day in some particular place, as for example: October 31, 1920, in the Koolau Range above Wahiawa, Oahu. Very little is known of their occurrence on the other islands, but three kinds of mines have been found in *Pelea* leaves on Kauai, and there is no doubt that there are other kinds yet to be found.

The *Opostega* larvae emerge from their leaf mines to form cocoons of dense silk. Those I have seen are straw-brown in color and are oval in broadest outline and lens-shaped in cross section. An illustration of a cocoon of one of the species is included here (figure 96).

Only a few specimens of Hawaiian *Opostega* are known. Perkins collected only one specimen of *maculata* and only two of *dives* in all the years of his Hawaiian survey work, and these three specimens are the only ones described in *Fauna Hawaiiensis*. Swezey, in spite of his many attempts to obtain specimens, was able to assemble only a few examples during the nearly half century of his work in Hawaii. He described *callosa* from three reared examples, *filiforma* from one caught specimen, *serpentina* from two reared examples, and *peleana* from one reared specimen. J. W. Beardsley tried hard to obtain specimens for my study but was able to collect and rear only a few examples. His experience with the difficulty in rearing the moths from infested leaves was similar to that of Swezey.

3. Antenna of the Hawaiian species.

4. Ventral aspect of the anterior part of the head capsule with the labium and maxillae of the Hawaiian species (*Br*, setal brush on maxillary lacinia; *C*, cardo; *Fs*, epicranial mandibular fossa; *G+Lc*, maxillary galea and lacinia including the maxillary lobe and brush; *GL*, transparent gula between ridges of hypostoma; *Ha*, hypostomal ridge; *Hp*, triangular plate of hypostoma; *M+SM*, mentum plus submentum; *MX*, maxilla; *MXLb*, maxillary lobe; *P1*, *P2*, *P3*, palpal segments; *Sp*, spinneret; *St*, maxillary stipes; *StL*, labial stipes).

5. Antenna of the American *nonstrigella*. *II*, second segment. Note the great difference between this and the Hawaiian species in figure 3.

6. Labium and maxilla of the American *nonstrigella* (*LP*, labial palpus; *Sp*, spinneret; *StL*, labial stipes). Note the differences between this and the Hawaiian species in figure 4.

7. Mandible of the Hawaiian species, ventral aspect (*cn*, "spined cone" on dorsum of mandible; *cnd*, condyle).

8. Dorsal aspect of the head capsule of the Hawaiian species (*A<sup>1</sup>*, *A<sup>3</sup>*, epicranial setae; *BL*, blade-like posterior dorsal region of epicranium; *ADFR*, adfrontal ridge; *AT*, antenna; *E*, epicranium; *EP+PLR*, epistoma and pleurostoma; *FR*, frons; *LtR*, lateral ridge of epicranium).

9. Ventral aspect of head capsule of the Hawaiian species [*E*, epicranium; *Fs*, epicranial mandibular fossa; *GL*, transparent gula between ridges of hypostoma; *Ha*, hypostomal ridge; *Hp*, triangular plate of hypostoma; *LtR*, lateral ridge of epicranium; *O<sup>3</sup>* (or *SO<sup>3</sup>*), third ocellar (or subocellar seta); *TR*, tentorial bridge; *VaT*, ventral arm of tentorium].

Walsingham stated that the specimens he studied for his *Fauna Hawaiiensis* report were males, but upon dissection we have found all of them to be females. Swezey did not designate the sexes of his type series of the four species he described, but the holotype of *callosa* is a male, and the holotypes of *filiforma*, *peleana* and *serpentina* are females. Beardsley obtained two males on Mt. Kaala, and their genitalia are figured here. In addition to the three above-mentioned males, I have seen another male collected at Pacific Heights, Honolulu, by Swezey and determined by him as *maculata*. This specimen was sent to Dr. John R. Eyer by Dr. Swezey many years ago, and Dr. Eyer most kindly sent it to me together with photographs and drawings that he had made of it and other species to aid me in gathering an understanding of these moths. Thus, I have seen only four male specimens, and their genitalia are all so closely similar that I wonder if they are not all one species. The opostegid material I have had for examination has been insufficient for the purposes of a proper study, and I must leave this group in an unsatisfactory state. It will take much hard work, specialized collecting, and the development of a satisfactory method of rearing the moths in the laboratory from infested leaves before adequate series of specimens can be assembled.

Heretofore, *Opostega* species have been reported only from Kauai, Oahu, and Molokai. In 1965, however, J. W. Beardsley, who was most kindly searching for specimens for use in the preparation of this text, found *Opostega* mines in *Pelea* leaves at two widely separated localities on Maui. One collection was made along Waikamoi Stream at about 4,000 feet elevation on Haleakala, and the other collection was made at about 3,000 feet elevation on the trail

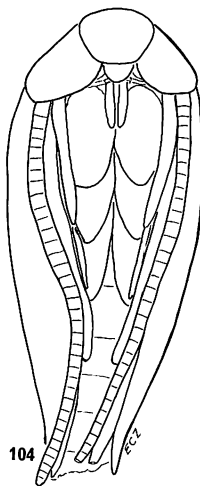


Figure 104—Ventral aspect of a pupa of *Opostega maculata* Walsingham (as determined by Swezey); length 2.1 mm.; Mt. Tantalus, Oahu. This is the only pupa of *Opostega* that I have seen. The specimen is glued to a card, and the apex of the abdomen is damaged. Note the great differences between this member of the Monotrysia and the pupae of the Ditrysia. The large expansions on either side of the head are the eye-caps formed by the basal antennal segments; these conceal the eyes. Note that the coxae of all three pairs of legs are exposed.

to Puu Kukui on West Maui. Careful searching will extend the known range of the genus to many new areas, and several new species may be discovered.

An examination of figure 102 will reveal the distinctive “signatures” engraved upon *Pelea* leaves by the larvae of *Opostega*. It may prove easier to identify some of the species of Hawaiian *Opostega* by their mines than by the moths. One is reminded of Freeman’s remarks (1964: 111) upon the large genus *Nepticula*, when he said:

Because of . . . similarity of [color] pattern, it is often impossible to identify many of the species in the adult stage. The larvae mine within the tissues of leaves, usually just beneath the upper epidermis, consuming the palisade layer of cells. Each of the species feeds in a characteristic manner. For example, *N. rosaefoliella* Clem. forms a serpentine mine usually along the edge of a rose leaf, and *N. juglandifoliella* Clem. forms a linear mine along a vein. The mine of an undescribed species on elm starts as a semi-serpentine track and abruptly enlarges into a viscera-like blotch; that of another undescribed species on willow terminates in an irregular blotch; and so on. Each species engraves its own symbolic characters, and whoever has learned to read the symbols can readily determine the species that made them.

See color plate 1, figures 1, 2.

## PROVISIONAL KEY TO THE HAWAIIAN SPECIES OF OPOSTEGA

(Prepared mostly from original descriptions. Old, faded specimens may not fit the dichotomies.)

1. Erect vestiture on front of head yellowish; eye-caps mostly white; thorax coppery with some iridescent greenish coloring; a large (expanse about 10 mm), dark species; type locality: Halemanu, Kauai. . . . . **dives** Walsingham.  
Not so. . . . . 2
- 2(1). Thorax white or creamy white. . . . . 3  
Thorax greyish, fuscous or brown. . . . . 4
- 3(2). “Thorax white. Forewings white with a slight brownish suffusion near base, a mid costal patch of very pale brownish, the apical third of wing suffused with the same shade; a dark fuscous apical spot within a pale brownish line at base of cilia”; type locality: Waialae Nui, Oahu. . . . . **callosa** Swezey.  
“Thorax creamy white. Forewings creamy white, a faint brown suffusion on basal third; from one-third of [posterior margin] a brownish streak extends obliquely to near a brownish patch just beyond middle of costa; some faint brownish suffusion in apical third; a small fuscous spot at apex within a brownish line at base of cilia”; type locality: Mt. Olympus, Oahu. . . . . **serpentina** Swezey.

- 4(2). "Thorax purplish grey. Forewings purplish grey, [posterior margin] fuscous brown except near base, at one-fourth of [posterior margin] a fuscous brown streak extends obliquely to end of cell, at two-thirds of costa a fuscous brown patch with an outwardly oblique extension, costa white before and beyond this patch, a fuscous apical spot preceded by fuscous streak at base of cilia"; type locality: Mt. Kaala, Oahu..... **filiforma** Swezey.  
Not so.....5
- 5(4). "Thorax pale ochreous brown. Forewings pale ochreous brown, more intense on the outer third, about middle of costa a spot with a light fuscous tinge, the costa whitish just before and after this spot"; type locality: Mt. Olympus, Oahu.....  
..... **peleana** Swezey.
- "Thorax tinged with grey. Forewings shining, cream-white, a grey dorsal patch at the base is followed by a mixed brown and greyish outwardly oblique patch about the middle of the [posterior margin], its outer extremity opposite to a short outwardly oblique brownish costal spot beyond the middle; before the apex are two slender dark brown and grey costal streaklets meeting on a small blackish apical spot from which another streaklet runs outward through the subapical cilia"; type locality: above 3,000 feet on Molokai; also on Oahu... **maculata** Walsingham.

**Opostega callosa** Swezey (figs. 94, moth; 98, male genitalia; 102, mine).  
*Opostega callosa* Swezey, 1921*b*:532, pl. 9, fig. A, leaf mine.

Endemic. Oahu (type locality: Waialae Nui), supposedly widespread in the Koolau Mountains.

Hostplants: *Pelea lydgatei*, *Pelea rotundifolia*, *Pelea* species.

The mine of this species, when complete, is a circular callous-like structure about half an inch in diameter, on the upper surface of the leaf. It is formed by the young larva producing at first a very slender mine, and after wandering for a time finally coming to a perfect circle, and then continuing in a close spiral inside of this till the center is reached. A proliferation of tissue is produced and the upper epidermis thickened up, and the larva feeds beneath it till fully grown, when it escapes for pupation. The cocoon is probably made amongst moss or debris on the ground, and is lenticular in shape, of a pale reddish brown silk. (Swezey, 1921*b*:532-533.)

**Opostega dives** Walsingham (figs. 91, head; 94, moth; 99, female genitalia).  
*Opostega dives* Walsingham, 1907*b*:711, pl. 25, fig. 13.

Endemic. Kauai (type locality: Halemanu).

Hostplant: *Pelea*.

This large, dark, unusual species was described from two examples which Walsingham said were males. They are, however, females. "It has never been reared, but it is believed to form mines of a type found in leaves of *Pelea anisata* Mann (the mokehana), *P. kauaiensis* Mann and *P. gayana* Rock at Kaholu-amano, Kauai." (Swezey, 1954:151.) Perkins (1913:clxix) said, "*O. dives* was found only once, the two individuals were taken running on a leaf of *Pelea* in the sunshine and one was noticed ovipositing."

**Opostega filiforma** Swezey (figs. 11-A, *a*, antenna; 94, moth; 100, female genitalia; 102, mine).

*Opostega filiforma* Swezey, 1921*b*:534, pl. 9, *D*, leaf mine.

Endemic. Oahu (type locality: Mt. Kaala, Waianae Mountains).

Hostplants: *Pelea clusiaefolia*, *Pelea elliptica*, *Pelea sapotaefolia*.

Swezey (1921*b*:534), commenting on the larval mine, said "It is a very slender thread-like mine, wandering without any special order throughout the leaf, at the last going down into the petiole and mining in the cambium layer."

**Opostega maculata** Walsingham (figs. 91, wing venation; 95, moth, female genitalia; 102, mine; 104, pupa; col. pl. 1:2).

*Opostega maculata* Walsingham, 1907*b*:711, pl. 25, fig. 12. Swezey, 1921*b*:533, pl. 9, fig. *B*, leaf mine.

Endemic. Oahu, Molokai (type locality: over 3,000 feet elevation).

Hostplants: *Pelea oblongifolia*, *Pelea rotundifolia*.

Parasite: Yoshimoto (1965:678) listed *Pauahiana lineata* Yoshimoto (Eulophidae) as a parasite reared by Swezey from Oahu specimens.

This moth was described from a single specimen which Walsingham determined as a male. He mistook the sex, because upon dissection it has proved to be a female.

Swezey reared this species on Oahu from *Pelea oblongifolia*, and he said that he considered mines which he found in *Pelea rotundifolia* to have been made by the same species. Swezey's records are from specimens he collected in the Koolau Mountains, and he described the mine from his collections as follows (1921*b*:533): It is "a close spiral produced outwardly from the center where the egg was laid on the upper surface of the leaf. The spiral may turn to the right or to the left. Just before issuing, the larva tunnels a short distance from the spiral. No proliferation of plant tissue takes place in connection with this mine as [it] does with the mine of *callosa*, in fact that is the only species having a proliferation of plant tissue in connection with its mine."

**Opostega peleana** Swezey (figs. 96, moth, cocoon; 101, female genitalia; 102, mine).

*Opostega peleana* Swezey, 1921*b*:534, pl. 9, fig. *E*, leaf mine.

Endemic. Oahu (type locality: Mt. Olympus, Koolau Mountains), Kauai?

Hostplants: *Pelea rotundifolia*, *Pelea sandwicensis*, *Pelea* species.



Swezey (1921*b*:535) stated that he had found the mine of this species on Kauai, but without having moths from Kauai that can definitely be determined as this species, I prefer to question the Kauai locality record. Swezey reared only two specimens, but he said that he had found the mines of the species in many localities on Oahu. He said that "The mine of this species . . . is at first a thread-like mine with numerous longitudinal somewhat parallel loops nearly the length of the leaf and somewhat curved with the concavity towards the margin, the enclosed area eventually becoming a large blotch mine. The whole mine is usually situated on one side of the midrib and occupying nearly that whole half of the leaf."

***Opostega serpentina*** Swezey (figs. 96, moth; 100, female genitalia; 102, mine).

*Opostega serpentina* Swezey, 1921*b*:533, pl. 9, fig. C, leaf mine.

Endemic. Oahu (type locality: Mt. Olympus), Kauai?

Hostplants: *Pelea elliptica* (type host), *Pelea clusiaefolia*, *Pelea sapotaefolia* (on Kauai), *Pelea* species.

Swezey said that he found the mines of this species on Kauai, but I prefer to question the record until moths obtained from similar mines from Kauai are studied and the identification confirmed. Swezey found his Oahu material in the Koolau Mountains, and he described the mine as follows (1921*b*:534): "The mine of this species . . . is made at first along the margin of the leaf. As it enlarges it becomes very serpentine, and finally has quite long back-and-forth loops nearly half across the width of the leaf. The cocoon is similar to that of *callosa*. Moths issued from cocoons twenty days after cocoons were formed."

## Superfamily **ADELOIDEA** (Herrich-Schäffer)

*Adelina* Herrich-Schäffer, 1857:58.

*Adeloidea*: Forbes, 1923:14.

*Incurvarioidea* Forbes, 1923:34, 72.

### Family **INCURVARIIDAE** Spuler

*Incurvaridae* Spuler, 1898a:35.

*Incurvariadae*: Hampson, 1918b:387.

*Incurvariidae*: Spuler, 1910:464. Forbes, 1923:72. D. R. Davis, 1967:11.

### Subfamily **PRODOXINAE** (Riley)

*Prodoxidae* Riley, 1881:637. Heinrich, 1918:27.

*Prodoxinae*: Forbes, 1923:73. D. R. Davis, 1967:26, redefinition and monograph.

The members of this group are called yucca and agave moths, and they include some moths with remarkable habits. The group is endemic to North America, with the greatest concentration of genera and species in southern California, Arizona, and northern Mexico. The superfamily is not represented in the endemic Hawaiian fauna, but larvae of a yucca moth were found recently in yucca grown in Hawaii, and it is presumed that a species of *Tegeticula* has become established in the Islands. I have not had an opportunity to search for the species, and none of my correspondents have reported finding it. I include these preliminary details in the expectation that evidence of the establishment of a yucca moth in Hawaii will be forthcoming at any time.

Adult prodoxids resemble the tineids, particularly because of their roughly haired heads and long maxillary palpi. Some species have erect, stiff, specialized bristles on their labial palpi (especially well-developed in *Prodoxus*) which are similar to the bristles on the palpi of Tineidae. *Tegeticula*, however, does not have such bristles on the palpi. The prodoxids, in addition to being monotrysian, exhibit many character differences from the tineids. The hindwings have a peculiar "loose" type of scaling (usually less dense on the males than on the females), and the aculeae often easily can be seen dispersed over the entire wing membrane.

The genitalia of the Prodoxinae are unlike those of the Opostegidae, which represent the Nepticuloidea, the only members of the Monotrysia which are endemic in Hawaii. The aedeagi of the prodoxids are sclerotized, and the ovipositors are conspicuously modified as unusual, heavily sclerotized, serrated, tissue-piercing saws.

Genus **TEGETICULA** Zeller

*Tegeticula* Zeller, 1873:323. Type-species: *Tegeticula alba* Zeller, 1873:232; monobasic.

*Pronuba* Riley, 1872:444 (homonym, not of Thompson, 1860).

*Thia* Edwards, 1888:181 (homonym, not of Leach, 1815).

*Thelethia* Dyar, 1893:301.

*Valentinia* Coolidge, 1909:112 (homonym, not of Walsingham, 1907). D. R. Davis, 1967:29, monograph.

These are the remarkable yucca moths, and much has been written about their extraordinary biologies. Don Davis recently published an excellent, well-illustrated revision and monograph of this group (1967), and I can do no better than to refer the reader to his publication for extensive discussion and bibliography. He gives information on all stages of the moths, their distributions and biologies, and includes highly instructive illustrations.

By means of the sawlike ovipositor, the eggs of *Tegeticula* are inserted singly in the yucca ovaries. The larvae, which are distinctive because they lack prolegs while retaining well-developed thoracic legs, feed upon the yucca seed. They normally destroy only a few seeds in each yucca seedpod. When ready to pupate, the larva lowers itself to the ground on a silk thread and burrows into the soil. There it pupates in a silken cocoon on the surface of which it incorporates an abundance of sand and soil particles. The pupae are provided with numerous, heavy, dorsal, spinose abdominal processes which enable them to work their ways out of the soil for eclosion of the moths. The adults emerge when the yuccas flower.

The remarkable association of the yucca moths (i.e., *Tegeticula* and *Prodoxus*) with the yucca plant has been known for many years. The life history of *Tegeticula* is analogous in some respects to that of the fig insects of the chalcidoid family Agaontidae, particularly in the fact that unless the pistils of the host are pollinated by the insect, no fruit will develop. *Tegeticula*, however, is further remarkable in that the act of pollination, as well as that of pollen collecting, are completely deliberate; whereas, in the fig insects these activities are performed accidentally, due largely to the unusual morphology of the fig flower.

In brief, the female *Tegeticula* first collects, with the aid of her specialized mouthparts, a quantity of pollen from one to several flowers; she then inserts her ovipositor into a yucca pistil and deposits one egg per puncture and a varying number per flower. Usually following oviposition, and sometimes even before this act is completed, she begins to force some of the pollen she is carrying, down the stigmatic tube of the flower. Thus, pollination of the flower is insured, as well as a supply of seeds for the larvae to feed upon. . . .

The exact sequence of events following emergence may vary somewhat; it is probable that, in most instances, the newly emerged female, on reaching the first blossom, begins to gather pollen. Immediately prior to this activity, the moth typically runs about the bases of the stamens and then quickly climbs up the inner side of a filament. . . . With coordinated movements of the head and mouthparts (the maxillary tentacles in particular), she succeeds in scraping pollen from the anther; then with the aid of her forelegs, the pollen is molded into a ball and firmly worked into a natural pocket under the head. Several stamens and more than one flower may be visited before the pollen gathering impulse subsides. Eventually the female climbs a pistil and assumes a position favorable for egg laying. . . .

Immediately following oviposition, the female climbs to the top of the pistil (if she has not already done so) and commences, amid considerable head and mouthpart movements, to work the pollen into the stigmatic cavity. The behavior of the moth during pollination is very characteristic and easily detectable, even from a slight distance. The entire forward portion of the body of *T. yuccasella* undergoes a series of rapid pumping or bobbing motions, during which time the pollen is not merely deposited on the stigma but is actually forced into the stigmatic tube. Portions of the mouthparts, notably the maxillary tentacles, are held stiffly erect under the head during this activity and appear to function collectively as a kind of plunger or ramrod. For *T. yuccasella*, a series of approximately 10-35 "bobbing" motions are conducted within an interval of usually less than 20 seconds in order to accomplish pollination. (D. R. Davis, 1967:24, 25, 32, 34.)

**Tegeticula** species.

Immigrant. This moth is probably a California species. First recorded from Hawaii by E. S. Shiroma in *Proceedings Hawaiian Ent. Soc.* 19(3):324, 1968 (1967), who reported the “interception of 6 . . . larvae found boring in seed pods of *Yucca* sp. from Hawaii destined to California on May 31, 1965 by Inspectors Tony Abear and John Graffam.” These larvae were determined as *Tegeticula* by D. M. Wiseman at the United States National Museum. No further details are known to me.

Hostplant: *Yucca*.

## Suborder **DITRYZIA**, continued from Volume 8

*Ditrysia* (Börner, 1939:1423). Hinton, 1946a:4, redefined.

The Ditrysia include the advanced Lepidoptera which have two sex openings in the female—an ostium through which copulation is effected and a separate ovipositor complex through which the eggs are laid. All of the Lepidoptera known in Hawaii except *Opostega* and *Tegeticula* belong to this suborder. Diagrams of the two types of reproductive organ complexes are given in figure 33.

## Series **HETEROCERA**, continued from Volume 8

*Phalaenae* Linnaeus, 1758:496.

*Nocturni* Latreille and *Sphingides* Latreille, 1802:400, 404.

*Nocturnes* Latreille, 1805:142.

*Nocturna* Latreille and *Crepuscularia* Latreille, 1809:187, 189, 209, 216. Leach, 1815:130, 131.

*Nocturni* Boisduval and *Crepusculares* Boisduval, 1829:32, 38.

*Heterocera* Boisduval, 1840:39.

As stated on page 33 of Volume 7 of this series, the names “Rhopalocera” and “Heterocera” have been so widely used that it would be difficult to eliminate them. One must agree with Hinton, however, that the use of the two terms as subordinial divisions of the Lepidoptera is untenable. The terms are retained here only for the convenience of separating the butterflies, or Rhopalocera, from the higher moths, or Heterocera.

The families of ditrysian Microlepidoptera known to be established in Hawaii at the time of the completion of this writing (1970) are the following:

### TINEOIDEA

#### TINEIDAE

### TORTRICOIDEA

#### TORTRICIDAE

### GRACILLARIOIDEA

#### GRACILLARIIDAE

#### BUCCULATRIGIDAE

#### LYONETIIDAE

### YPONOMEUTOIDEA

#### YPONOMEUTIDAE

#### SCHRECKENSTEINIIDAE

### PTEROPHOROIDEA

#### PTEROPHORIDAE

### ALUCITOIDEA

#### CARPOSINIDAE

#### ALUCITIDAE

### GELECHIOIDEA

#### SCYTHRIDIDAE

#### AGONOXENIDAE

#### CYCNOIDIIDAE

#### GELECHIIDAE

There is considerable difference of opinion concerning the superfamily placement of some families, and even the names of some families are subject to controversy. One may rightly ask if several of the so-called "superfamilies" used for Lepidoptera are truly superfamilies as that term is applied to other orders. Much work remains to be done to establish an acceptable suprageneric classification. I have not yet seen a workable key to the supposed superfamilies of Lepidoptera.

It has been necessary to make some rather arbitrary decisions in treating the Hawaiian fauna, and no doubt some changes in my taxonomy will be required as more study is done.

In passing, and in connection with the names of families and type-species of genera, I wish to call attention to a work that appears not well known but which may on occasion be of considerable assistance, if used with caution. It is Hampson's paper, published in 1918, entitled *Some Small Families of the Lepidoptera Which Are Not Included in the Key to the Families in the Catalogue of Lepidoptera Phalaenae, a List of the Families and Subfamilies of the Lepidoptera with Their Types and a Key to the Families*. The key to the families of Microlepidoptera in that work was prepared by J. H. Durrant. Hampson unfortunately based the family names on the oldest included genera instead of rightly giving priority to the oldest family-group names. Hence, many of his choices of family names are unacceptable today. Nevertheless, his list is of value and may be consulted with profit. Most unfortunately, Hampson did not cite the authors of the family names, nor did he give references. Hampson listed type-species for many genera, and some of these citations are the first designations of type-species.

### Superfamily **TINEOIDEA** (Latreille)

*Tineites* Latreille, 1810:347, 363.

*Tineoidea*: Mosher, 1916:28, 31, 44. Forbes, 1923:35, 115.

### Family **TINEIDAE** (Latreille)

*Tineae* Linnaeus, 1758:496, 534, as a division of *Phalaena*.

*Tineites*: Latreille, 1810:347, 363.

*Tineida*: Leach, 1815:133.

*Tineidae*: Samouelle, 1819:248. Stainton, 1854:10, 16. Hemming, 1957:254, 256, 259, 317.

*Tineaedes*: Billberg, 1820:93.

*Tinearia*: Gravenhorst, 1843:167.

*Tineariae*: Zetterstedt, 1840:990.

*Tineacea*: Zeller, 1846*b*:268.

*Tineides*: Herrich-Schäffer, 1843:14. Zeller, 1847*c*:801.

*Tineina*: Herrich-Schäffer, 1857:58.

*Tineinae*: Walsingham, 1890:144. Spuler, 1898:35.

*Tinaeidae* Corbet and Tams, 1943*c*:103. Hemming, 1957:263, 317; synonymy.

*Monopidae* Spuler, 1910:462.

*Phycidae* Hampson, 1918*b*:387.

Busck, 1903*a*; Căpușe, 1966; Chambers, 1872–1878*b*; Clemens, 1872; Dietz, 1905; Gozmány, 1967; Meyrick, many titles; G. Petersen, 1957–58; Stainton, 1849, 1851, 1854, 1855–67; Walsingham, 1882.

See Hemming, 1957, Opinion 450, International Commission on Zoological Nomenclature.

G. Petersen, 1957, has published an illustrated work on the genitalia of the Palaearctic tineids.

The family Tineidae includes many species of economic importance, and an unusually large number of species has followed man to the far corners of the earth. It is significant that although 25 species are now known in Hawaii, all of them are introduced, and the family does not appear to be represented in the endemic fauna. Except for the Palaearctic region, the family is mostly in a state of confused taxonomy the world over, and the treatment of any limited fauna must be considered tentative.

The habit of some larval tineids of eating wool, hair, feathers, and other animal products is familiar to us, but the food of several of the species of the family found in Hawaii is not exactly known. Some of those species are considered “scavengers” or “refuse eaters”, and they are believed to feed upon dead or rotting vegetable matter. Although some larvae that inhabit dead or decaying vegetable matter may appear to eat such material, it may be that some of them are actually feeding upon the remains of arthropods in the vegetable matter. Some glean fragments of dead arthropods, and perhaps molted arthropod skins, from the surfaces they inhabit. It is true, however, that some species do feed upon plant tissues, as does the bud moth of sugarcane (see *Neodecadarchis*, below), and many species, including *Nemapogon*, eat fungi. The strange larvae of *Paraclystis* Meyrick are termitophiles in the nests of African *Schedorhinotermes* (Harris, 1968: 111, fig. 4).

There are two principal tineids in Hawaii whose habits are such that they frequently come to attention in the home. These are the case-making clothes moth (*Tinea pellionella* Linnaeus) and the webbing clothes moth (*Tineola bisselliella* Hummel). One of the tapestry moths (*Trichophaga mormoris* Meyrick = *percna* Corbet and Tams) may rarely be found in houses in Hawaii. Another species whose case-bearing larvae are often noticed crawling on the walls of rooms is *Phereoeca allutella* (Rebel), but it is not known to damage clothing and other household items as do the species previously mentioned. There may be a few other house-inhabiting species in Hawaii which have not yet been recognized, and infestations of *Nemapogon* may be found.

Marlatt (1908: 1–2) has said:

The clothes moths all belong to the group of minute Lepidoptera known as Tineina, the old Latin name for cloth worms of all sorts. . . . The common species of clothes moths have been associated with man from the earliest times and are thoroughly cosmopolitan. They are all probably of Old World origin, none of them being indigenous to the United States. That they were well known to the ancients is shown by Job's reference to “a garment that is moth eaten,” and Pliny has given such an accurate description of one of them as to lead to the easy identification of the species. That they were early introduced into the United States is shown by Pehr Kalm, a Swedish scientist, who took a keen interest in house pests. He reported these tineids to be abundant in 1748 in Philadelphia, then a straggling village, and says that clothes, worsted gloves, and other woolen stuffs hung up all summer were often eaten through and through by the worms, and furs were so ruined the hair would come off in handfuls.

What first led to the association of these and other household pests with man is an interesting problem. In the case of the clothes moths, the larvae of all of which can, in case of necessity, still subsist on almost any dry animal matter, their early association with man was probably in the role of scavengers, and in prehistoric times they probably fed on waste animal material about human habitations and on fur garments. The fondness they exhibit nowadays for tailor-made suits and other expensive products of the loom is simply an illustration of their ability to keep pace with man in his development in the matter of clothing from the skin garments of savagery to the artistic products of the modern tailor and dressmaker.

The taxonomy of the Tineidae is mostly chaotic. I have not found any satisfactory published system of classification for the Pacific faunas. Moreover, I do not know of any wholly acceptable published definition of the family. Hinton (1955:227) has already drawn attention to the fact that even eminent lepidopterists have placed species in the Tineidae that do not belong even to the same suborder. It is beyond the scope of this monograph to enter deeper into the taxonomy of the Tineidae than is required for the elucidation of the Hawaiian representatives. This I regret, because the study is both challenging and exciting, and the rewards of such research may be great. Unfortunately, we do not yet know enough about the representatives of the Tineidae of Hawaii to enable a good classification of even those species to be prepared. The work of Günther Petersen and A. K. Zagulyaev have done much in recent years to give us a better understanding of the Palaearctic Tineidae.

Hinton made an advanced study of the larvae of some Tineidae, mostly species found in Britain, but, most unfortunately, he did not continue his excellent work and it stands incomplete. Had he pursued to a conclusion the worthy studies which he began, entomologists might forever have been in his debt.

In the Karl Jordan memorial volume of the *Transactions of the Royal Entomological Society of London* (1955:228), Hinton reported his conclusions based upon the study of some larval Tineidae as follows:

On their structural features the larvae of the Tineidae may be placed in four subfamilies: Acrolophinae, Scardiinae [Scardiinae], Nemapogoninae, and Tineinae. Such a division is partly supported by the feeding habits of the larvae. The Acrolophinae live in silken galleries and webs in the ground, and are known to feed on clover and on the roots of grasses. The Scardiinae [Scardiinae] feed upon fungi. The Nemapogoninae feed principally upon fungi in or on decaying wood, and a few species attack stored vegetable products, especially when these are mouldy. The Tineinae normally feed upon more or less dry animal matter, especially hair and feathers, and they seem to be the only group in the family capable of splitting disulphide bonds.

Hinton expanded his views in his useful paper *The Larvae of the Species of Tineidae of Economic Importance* (1956), and that paper should be consulted by all who have reason to study the Tineidae. His paper may be used as a point of departure for future work in this field.

As stated in the foregoing quotation, Hinton was able to characterize four subfamilies in the limited number of tineid larvae he studied—the Acrolophinae, Scardiinae, Nemapogoninae, and Tineinae. Most unfortunately, however, Hinton did not characterize the adults of the supposed subfamilies, and we are left without an outline of how to arrange the adult moths in subfamilies according to Hinton's system.

It should be noted that Hinton (1956:260) stated that he had previously erected a "new subfamily, the Scardiinae" (1955:228), but Scardiinae was used earlier by Eyer in 1924:320 (see his figure on that page). Most unfortunately, Hinton (1955, 1956) and Diakonoff and Hinton (1956) used the



subfamily name Nemapogoninae without giving an authority for it. Some workers have considered Hinton or Diakonoff and Hinton to be its authors. However, Hinton, *in litteris*, disclaims credit for it. Diakonoff, *in litteris*, now credits Nemapogoninae and Scardiinae to an obscure Russian paper or thesis by Zagulyaev, 1954, but it is possible that this work has not been "published" in a form acceptable under the International Code of Zoological Nomenclature. I have here considered the Nemapogoninae to be distinct from the Setomorphinae, but if they are considered the same, then the name Setomorphinae has priority. If the Nemapogoninae prove to be the same as the Setomorphinae and also equivalent to the Erechthiinae, then it is Erechthiinae which has priority. Perhaps the name Teichobidae Staudinger and Wocke, 1871:276, is also involved in this complex.

Of the four subfamilies of Tineidae recognized by Hinton in 1955, the Acrolophinae and Scardiinae are, to my knowledge, absent from Hawaii. We have also to consider *Opogona* in Hawaii. Hinton, unfortunately, did not include *Opogona* in his studies. He may have been misled by the opinions of some workers who have excluded *Opogona* from the Tineidae. Some workers might conclude from a study of the larvae alone that *Opogona* belongs to the Nemapogoninae, but this is highly unlikely, and I have given the group full subfamily status here. Also, I cannot agree that *Opogona* should be excluded from the Tineidae, the singular appearance of the head of the adult notwithstanding.

Unhappily, we do not know the larvae of all of the genera of Tineidae now present in Hawaii. Hence, it is impossible to present in this text a complete analysis of the Hawaiian group according to the Hinton system. I have not seen larvae of *Crypsithyroides*, *Mecomodica* or *Pantheus*, and no adequate descriptions of these larvae are known to me.

Larvae of Tineidae have the following characters in common: thoracic legs well developed; prolegs on abdominal segments 3 to 6 and 10 and crochets on prolegs of segments 3 to 6 arranged in ellipses in complete or nearly complete uniordinal series; abdomen without an anal fork; head with the adfrontal sclerites reaching to or nearly to the vertical triangle with the front extending from about one-third to about three-fourths or more of the distance to the vertical triangle; raised ocellar lenses may be present or absent and, when present, they may number from one to six; when six ocelli are developed, 1 and 2 are in a subvertical line considerably caudad of 3 and 4; prothorax with the L group of setae trisetose in the genera in Hawaii; abdominal segments 1 to 7 have setae L1 and L2 always widely separated with L1 caudad of an imaginary vertical line drawn from the spiracle (in some species L1 may be directly or nearly directly caudad of the spiracle or even somewhat caudad and dorsad, whereas it is considerably below the level of the spiracle in other species), and L1 and L2 may be arranged either subhorizontally, obliquely, or subvertically.

After a study of the larvae of some of the tineids found in Hawaii, I have tentatively concluded that they may be separated into six groups or subfamilies: Tineinae, Dryadaulinae, Erechthiinae, Setomorphinae, Nemapogoninae, and Hieroxestinae. I have not been allowed time to devote adequate study to the generic and suprageneric classification of the larvae and adults of the Tineidae

(and this would be a major, long-term project by itself), and my arrangement must be considered provisional and perhaps only suggestive. It is probable that the Tineidae of the world will eventually be subdivided into additional subfamilies and tribes, because it is obvious that the family contains many subdivisions. The task of such revised taxonomy will be difficult, and success will be long in coming.

PROVISIONAL KEY TO THE SUBFAMILIES OF  
TINEIDAE IN HAWAII BASED UPON THE LARVAE

1. SV group of setae on meso- and metathorax bisetose;  
(adults rough-headed) ..... **Tineinae.**  
SV group of setae on meso- and metathorax unisetose;  
(adults either rough-headed or smooth-headed) ..... 2
- 2(1). Prolegs on abdominal segments 3 to 6 with a line or  
band of recurved spinelets on cephalic sides above  
crochets; (adults smooth-headed) ..... 5  
Prolegs without such spinelets; (adults rough-headed) ... 3
- 3(2). Tarsi of prothoracic legs notably long, slender and  
acuminate, longer than tibiae; prolegs elongated;  
(pinacula and setae dark in known larva) .....  
..... **Dryadaulinae.**  
True legs and prolegs normal, not unusually slender .... 4
- 4(3). Derm with dense, conspicuous microtrichia; pinacula  
of setae V1 fused to coxae; abdominal segment 8  
with setae D1 slightly more widely separated than  
setae D2; abdominal segment 9 with setae D1  
distinctly cephalad of a vertical line drawn from D2,  
and seta L1 nearer to SD1 than to L3 (or L2?) ....  
..... **Nemapogoninae.**  
Derm appearing smooth and without conspicuous  
microtrichia; pinacula of setae V1 free from coxae;  
abdominal segment 8 with setae D2 much more  
widely separated than setae D1; abdominal segment  
9 with seta D1 in line with or slightly caudad of a line  
drawn vertically from D2, and seta L1 closer to L3  
(or L2?) than to SD1 ..... **Erechthiinae.**
- 5(2). Labial palpus with segment 2 very short, only about as  
long as breadth of segment 1; mandibles unidentate;  
head with frons extending dorsad only to about  
halfway between clypeal suture and vertical triangle  
(the basal subtriangular emargination at the top of  
the head that divides the head into its right and left  
lateral hemispheres) and ending distinctly ventrad of  
(anterior to) setae AF2 ..... **Setomorphinae.**

Labial palpus with segment 2 conspicuously elongate, more than one-half as long as segment 1; mandibles 4- or 5-dentate; head with frons extending farther dorsad and ending nearer vertical triangle and dorsad (caudad) of setae AF2. . . . . **Hieroxestinae.**

The larvae of some of the genera of the subfamily Tineinae may be distinguished by the following key which has been modified from details given by Hinton, 1956:

#### TINEINAE LARVAE

1. Prothoracic coxae very narrowly separated on midline or fused. Head with a large ocellar lens on each side. Larva in a flattened, fusiform, portable case. . . . . 2
  - Prothoracic coxae obviously separated from each other on midline; other characters variable. . . . . 3
- 2(1). Procoxae very narrowly separated from each other on midline. Meso- and metathorax with the SV setal group in an almost horizontal line. Head with seta O2 very close to posterior margin of ocellus and anterior to a point above O3. . . . . **Praeacedes.**
  - Procoxae fused with each other on midline. Meso- and metathorax with SV group of setae in a nearly vertical line. Head with seta O2 far caudad of ocellus and posterior to a point above O3. . . . . **Phereoeca.**
- 3(1). SV setal group of meso- and metathorax in a slightly oblique or nearly horizontal line. Ninth abdominal segment with L setal group bisetose. First 8 abdominal segments with seta SD2 considerably cephalad of spiracle. Spiracles of 7th abdominal segment approximately as large as those of 8th abdominal segment. Head without convex ocellar lenses and usually without pigmented spots. Larva not in a portable case. . . . . **Tineola.**
  - SV setal group of meso- and metathorax in a vertical or nearly vertical line. Ninth abdominal segment with L setal group trisetose. First 8 abdominal segments with seta SD2 more or less directly dorsad of spiracle. Spiracles of 7th abdominal segment only one-half to two-thirds as large as spiracles of 8th segment. . . . . 4
- 4(3). Setae L1 and L2 of first 7 abdominal segments in a nearly vertical line; L1 directly behind spiracle. . . . . 5
  - Setae L1 and L2 of first 7 abdominal segments in a more or less horizontal line; L1 considerably below the spiracle. . . . . 6

- 5(4). Antenna with 1st segment at least as long as 2nd. Seta SD1 of prothorax nearer to XD2 than is XD1. First 8 abdominal segments with SV setae always on separate pinacula (pinacula hardly visible on unstained specimens). Seta SD1 as far, or distinctly farther, from spiracle than is seta L1. Ninth abdominal segment with setae D1 and SD1 always on separate pinacula. Prolegs of segments 3 to 6 with ellipse of crochets nearly always closed on mesal side. Microscopical spines of abdomen subtriangular and not produced into long, slender microtrichia . . . . . **Trichophaga.**

Antenna with 1st segment much shorter than 2nd. Seta SD1 of prothorax slightly farther from seta XD2 than is XD1. First 8 abdominal segments with SV setae always on the same pinaculum. Seta SD1 always nearer to spiracle than L1. Ninth abdominal segment with setae D1 and SD1 always on the same pinaculum. Prolegs of segments 3 to 6 with ellipse of crochets always narrowly open on mesal side. Microscopical spines of abdomen slender microtrichia . . . . . **Monopis.**

- 6(4). Prothorax with distance between setae SD1 and XD2 twice as great as that between XD1 and XD2; seta L1 directly ventrad of L2. First 9 abdominal segments with SV setae minute. Cuticle of thorax and abdomen between pinacula without microtrichia but with dense, more or less flat-topped, microscopical tubercles . . . . . **Tinea.**

Prothorax with distance between setae SD1 and XD2 much less than twice as great as that between XD2 and XD1; seta L1 between and below L3 and L2 so that it is posteroventrad from L2. First 9 abdominal segments with SV setae long and distinct. Cuticle of thorax and abdomen between pinacula with dense, slender microtrichia and without numerous more or less flat-topped tubercles . . . . . **Niditinea.**

A general key to the adults of the genera of Tineidae known to me to be present in Hawaii follows. This should be considered a preliminary key, and by use it may be corrected, altered, and strengthened. Unfortunately, I have not had an opportunity to test the key as it should be tested.

# KEY TO THE ADULTS OF THE GENERA OF TINEIDAE FOUND IN HAWAII

1. Head with mostly smooth, prostrate vestiture, front always smooth-scaled, at most with erect tufts on crown . . . . . 2  
 Head, including front (at least laterad), mostly bristling with masses of erect hairs and scales . . . . . 4
- 2(1). Maxillary palpi very long (may be almost as long as labial palpi and at times may appear almost to be a proboscis); proboscis present, but small; head with a characteristic, protuberant "brow-ridge" of scales extending across vertex between antennae (figure 211); wings narrow and venation reduced, as in figure 211 . . . . .  
 . . . . . **Opogona** in the **Hieroxestinae**.  
 Maxillary palpi and proboscis absent; head without a "brow-ridge" as described above; venation as in figures 201 and 205 of *Lindera* and *Setomorpha* of the Setomorphinae . . . . . 3
- 3(2). Forewing with 11 veins in the male and 12 veins in the female and with vein 7 out of 8 and 8 out of 9; hindwing with costal margin sinuate just distad of middle; wing shape and venation as in figure 201; (our species with terminal segment of labial palpus broad and conspicuously flattened, about as broad as basal antennal segment); vestiture of metascutum and metascutellum consisting mostly of sharp-pointed hairs or narrow hair-scales . . . . .  
 . . . . . **Setomorpha**.  
 Forewing with 12 veins in both sexes, vein 8 separate from 9; hindwing with costal margin continuously arcuate; wing shape and venation as in figure 205; (our species with terminal segment of labial palpus only moderately flattened and much narrower than basal antennal segment); middle of metascutellum clothed with broad-tipped squamae and with a similar patch of squamae on either side of the posterior margin of the metascutum, metascutum otherwise bare . . . . . **Lindera**.
- 4(1). Forewing with an unusual, specialized, naked-appearing, "subhyaline spot" or "fovea" at cell apex, this spot often to be seen in more contrast on underside of wing; part of the **Tineinae** . . . . . 11  
 Forewing without such a modified area . . . . . 5

- 5(4). Apices of forewings either upturned or bent downward or prolonged (be sure your specimen has not had the apices of the wings artificially flattened during the mounting process), or if not so bent (as apparently sometimes in *Decadarchis*), then forewing has only 10 veins (only eight veins arise from the cell) and there is an apical areole in the cell; terminal segment of labial palpus never broad, flattened and paddle-shaped;

**Erechthiinae** .....6

- Apices of forewings not turned up or down and not produced; forewings with 11 or, in most species, with 12 veins (nine or 10 veins arise from cell), or with terminal segment of labial palpus broad, flattened, and paddlelike.....12

[NOTE: use couplet 5(4) with caution. If your specimen does not appear to agree with the genera beyond couplet 12(5), then try 6(5).]

- 6(5). Hindwing with vein 1b abruptly angled at about middle or distinctly sinuous, as in figures 168–170, 183; forewing with only 10 veins; labial palpus greatly expanded beneath by a large mass of erect scales.....7

- Hindwing with vein 1b at most gently arcuate, as in figures 192, 196; forewing usually with 11 veins (may be somewhat confused in *Mecomodica*); labial palpus without such a mass of erect vestiture.....10

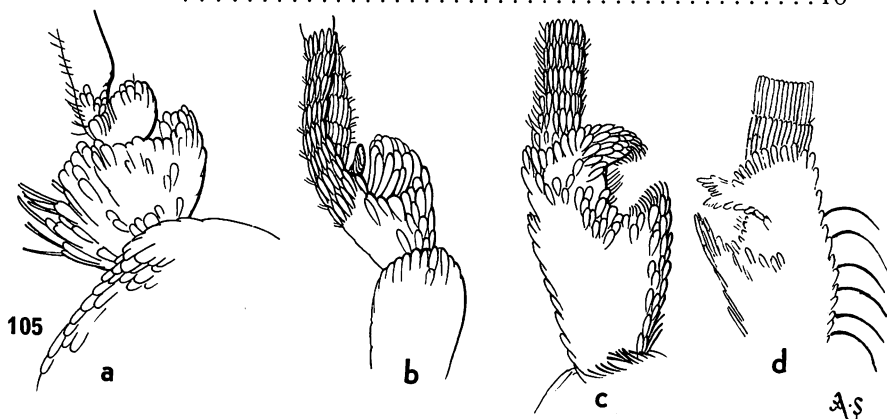


Figure 105—Details of the bases of the antennae of some male moths. *a*, *Blastobasis inana* (Butler), Oahu; *b*, *Mecomodica fullawayi* (Swezey), paratype, Ocean Island; *c*, *Decadarchis simulans* (Butler), Honolulu; *d*, *Pantheus penicillata* (Swezey), Kauai (the fine hairs on the segments of the antennal shaft are much less conspicuous on this species than on the others illustrated here).

- 7(6). Basal antennal segment either without a pecten (comb of several long, stiff bristles) or with a poorly developed pecten; forewing (descaled and slide-mounted) with costal and posterior margins convexly arcuate to apex, as in figures 183–184, chorda and areole present. . . . . **Decadarchis.**  
 Basal antennal segment with a well-developed pecten; forewing (descaled and slide-mounted) with costal and posterior margins concave distad (figures 168–169 of *minuscula* and *flavistriata*), or at least not convex (figure 170 of *penicillata*) . . . . . 8
- 8(7). Head with frons, except laterad, clothed with prostrate or subprostrate, broad-tipped, dorsally directed squamae; face usually appearing flattened or even concave in male. . . **Lepidobregma.**  
 Head with face clothed entirely with hairlike erect vestiture. . . . . 9
- 9(8). Hindwing with a bare, transparent area near base; forewing with origin of vein 2 far removed from vein 3; hindwing with costa and vein 8 very slightly arcuate, for most part appearing nearly straight; venation as in figure 168; (basal antennal segment of male not “notched”; male forewing without a “sex patch” beneath; hindwing of male lacking a subcostal brush); hairs on head sharply pointed; first labial palpal segment lacking specialized erect spines (these are confined to second segment) . . . . . **Neodecadarchis.**  
 Hindwing lacking a bare, transparent area near base; forewing with origin of vein 2 as near to 3 as vein 4 is to 3; hindwing with costa and vein 8 conspicuously sinuous, venation as in figure 170; (basal antennal segment of male strongly “notched” as in figure 105; underside of forewing of male with a conspicuous mat of dense, specialized squamae in cell; hindwing of male with a strong subcostal brush); hairs on head apically blunted or emarginate; outer side of first labial palpal segment with several stiff, dark, erect bristles similar to those on segment 2. . **Pantheus.**
- 10(6). Hindwing with costal margin obviously arched, wings as in figure 192. . . . . **Erechthias.**

- Hindwing with costal margin nearly straight to beyond middle, as in figure 196; (male antenna with a conspicuous "notch" involving several segments beyond the second in addition to the first segment, as in figure 105).....**Mecomodica.**
- 11(4). Antennae much shorter than a forewing; veins 3 and 4 stalked in forewing; venation as in figures 148–149.....**Monopis.**
- Antennae as long or longer than a forewing; veins 3 and 4 in forewing free; venation as in figure 106.....**Crypsithyroides.**
- 12(5). Forewing with vein 1b forked basad.....13
- Forewing with vein 1b not forked basad.....18
- 13(12). Forewing with only 11 veins (evidently 4 and 5 fused); venation as in figure 113.....**Niditinea.**
- Forewing with all 12 veins present.....14
- 14(13). Hindwing with only seven veins (5 and 6 fused).....**Praecedes.**
- Hindwing with all eight veins present.....15
- 15(14). Forewing with veins 7 and 8 stalked.....16
- Forewing with all veins free.....17
- 16(15). Hindwing with veins 5 and 6 connate or shortly stalked.....**Tinea.**
- Hindwing with vein 6 free and closer to 7 than to 5.....**Nemapogon.**
- 17(15). Maxillary palpi very short, hardly longer than basal labial palpal segment; forewing with costal area not thickened, vein 1b forked far basad of middle and origin of vein 11 nearly opposite to point of forking of 1b; venation as in figure 123.....**Tineola.**
- Maxillary palpi obviously longer than basal segment of labial palpi; forewings with costal area thickened, vein 1b forked at about middle and vein 11 beginning at a point distinctly basad of place of forking of 1b; venation as in figure 143.....**Trichophaga.**
- 18(12). Terminal segment of labial palpus narrow and pointed; hindwing with all eight veins present; wings comparatively narrow, venation as in figure 135.....**Phereoeca.**



Terminal segment of labial palpus very large, broad, flat, and paddlelike; hindwing with only seven veins (evidently 3 and 4 fused); wings broad, venation as in figure 157, **Dryadaulinae** . . . . .  
.....**Choropleca.**

Subfamily **TINEINAE**

The limits of the true group Tineinae have not yet been correctly defined and are unknown. I use the group term in a temporary and wide sense and include within it in Hawaii not only typical Tineinae but also some genera which probably will be removed into separate subfamilies or tribes when the family is better known. The world fauna is in a highly confused state of taxonomy.

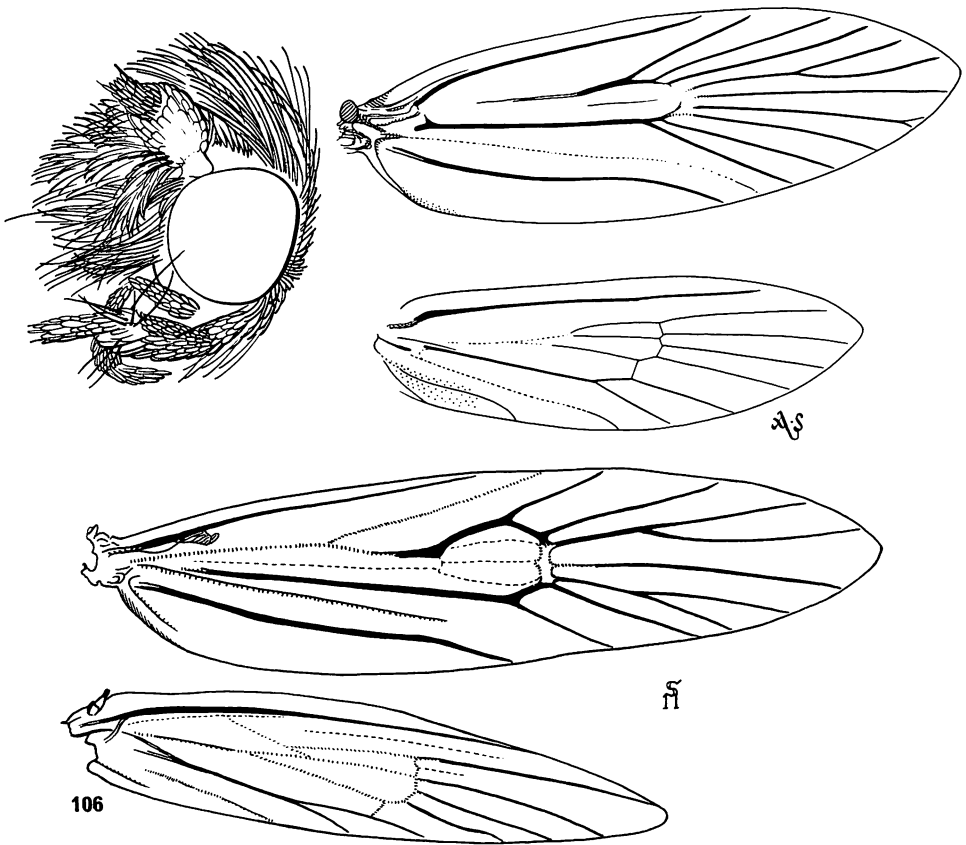


Figure 106—Top, head and wing venation of the female holotype of *Crypsithyroides obumbrata* (Butler), Honolulu (BM slide 3938). Bottom, wing venation of *Crypsithyris mesodryas* Meyrick, the type-species of *Crypsithyris*, lectotype male from Ceylon (BM slide 9604 Clarke).

Genus **CRYPSTHYRODES** Zimmerman, **new genus**

Head with crown and front very rough-haired overall; ocelli absent; proboscis very short; antennae about as long as a forewing, smooth-scaled, except distad, and ciliations minute, first segment without a pecten or with only one or two setae, apex (of first segment) simple (not "notched") in male; maxillary palpi long and folded, about as long as labial palpi; labial palpi pendant, smooth scaled, second segment subequal in length to terminal segment, or a little longer, and apex about as broad as one-half the length of terminal segment in type-species, compressed, narrowly elongate-subtriangular, not expanded by vestiture, lateral and terminal erect bristles strongly developed and terminal segment smooth-scaled, narrow, subulate. Thorax and abdomen without crests. Metatibiae expanded dorsally and ventrally with long hairs and scales. Wing shape and venation as illustrated (figure 106); forewings with a "subhyaline spot" at apex of cell (visible on both dorsal and ventral surfaces of the wing), without raised scales. Genitalia as illustrated; uncus expanded distad; gnathus expanded and bifid.

Type-species: *Blabophanes obumbrata* Butler, 1881:396.

This genus is close to *Crypsithyris* Meyrick, 1907a:752 (type-species: *Crypsithyris mesodryas* Meyrick), but *Crypsithyris* (figure 106) has differently shaped wings. In the forewing of *Crypsithyris* veins 4 and 5 are long-stalked, whereas in *Crypsithyroides* they are free from the cell. In *Crypsithyris* vein 11 in the forewing arises from near the middle of the cell and far from 10, whereas in *Crypsithyroides* it arises from close to 10 near the end of the cell. The illustrations demonstrate these and other differences. The male genitalia of the species of *Crypsithyris* (figures 109–110) which I have examined have the uncus and gnathus simple, whereas the uncus is expanded and the gnathus is expanded and divided in *Crypsithyroides*. Also, the sacculus has small membranous lobes or "flaps" in *Crypsithyris* which are absent from *Crypsithyroides*. The illustrations display these differences better than they can be described in words.

*Crypsithyroides* is to be taken as being of feminine gender.

There have been two species recorded from Hawaii as *Crypsithyris*, but the records are in error. One of these is *Crypsithyris enixa* Meyrick, 1921b:197, but this is based upon specimens of *Crypsithyroides obumbrata* (Butler) which were misidentified by Meyrick. The other erroneous record is of *Crypsithyris pheretropa* Meyrick, 1931:105 (figures 107, 109), but this was an incorrect determination for *Phereoeca allutella* (Rebel), for details of which, see pages 296–304.

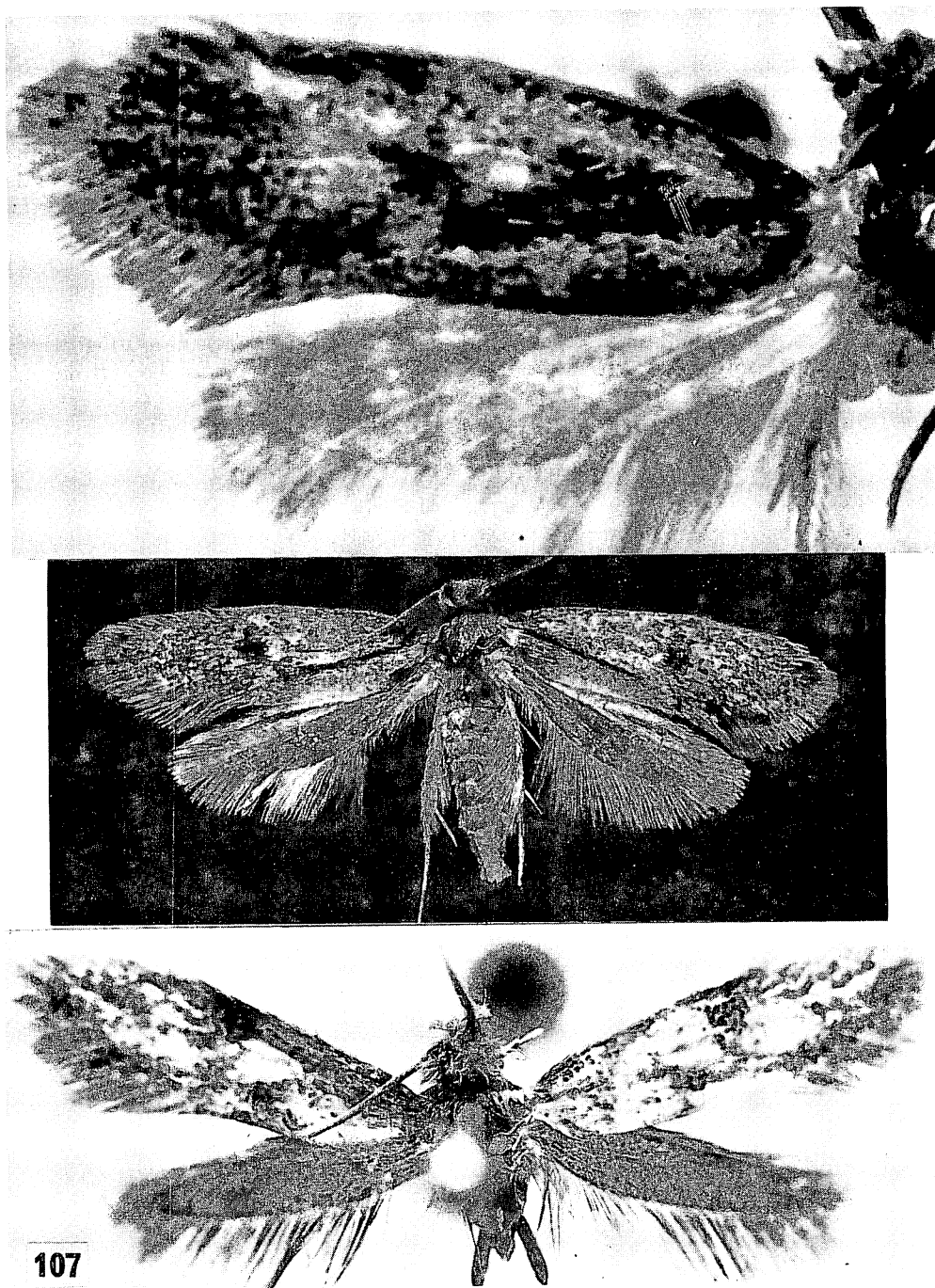


Figure 107—See page 269 for legend.

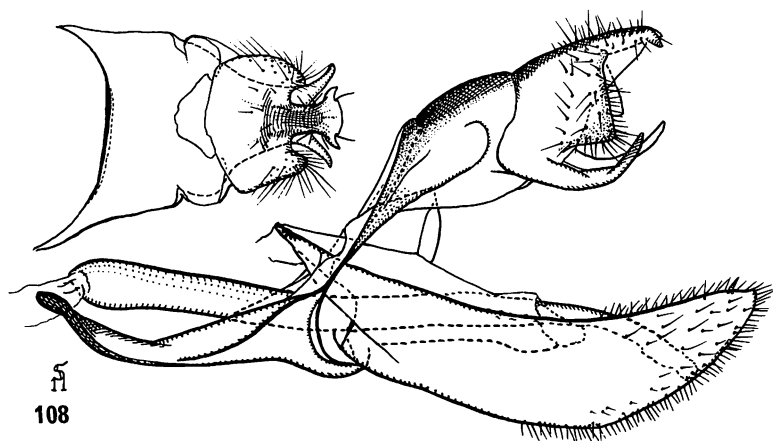


Figure 108—*Crypsithyroides obumbrata* (Butler), male genitalia in lateral aspect with an insert of the tegumen, uncus, and arms of the gnathus in dorsal aspect; Kaimuki, Oahu (slide Z-XII-30-66).

***Crypsithyroides obumbrata* (Butler) Zimmerman, new combination**  
(figs. 106, head and wing venation; 107, moth; 108-110, male genitalia;  
111, female genitalia; 112, larval case).

*Blabophanes obumbrata* Butler, 1881:396.

*Monopis obumbrata* (Butler) Walsingham, 1907b:728.

*Crypsithyris enixa* as a misidentification by Meyrick for Swezey, *Proc. Hawaiian Ent. Soc.* 5(2):185, 1923, not of Meyrick, 1921b:197.

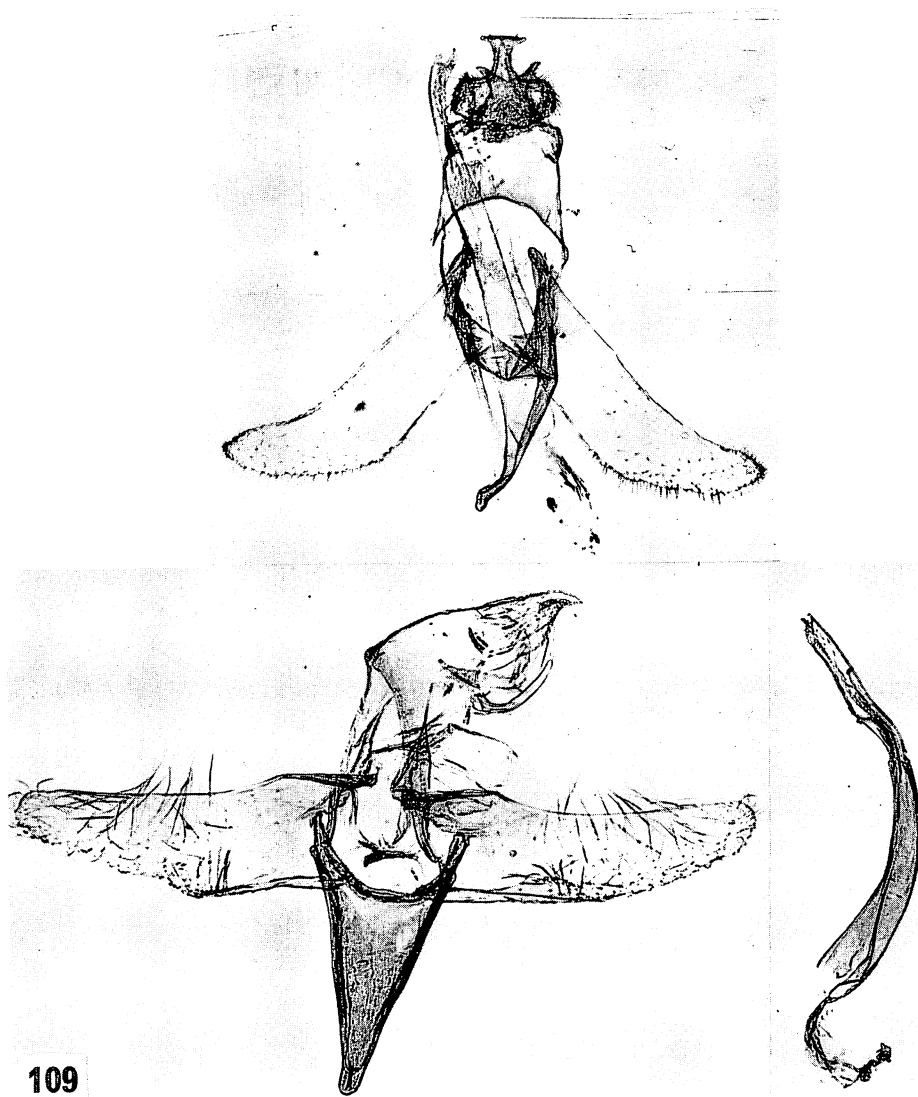
*Crypsithyris sladeni* Bradley, 1957:111, figs. 28, 111, 112. **New synonym.**

Oahu (type locality: Honolulu).

Immigrant. This species was originally described from a single specimen collected in Honolulu by Blackburn who said "occasionally taken in Honolulu" (the Blackburn locality code on the holotype reads "81.7 71"). There are no other records of it under the name *obumbrata* in Hawaii, but it was found, during the preparation of this volume, that Meyrick had confused this species with his own species *Crypsithyris enixa* (figure 110), described from Java, and since 1922 it has been called *enixa* in Hawaiian literature. I have also found that Bradley redescribed the species as *Crypsithyris sladeni* from specimens he collected in bat-infested caves on Rennell Island (off the southern Solomon Islands.) J. F. G. Clarke found it in bat caves in the Caroline Islands, and it also occurs in Malaya.

Dr. Swezey reared the moths from oblong, flat, brown cases (figure 112) which he found in trash in the axils of the leaves of date palm and under a board on the ground in the cellar of his house in Manoa Valley, Honolulu. The food of the larva is, however, unknown.

Figure 107—Top, *Crypsithyroides obumbrata* (Butler), holotype female, Honolulu, forewing 7.0 mm. (BM slide 3938); the pale mark near apical quarter of costa of forewing is a hole; note the "subhyaline spot" near middle of forewing. Middle, another example of the same species which was misidentified as *Crypsithyris enixa* Meyrick, forewing 6.0 mm.; Kaimuki, Oahu. Bottom, the male holotype of *Crypsithyris pheretropa* Meyrick, Shillong, Assam, expanse 9.25 mm. (BM slide 3989, genitalia on figure 109); this species was erroneously recorded from Hawaii.



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Figure 109—Top, *Crypsithyroides obumbrata* (Butler), ventro-caudal view of the male genitalia, aedeagus in situ; Kaimuki, Oahu (slide Z-XII-30-66). Bottom, *Crypsithyris pheretropa* Meyrick, male genitalia of the holotype from Assam (BM slide 3989); the flaplike process on each sacculus is folded over and obscured; this species was erroneously reported from Hawaii; see the figure of the moth on figure 107.

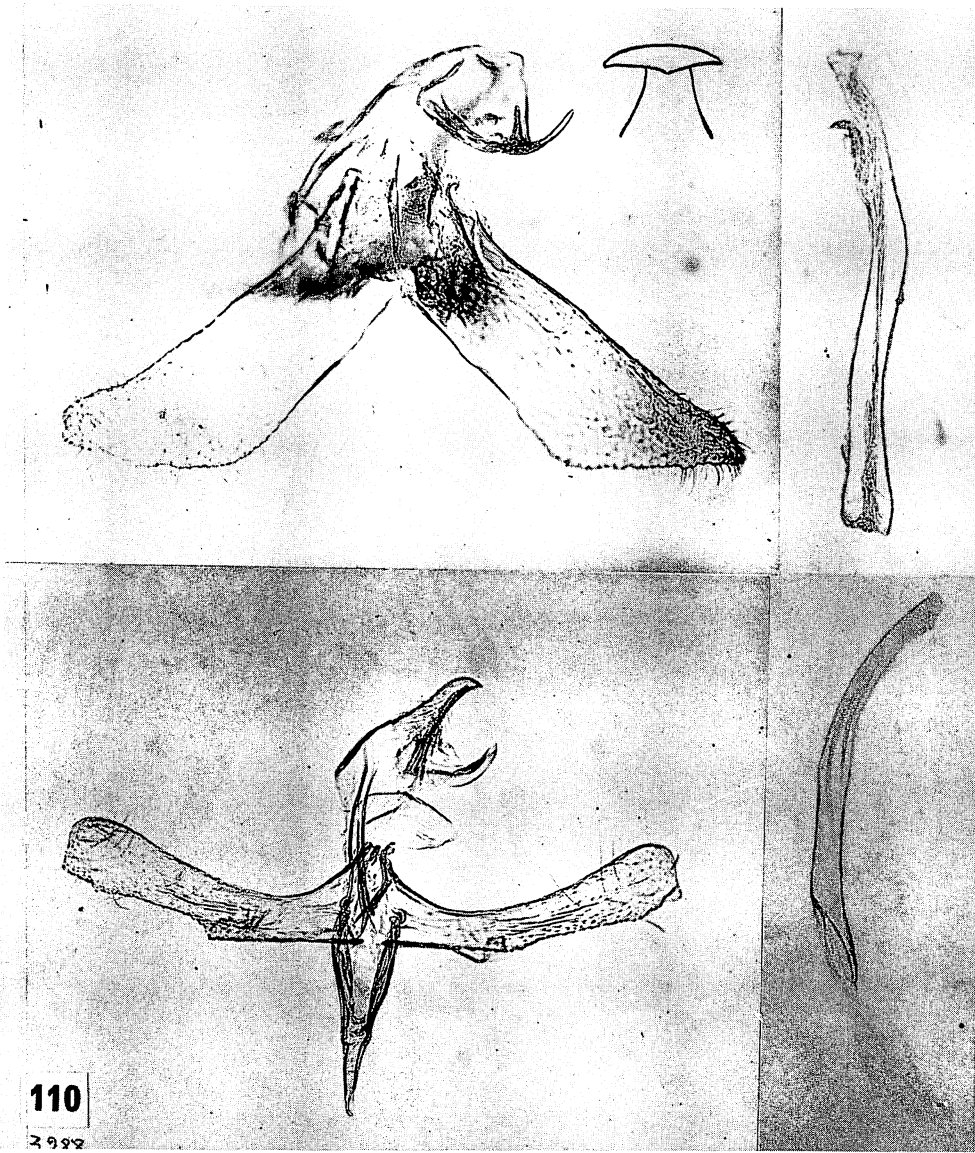


Figure 110—Top, *Crypsithyroides obumbrata* (Butler), male genitalia; the uncus is broken and is shown sketched separately in caudal view (not to exact scale) (BM slide 5423); the saccus and vinculum are bent under and are out of focus; see figures 108 and 109. Bottom, *Crypsithyris enixa* Meyrick, Java (BM slide 3988); the marginal flaplike processes of the sacculi are folded over and partly obscured; the genitalia are generically similar to the type-species of *Crypsithyris*; this species was erroneously recorded from Hawaii when specimens of *Crypsithyroides obumbrata* were confused with it.

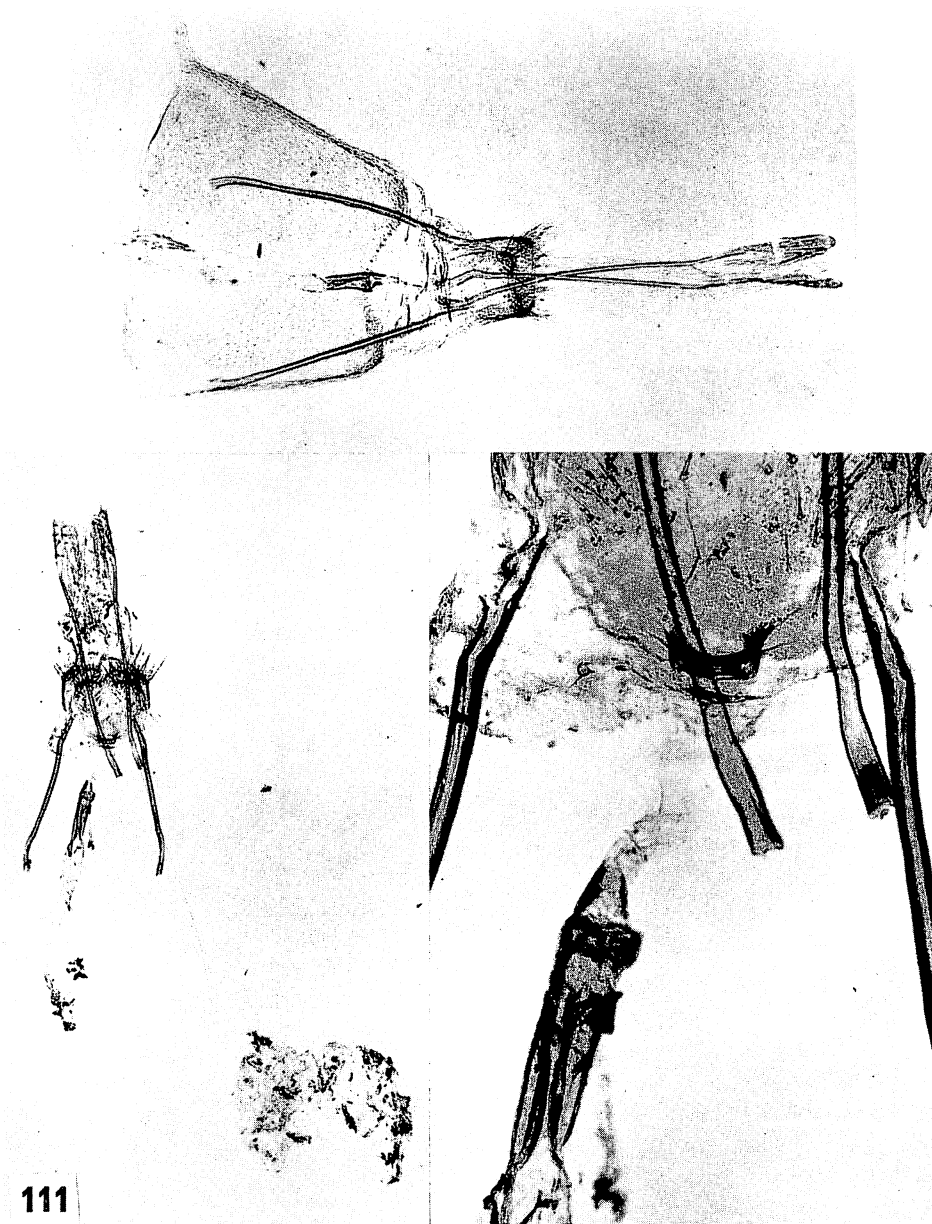
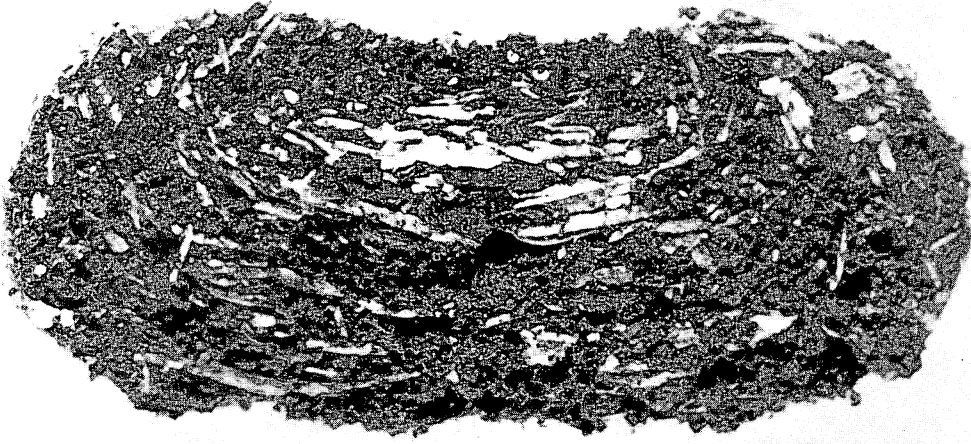


Figure 111—Female genitalia of *Crypsithyroides obumbrata* (Butler). Top, the holotype (BM slide 3938); bursa copulatrix not shown. Bottom, another example from Kaimuki, Oahu (slide Z-1-5-67); the delicate bursa copulatrix was partly decomposed so that a poor slide preparation resulted.



112

Figure 112—*Crypsithyroides obumbrata* (Butler), larval case; the hole in the middle is a pinhole.

#### Genus **NIDITINEA** Petersen

*Niditinea* Petersen, 1957:134. Type-species: *Tinea spretella* Denis and Schiffermüller.

Only a few European species have been assigned to this genus.

**Niditinea spretella** (Denis and Schiffermüller) (figs. 113, head and venation; 114, moth, male genitalia; 115, female genitalia; 116, larva).

*Tinea spretella* Denis and Schiffermüller, 1775:142.

*Tinea fuscipunctella* Haworth, 1828:562. Walsingham, 1882:171; 1907b:729.

*Acedes fuscipunctella* (Haworth) Hinton, 1956:314, figs. 184–187, larva.

*Niditinea fuscipunctella* (Haworth) G. Petersen, 1957:134, figs. 96–98, male and female genitalia.

*Tinea nubilipennella* Clemens, 1859:259. Synonymy by Dyar, 1903:571.

*Tinea abligatella* Walker, 1863:476. Synonymy by Walsingham, 1881:242.

*Tinea ignotella* Walker, 1864:1003. Synonymy by Walsingham, 1881:242.

*Oecophora frigidella* Packard, 1867:62. Synonymy by Dyar, 1903:571.

*Tinea eurinella* Zagulyaev, 1952:284, figs. 1–4. Synonymy by G. Petersen, 1957:134.

Although this nearly cosmopolitan species is not known to be established in Hawaii, it may be there. It was first recorded from Hawaii by Walsingham (1907b:729) from two specimens collected at Kona and Olaa, on the island of Hawaii, by Perkins in 1892 and 1895, but Walsingham was in error in his identifications. I have studied the two Perkins' specimens (now in the British



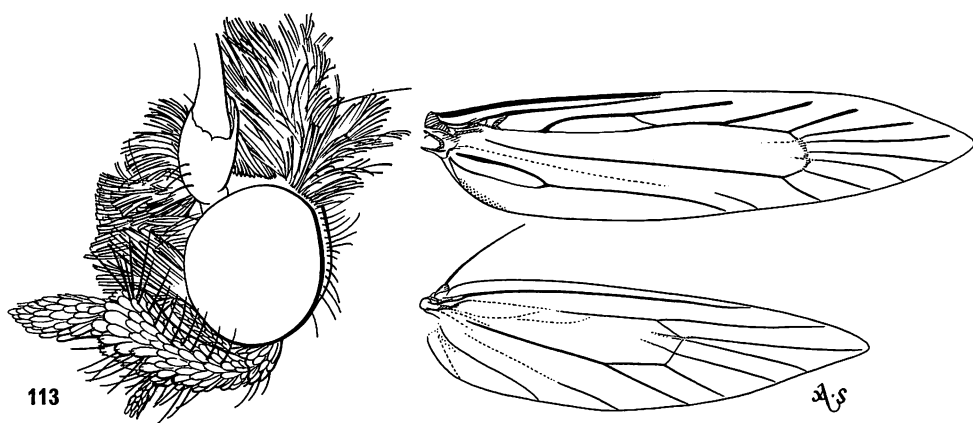


Figure 113—*Niditinea spretella* (Denis and Schifferrmüller), head and wing venation; England (BM slide 5188).

Museum), and I have found that they belong to *Praeacedes thecophora* (Walsingham). I have not seen any specimens from Hawaii. Because *Niditinea spretella* is so widely distributed, because its name has appeared in Hawaiian literature, and because it may yet be found in Hawaii, I have not deleted from this text the information I have assembled on the species.

The larvae are case-makers. The cases have an opening at each end, and they are rougher and thicker in cross section than those of *Tinea pellionella*. Hinton (1956:314, figs. 184–187) has given a modern description of the larva and a summary of the habits of the species. He noted that “it is commonly recorded out-of-doors in bird nests, where it may be supposed to feed on feathers and hair. . . .” Forbes (1923:126) recorded it from “trash in pigeons’ nests and similar refuse” in America, and it has been reported from various stored grains and dried food products where it probably feeds upon the remains of arthropods and other animal substances.

Parasite: *Apanteles carpatus* (Say) has been recorded from it in North America.

#### Genus **TINEA** (Linnaeus) Denis and Schifferrmüller

*Phalaena Tinea* Linnaeus, 1758:534. Type-species: *Phalaena Tinea pellionella*

Linnaeus. See Hemming, 1957:254, 256.

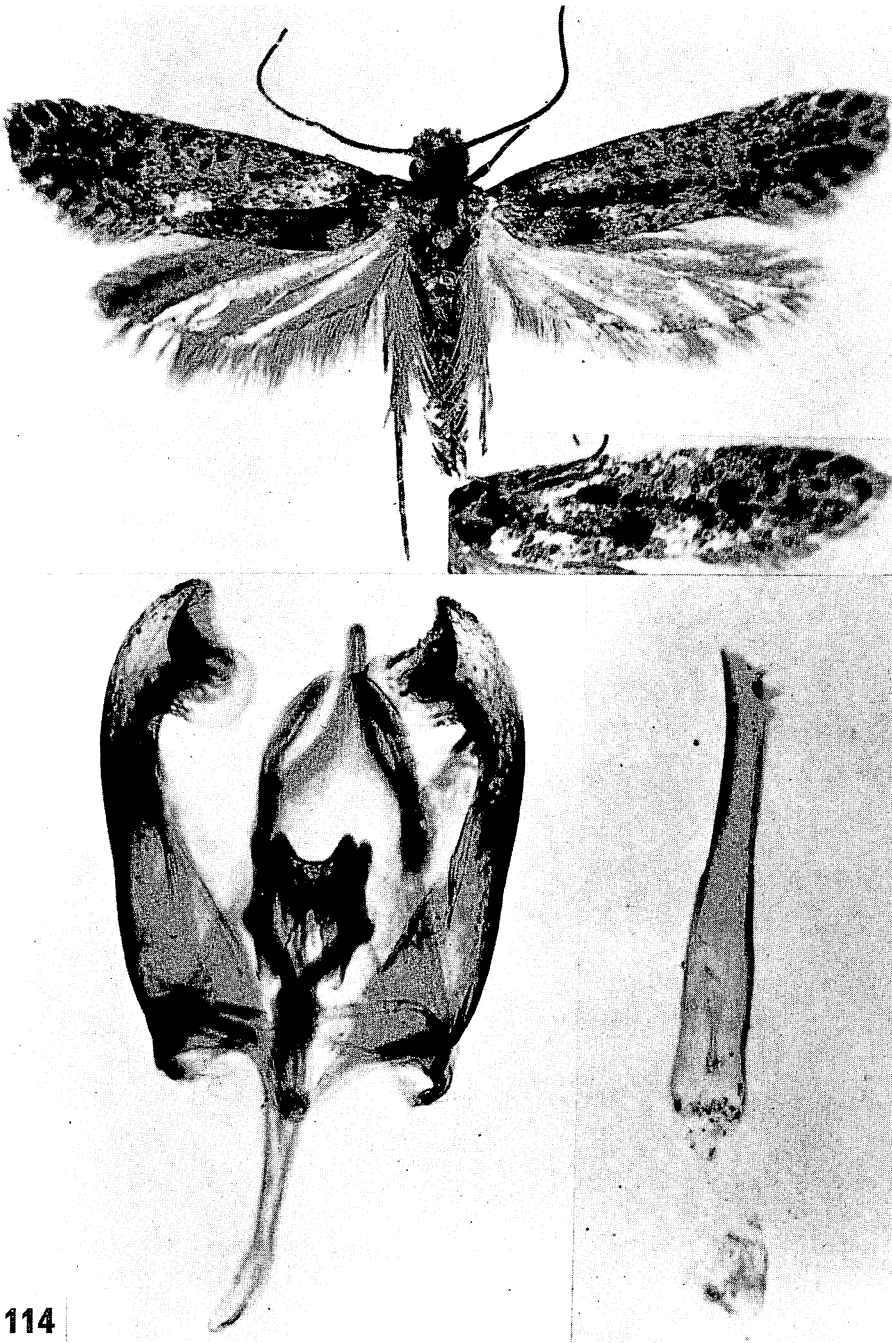
*Tinea*: Denis and Schifferrmüller, 1775:133. Fabricius, 1775:655.

*Acedes* Hübner, 1831 (1825):401.

*Autoses* Hübner, 1831 (1825):401.

G. Petersen, 1957:143.

A large number of species has been assigned to the genus *Tinea* from most parts of the world, but most of them do not belong to *Tinea*. The taxonomy is in chaos. No one knows the true nature of the genus or its natural distribution.



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Figure 114—*Niditinea spretella* (Denis and Schiffermüller). Top, a female from Granada, Spain; expanse 16 mm.; the dark area on the left hindwing is a shadow. The right forewing of another specimen is inset. Bottom, male genitalia, aedeagus at right (BM slide 5188); England.

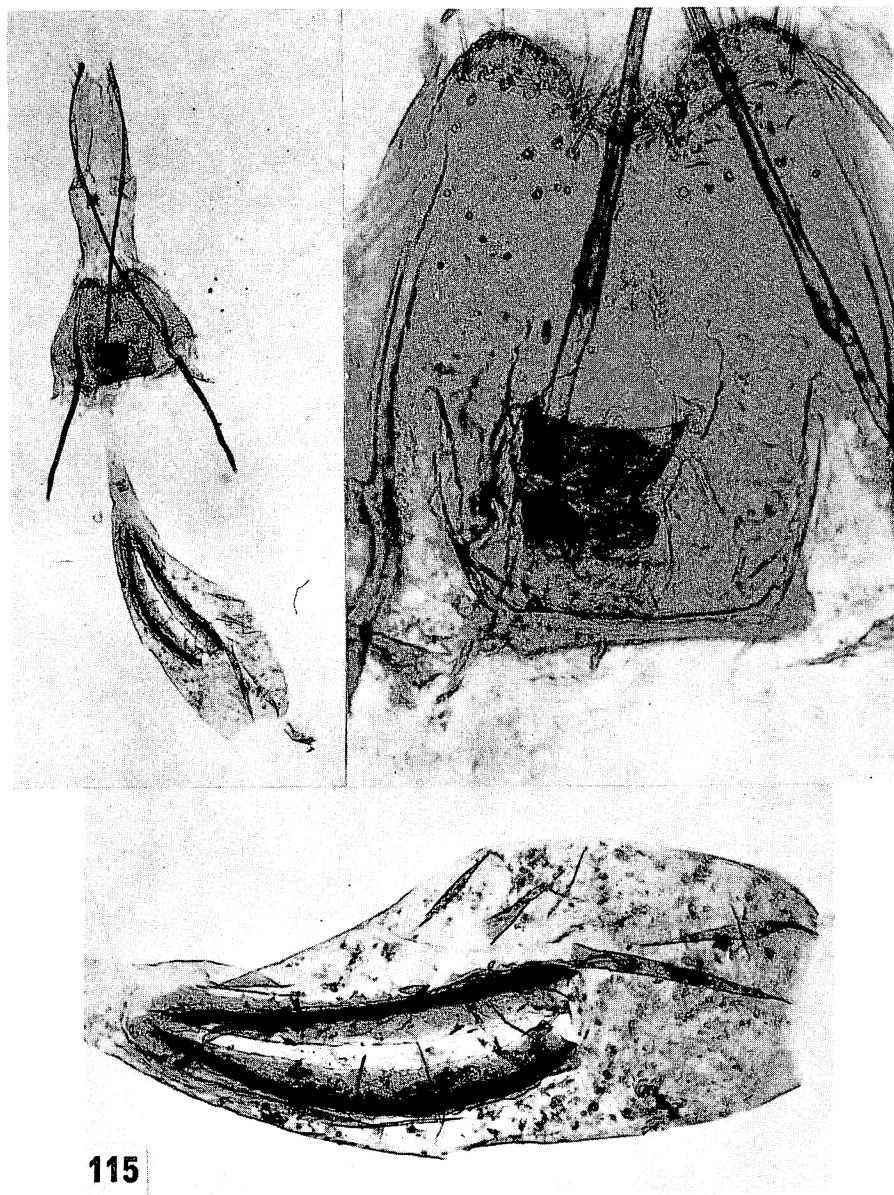
**115**

Figure 115—*Niditinea spretella* (Denis and Schiffermüller). Female genitalia of an English specimen (BM slide 14277).

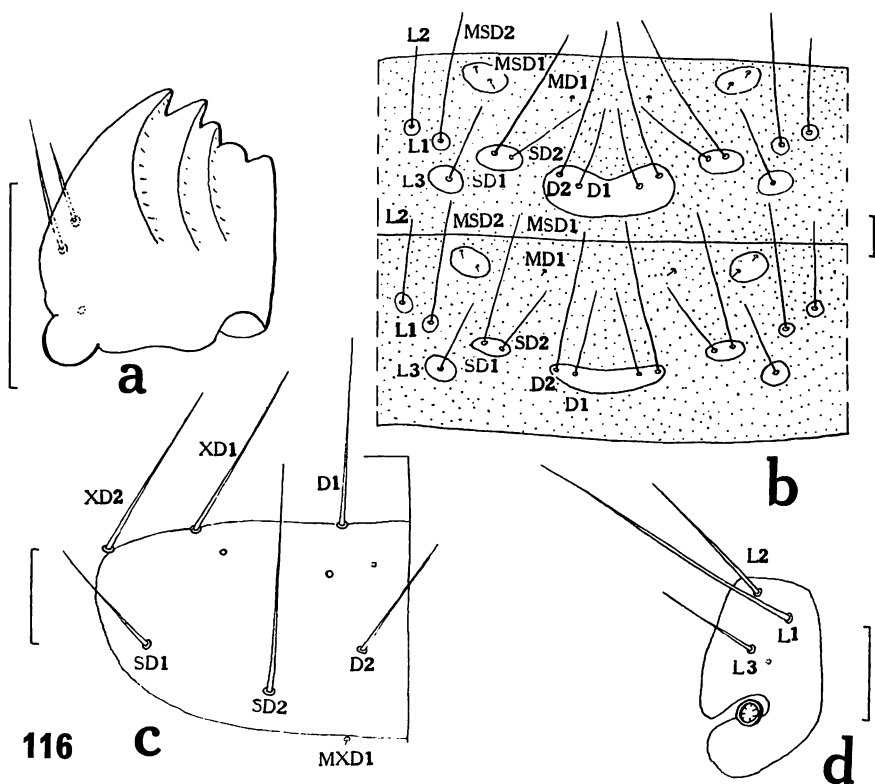


Figure 116—Details of the larva of *Niditinea spretella* (Denis and Schifferrmüller). *a*, right mandible, ventral aspect; *b*, dorsal and lateral setae of meso- and metathorax; *c*, left side of pronotum; *d*, spiracle and L group of setae on prothorax. (From Hinton, 1956.)

***Tinea pellionella*** (Linnaeus) (figs. 117, head venation; 118, female genitalia; 119, egg, larva; 120–121, larva; 122, pupa; 125, 130, male genitalia; 129, moth).

*Phalaena Tinea pellionella* Linnaeus, 1758:536; 1767:888.

*Tinea pellionella* (Linnaeus) Fabricius, 1775:659.

*Tinea Merdella* Zeller, 1852*b*:162 (formerly confused under *tristigmatella* in Zeller, 1847*c*:808, but not described there as erroneously cited in various publications).

*Tinea Dubiella* Stainton, 1859*a*:183.

*Tinea griseella* Chambers, 1873:88.

*Tinea griseella* Chambers, 1878*b*:164.

Dyar, 1903 (1902):572, synonymy. Marlatt, 1908:2, fig. 1. Mosher, 1916:47, figs. 30–31 (pupa). Silvestri, 1943:102, figs. 121–126, general discussion. G. Petersen, 1957:145, figs. 109–110 (male and female genitalia).

The case-making clothes moth.

Oahu and probably the other main islands.

Immigrant. Nearly cosmopolitan. First recorded from Hawaii by Swezey in 1922 (*Proc. Hawaiian Ent. Soc.* 5:188, 1923) from specimens taken by him in Honolulu. His statement that the species was recorded earlier in *Fauna Hawaiiensis* appears to be in error. Walsingham (1907b:729) merely listed it as the type-species of *Tinea* and he did not mention any Hawaiian specimens.

Parasites: none have yet been reported upon it in Hawaii to my knowledge, but *Apanteles carpatus* (Say) probably attacks it in the Islands. Other parasites are known elsewhere, and a list of parasites has been given by Hinton (1956:307).

The larva constructs and always bears a case, and this habit renders easy its differentiation from *Tineola bisselliella*, which may infest the same materials at the same time but does not construct a case. The forewings of the adults are brownish with paler discal areas and usually with some dark maculae. It has been reared from woolens in Hawaii, and it is probably repeatedly introduced to the Islands. Elsewhere it has been reared from birds' skins, birds' nests, hair, feathers, furs, wool, carpets, etc. In the British Museum I have seen some beautiful larval cases made from peacocks' feathers. Hinton (1956:303-307, figures, 147-160) published an extended list of materials attacked by the larvae, described and illustrated the larva in a modern way, and provided extensive bibliographic details. He stated that "the larva is most frequently found feeding on keratin-containing substances such as hair, fur, and feathers or on materials containing these. Of the Tineidae attacking furs and woolens in Europe and most other temperate parts of the world it is second in importance only to *Tineola bisselliella* (Humm.)." *Tinea pellionella* is common in birds' nests in Europe. The larvae are said to be able to utilize only animal sterols and, therefore, confine their attacks to animal products. In contrast, *Tineola bisselliella* larvae are able to feed on certain plant material as well as animal substances.

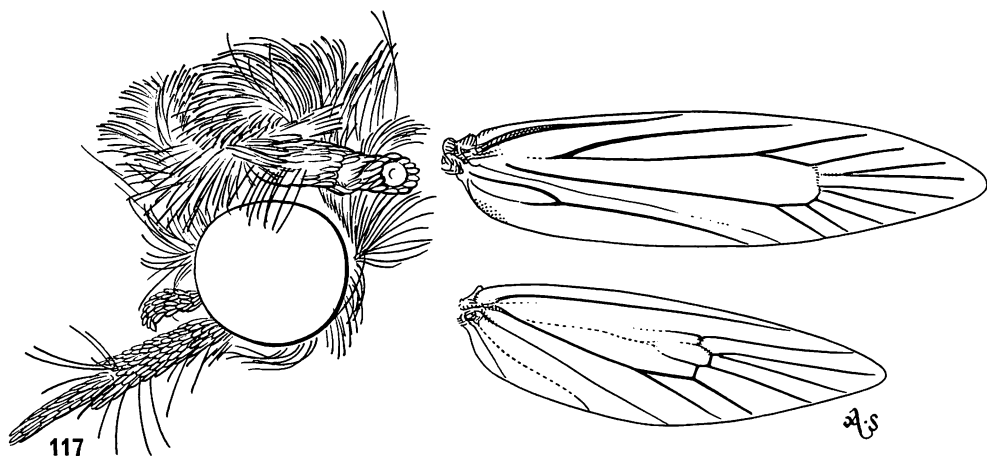


Figure 117—*Tinea pellionella* (Linnaeus), head and wing venation of an English specimen (BM slide 2248). Only part of the folded maxillary palpus is exposed in the drawing.

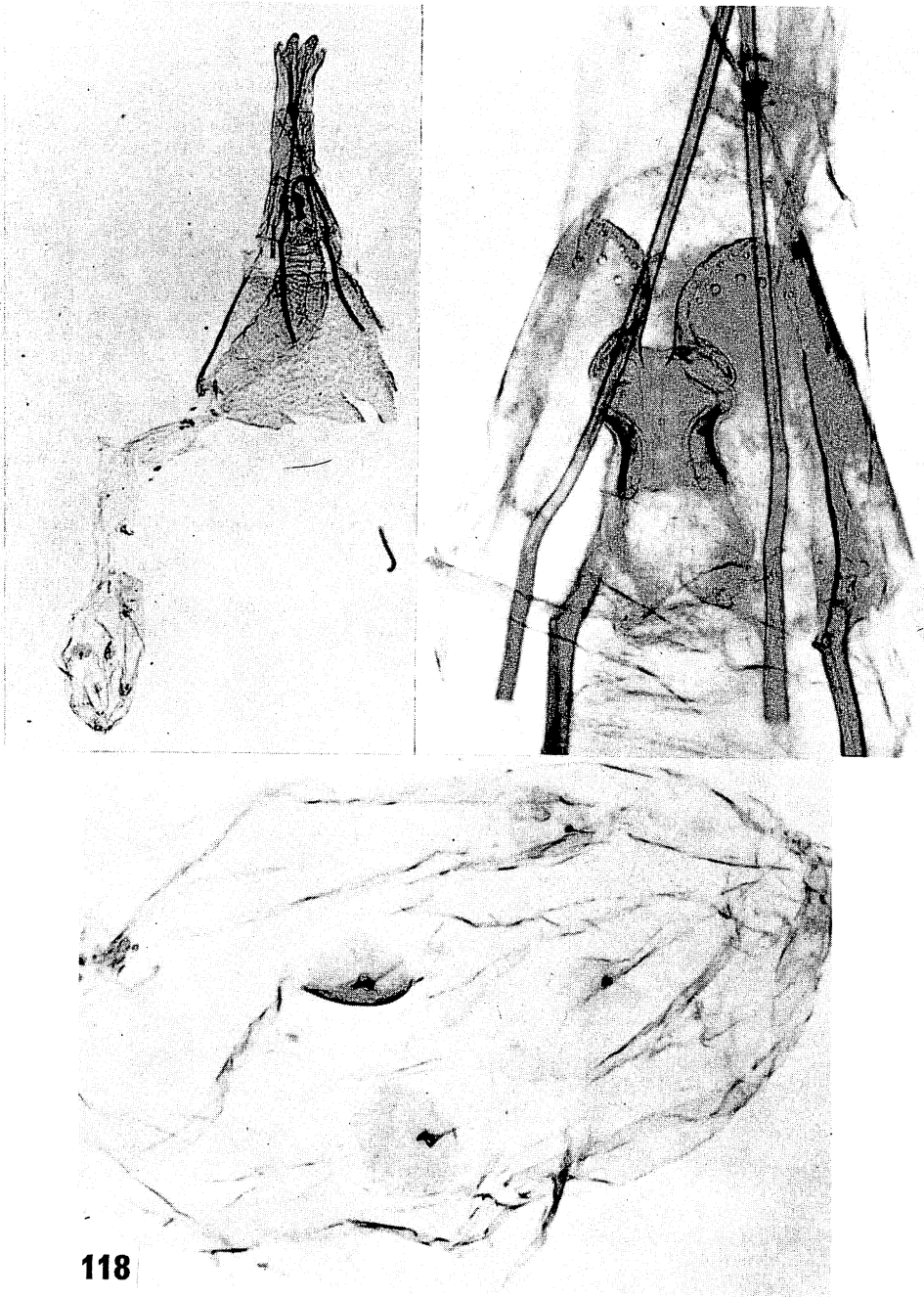


Figure 118—*Tinea pellionella* (Linnaeus), female genitalia; England (BM slide 7185). This example is unusual because it has four signa instead of the normal two.

The case-making clothes moth . . . constructs for its protection a true transportable case. It was characterized by Linnaeus, and carefully studied by Réaumur, early in the last century. Its more interesting habits have caused it to be often the subject of investigation. . . .

The moth expands about half an inch, or from 10 to 14 mm. Its head and forewings are grayish yellow, with indistinct fuscous spots on the middle of the wings. The hind wings are white or grayish and silky. It is the common species in the North [of the United States], being widely distributed and very destructive. Its larva feeds on woolens, carpets, etc., and is especially destructive to furs and feathers. In the North it has but one annual generation, the moths appearing from June to August, and, on the authority of Professor Fernald, even in rooms uniformly heated night and day it never occurs in the larval state in winter. [I, too, have found this to be true in New Hampshire. E.C.Z.] In the South, however, it appears from January to October, and has two or even more broods annually.

The larva is a dull white caterpillar, with the head and the upper part of the next segment light brown, and is never seen free from its movable case or jacket, the construction of which is its first task. If it be necessary for it to change its position, the head and first segment are thrust out of the case, leaving the thoracic legs free, with which it crawls, dragging its case after it, to any suitable situation. With the growth of the larva it becomes necessary from time to time to enlarge the case both in length and circumference, and this is accomplished in a very interesting way. Without leaving its case the larva makes a slit halfway down one side and inserts a triangular gore of new material. A similar insertion is made on the opposite side, and the larva reverses itself without leaving the case and makes corresponding slits and additions in the other half. The case is lengthened by successive additions to either end. Exteriorly the case appears to be a matted mass of small particles of wool; interiorly it is lined with soft whitish silk. By transferring the larva from time to time to fabrics of different colors the case may be made to assume as varied a pattern as the experimenter desires, and will illustrate, in its coloring, the peculiar method of making the enlargements and additions described.

On reaching full growth the larva attaches its case by silken threads to the garment or other material upon which it has been feeding, or sometimes carries it long distances. In one instance numbers of them were noticed to have scaled a 15-foot wall to attach their cases in an angle of the cornice of the ceiling. It undergoes its transformations to the chrysalis within the larval case, and under normal conditions the moth emerges three weeks later, the chrysalis having previously worked partly out of the larval case to facilitate the escape of the moth. The latter has an irregular flight and can also run rapidly. It has a distinct aversion

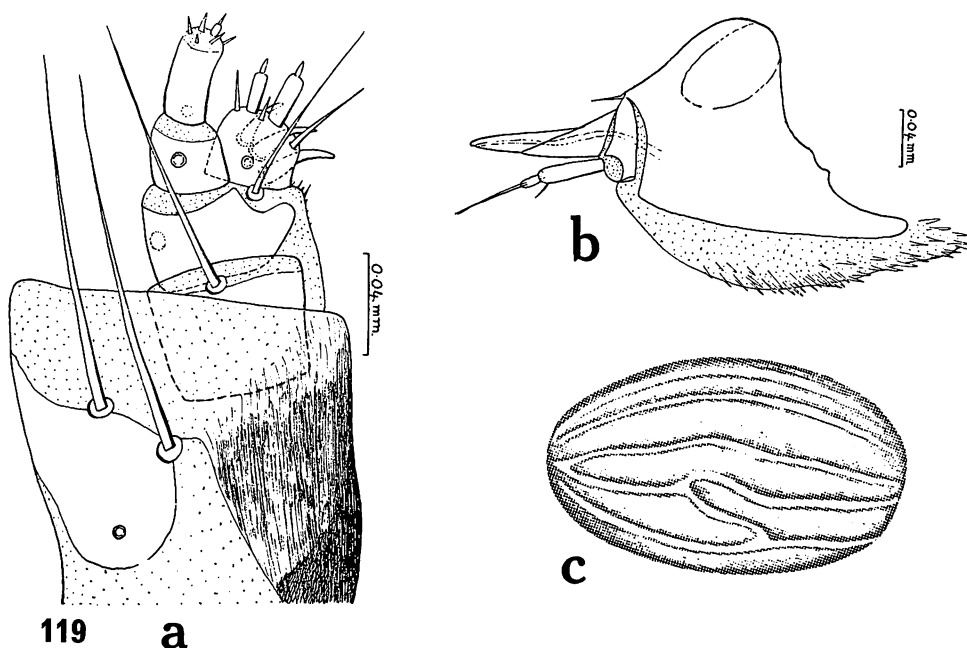


Figure 119—*Tinea pellionella* (Linnaeus), egg and details of parts of the mature larva. *a*, ventral aspect of right maxilla; *b*, right side of prementum-hypopharynx (after Hinton, 1956); *c*, egg (after Titschack, 1922).

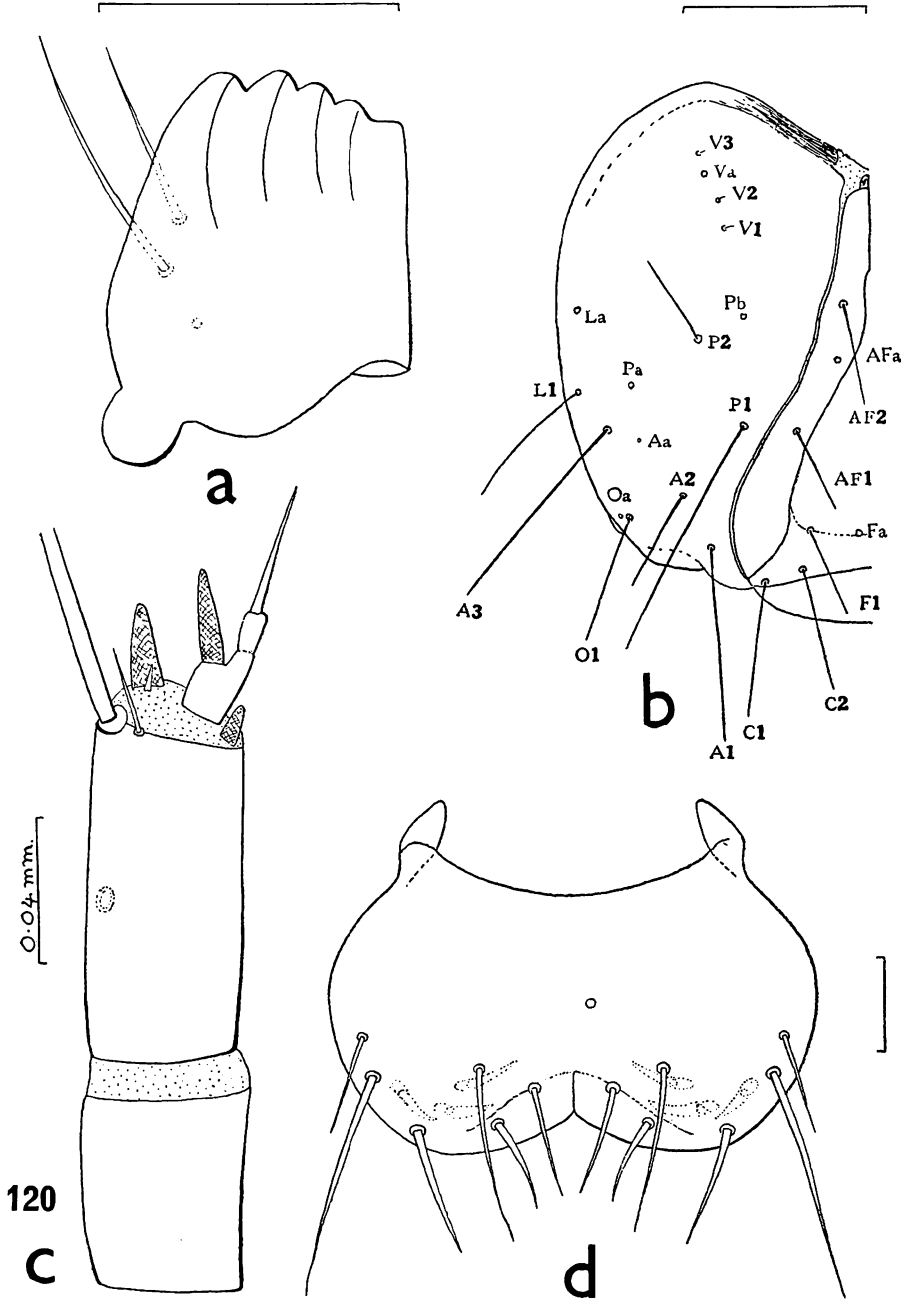


Figure 120—*Tinea pellionella* (Linnaeus), details of mature larva. *a*, ventral aspect of right mandible; *b*, frontal aspect of right side of head; *c*, antenna; *d*, dorsal aspect of labrum. (Modified from Hinton, 1956.)



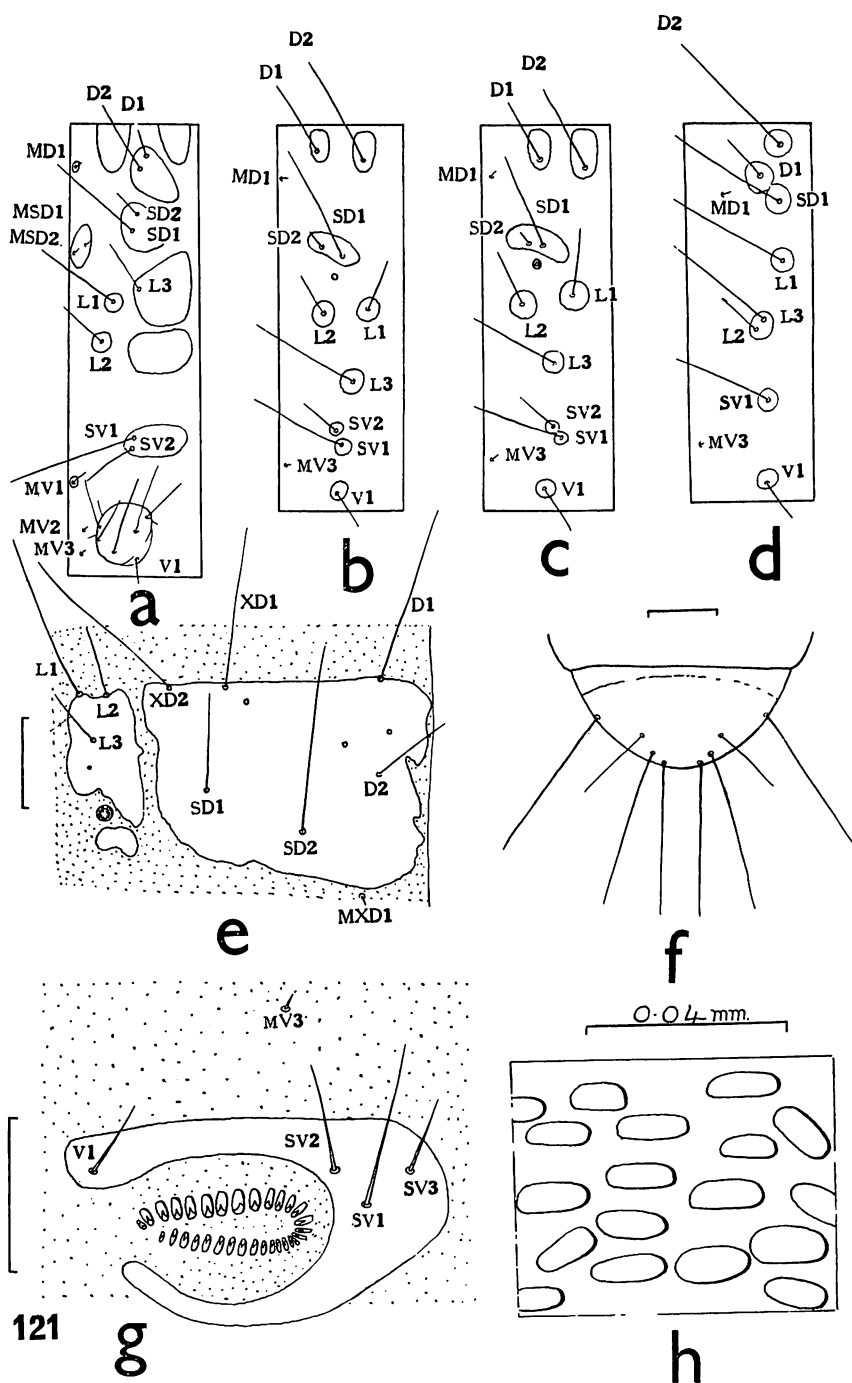


Figure 121—*Tinea pellionella* (Linnaeus), mature larval details (after Hinton, 1956). *a*, mesothorax; *b*, *c*, *d*, abdominal segments 7, 8, and 9 from the left side; *e*, dorsal and lateral setae of the left side of the prothorax; *f*, dorsal aspect of tenth abdominal segment; *g*, right proleg of fourth abdominal segment; *h*, microsculpture of cuticle of eighth abdominal segment. Scale lines, except where noted otherwise, = 0.22 mm.

to light, and usually conceals itself promptly in garments or crevices whenever it is frightened from its resting place. The moths are comparatively short-lived, not long surviving the deposition of their eggs. . . . The eggs . . . are commonly placed directly on the material which is to furnish the larvae with food. In some cases they may be deposited in the crevices of trunks or boxes, the newly hatched larvae entering through these crevices.

In working in feathers this insect occasionally causes a felting very similar to that produced by the black carpet beetle, *Attagenus piceus* Ol. (Marlatt, 1908:2-4.)

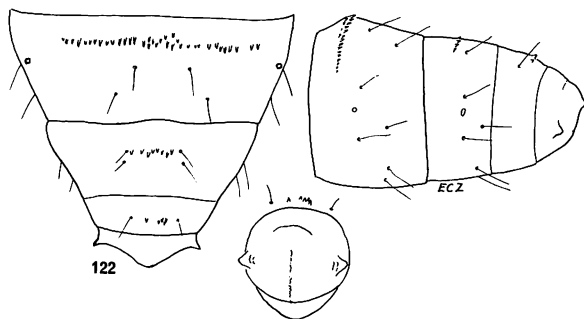


Figure 122—Details of the pupa of *Tinea pellionella* (Linnaeus). Dorsal, lateral, and direct caudal aspects of abdominal segments seven to ten of an English specimen. (The abdomen on this cast skin is artificially depressed.)

### Genus **TINEOLA** Herrich-Schäffer

*Tineola* Herrich-Schäffer, 1853:23. Type-species: *Tinea bisselliella* Hummel.  
G. Petersen, 1957:141.

This is an Old World group which supposedly contains a rather large number of species.

***Tineola bisselliella*** (Hummel) (figs. 69*c*, larval chaetotaxy; 123, head, venation; 124, moth, female genitalia; 125, male genitalia; 126, egg, larva, pupa; 69, 127, larva).

*Tinea bisselliella* Hummel, 1823:13.

*Tineola bisselliella* (Hummel) Herrich-Schäffer, 1853:23, pl. 41, figs. 281, 281*a*.

*Tinea crinella* Treitschke, 1832:21. Synonymy by Chambers, 1878*b*:163.

*Tinea Destructor* Stephens, 1834:346. Synonymy by Chambers, 1878*b*:163.

*Tinea Lanariella* Clemens, 1859:257. Synonymy by Zeller, 1873:23.

*Tinea furciferella* Zagulyaev, 1954:156, figs. 1-5. Synonymy by G. Petersen, 1960:225.

Titschack, 1922, biology, morphology. Silvestri, 1943:113, figs. 137-138.

G. Petersen, 1957:142, figs. 107, 108 (male and female genitalia).

The webbing clothes moth.

Oahu, Hawaii, and probably the other main islands.

Immigrant. Nearly cosmopolitan. Meyrick considered it to be African in origin. Although it must have been here earlier, the first record that I know for Hawaii is that by Illingworth, 1917:274.

Parasite: *Apanteles carpatus* (Say) ( = *Protapanteles hawaiiensis* Ashmead). Other parasites and predators are known elsewhere; see Hinton, 1956:289, for a list.

The adult is a shiny, pale, buff-colored moth with immaculate forewings. It has been reared from horsehair, woolens, and hairbrushes in Hawaii. Elsewhere it is a common pest of woolens, furs, hair, feathers (it is a serious pest on ostrich plumes in Africa), and a long list of other materials. It may cause major damage to dried insects in collections. The mouthparts of the adults are degenerate, and no food is taken by them.

The larvae do not make cases, but they spin thin silken webs on their food material. The larvae are said to be able to utilize plant material as well as animal sterols. This ability differs from that of the larvae of *Tinea pellionella* which can utilize animal products only. For a description of the larva and an unusually detailed account of the life history, habits, and physiology, together with an extensive bibliography, see Hinton, 1956:280–289, figs. 89–93. The mature larva is about 7 to 9 mm. long. "From all other *Tineinae* known to me that have not more or less fused coxae, it may be distinguished immediately by having the SV group [of setae on the thorax] in a feebly oblique or nearly horizontal line instead of in a vertical or nearly vertical line. The presence of only two instead of three L setae on the ninth abdominal segment is a further important distinguishing feature of the genus." (Hinton, 1956:280.) The number of eggs laid is usually about 100 with an average of about five to seven per day, but the numbers vary greatly.

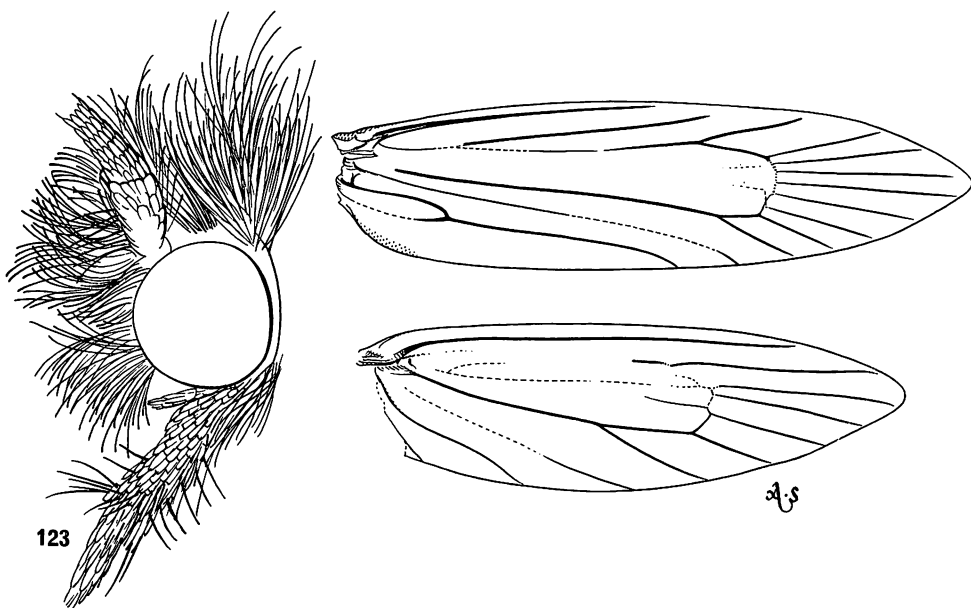


Figure 123—Head and wing venation of *Tineola bisselliella* (Hummel), English examples (BM slide 4236).

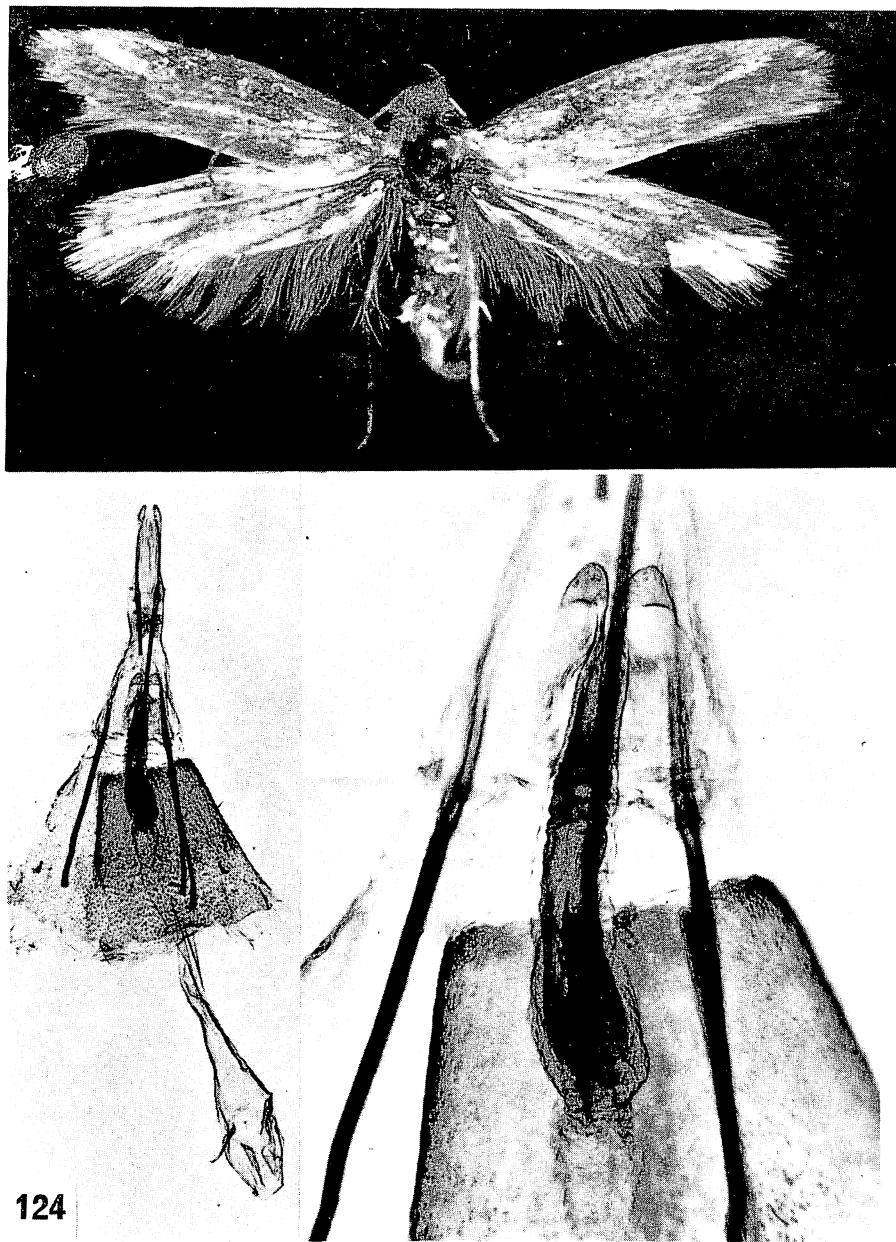


Figure 124—*Tineola bisselliella* (Hummel). Top, a specimen from Olaa, Hawaii; forewing 5.75 mm. Bottom, female genitalia from an English specimen (BM slide 8135).

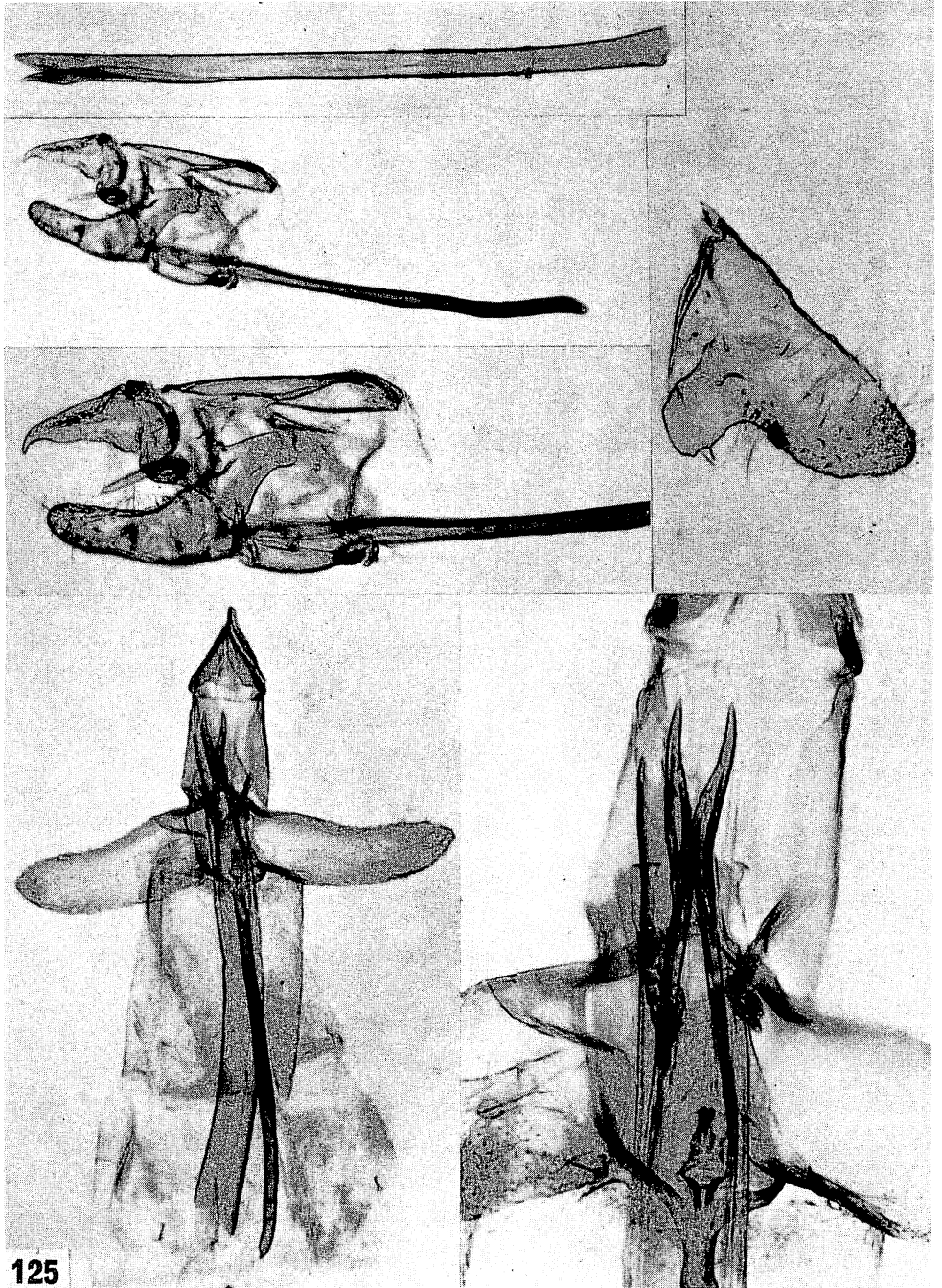


Figure 125—*Tinea* and *Tineola*. Top four figures are of the male genitalia of an English specimen of *Tineola bisselliella* (Hummel) with the aedeagus and left valva removed and mounted separately (BM slide 8112). Bottom two figures are of the neotype of *Tinea pellionella* (Linnaeus), an English specimen (slide 3222 in the F.N. Pierce collection in the British Museum).

Grace Griswold (1931:764) found that adult males live about six weeks and adult females about three weeks. She has also published an extensive, illustrated report on the biology (1944) which should be consulted by all persons interested in additional information. She reported that the larvae may attack and damage many substances; if their diet should be inadequate, however, they will not reach maturity, although they may grow to considerable size. The length of larval life may vary from a month to over two years, depending upon the diet. The number of larval instars, which may vary from five to 12, and their rate of growth is directly correlated with quality of diet. The duration of the pupal stage varies inversely according to temperature: at 65° F she found the duration to be 22 to 23 days, and at 75° F it was 11 to 13 days. She found the developmental period from egg to adult to range from 36 to 780 days. Other details, including illustrations, may be found in Austen and McKenney Hughes, 1932.

Roth and Willis (1952) studied the species to find an attractant for the adults, because, as they noted, "at present there appears to be no effective method in use for trapping clothes moths. . . ." Among other details, they reported that the females produce a scent which attracts and sexually stimulates the males.

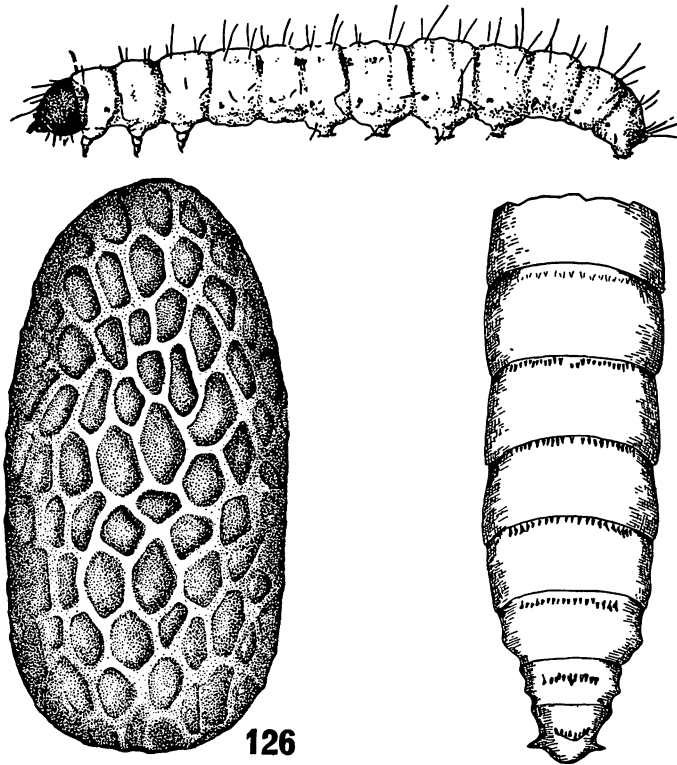


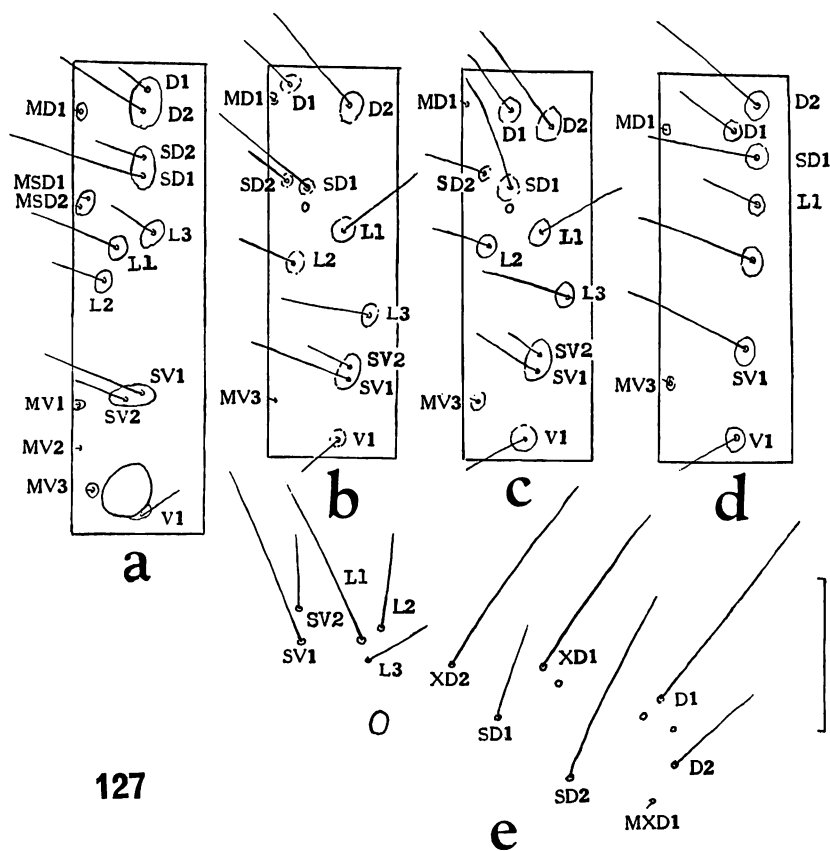
Figure 126—*Tineola bisselliella* (Hummel), egg, larva, and dorsum of the abdomen of a pupa (note the transverse single rows of stout, thornlike setae). (After Griswold, 1944.)

Urbach and Gottlieb (1941) reported an interesting case of asthma and allergic rhinitis in a patient residing in a dwelling heavily infested with webbing clothes moths. Colton (1927) published an historical account of the moth and its control.

The webbing, or Southern clothes moth . . . is the more abundant and injurious species in the latitude of Washington and southward. It occurs also farther north, though in somewhat less numbers than the preceding species [*Tinea pellionella*]. It presents two annual broods even in the Northern States, the first appearing in June from eggs deposited in May, and the second in August and September. It is about the size of *pellionella*. The forewings are, however, uniformly pale ochreous, without markings or spots. Its larva feeds on a large variety of animal substances—woolens, hair, feathers, furs, and in England it has even been observed to feed on cobwebs in the corners of rooms, and in confinement has been successfully reared on this rather dainty food substance. . . .

Frequently this species is a very troublesome pest in museums, particularly in collections of the larger moths [which may be riddled by them]. . . . Doctor Riley reared it in conjunction with the Angoumois grain moth (*Sitotroga cerealella*) from grain, it being apparent that its larvae had subsisted on dead specimens of the grain moth. It is very apt to attack large Lepidoptera on the spreading board, and has, in fact, been carried through several generations on dried specimens of moths.

The larva of this moth constructs no case, but spins a silky, or more properly cobwebby, path wherever it goes. When full grown it builds a cocoon of silk, intermixed with bits of wood, resembling somewhat the case of *pellionella*, but more irregular in outline. Within this it undergoes its transformation to the chrysalis, and the moth in emerging leaves its pupal shell projecting out of the cocoon. . . . (Marlatt, 1908:4-5.)



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Figure 127—*Tineola bisselliella* (Hummel), details of the mature larva. *a*, mesothorax; *b*, *c*, *d*, seventh, eighth, and ninth abdominal segments; *e*, dorsal, lateral, and subventral setae of the left side of the prothorax (viewed as if the head were in the direction of the upper left hand corner of the illustration). (After Hinton, 1956.)

Genus **PRAEACEDES** Amsel

*Praeacedes* Amsel, 1954:54. Type-species: (*Praeacedes deluccae* Amsel) = *Tinea thecophora* Walsingham, 1908a, monotypic.

*Titaenoses* Hinton and Bradley, 1956:42. Type-species: *Tinea thecophora* Walsingham, monotypic.

Only one species has thus far been assigned to this genus.

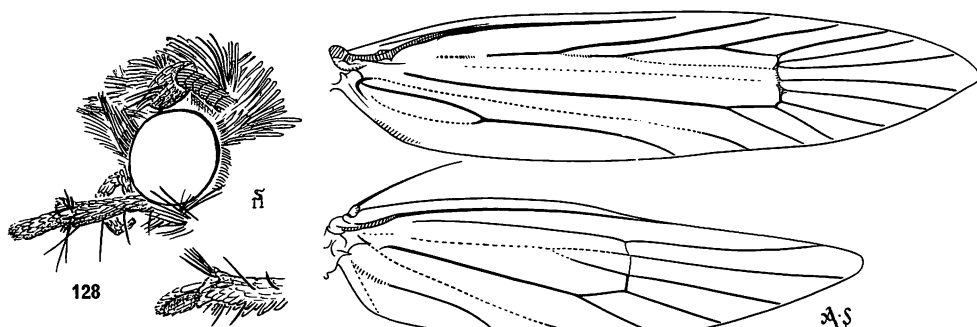


Figure 128—*Praeacedes thecophora* (Walsingham); head, with a separate lateral view of part of a labial palpus, and wing venation. Mt. Tantalus, Oahu (BM slide 3022).

***Praeacedes thecophora*** (Walsingham) (figs. 128, head, venation; 129 moth, larval case; 130, male genitalia; 131, female genitalia; 132–133, larva; 134, pupa).

*Tinea thecophora* Walsingham, 1908a:1024.

*Tinea despecta* Meyrick, 1919:274.

*Praeacedes deluccae* Amsel, 1954:54, fig. 7 (worthless!).

*Titaenoses thecophora* (Walsingham) Hinton and Bradley, 1956:44.

Kauai, Oahu, Hawaii, Laysan, and probably several other islands.

Immigrant. Described from Tenerife. Widely spread by man and known from Bermuda, Brazil, Peru, Venezuela, Mexico, southern United States, southern Europe, Africa, Malaya, Australia, Solomon Islands, Rapa, and other localities. First recorded from Hawaii by Swezey in 1951:313 from specimens collected by Perkins in Honolulu as early as 1909, and other specimens collected later but which had been misidentified in Hawaiian literature as "*Tinea fuscipunctella* Haworth". However, Blackburn found the species in Honolulu before 1880, but his specimens were misidentified by Butler (1881:396) as *Blabophanes rusticella*. Walsingham (1907b:729) noted this misidentification and listed the species as "*Tinea* sp.?" I have verified this information, and a genitalia slide has been prepared at the British Museum (slide number 4216). The species has commonly been misidentified in various parts of the world.



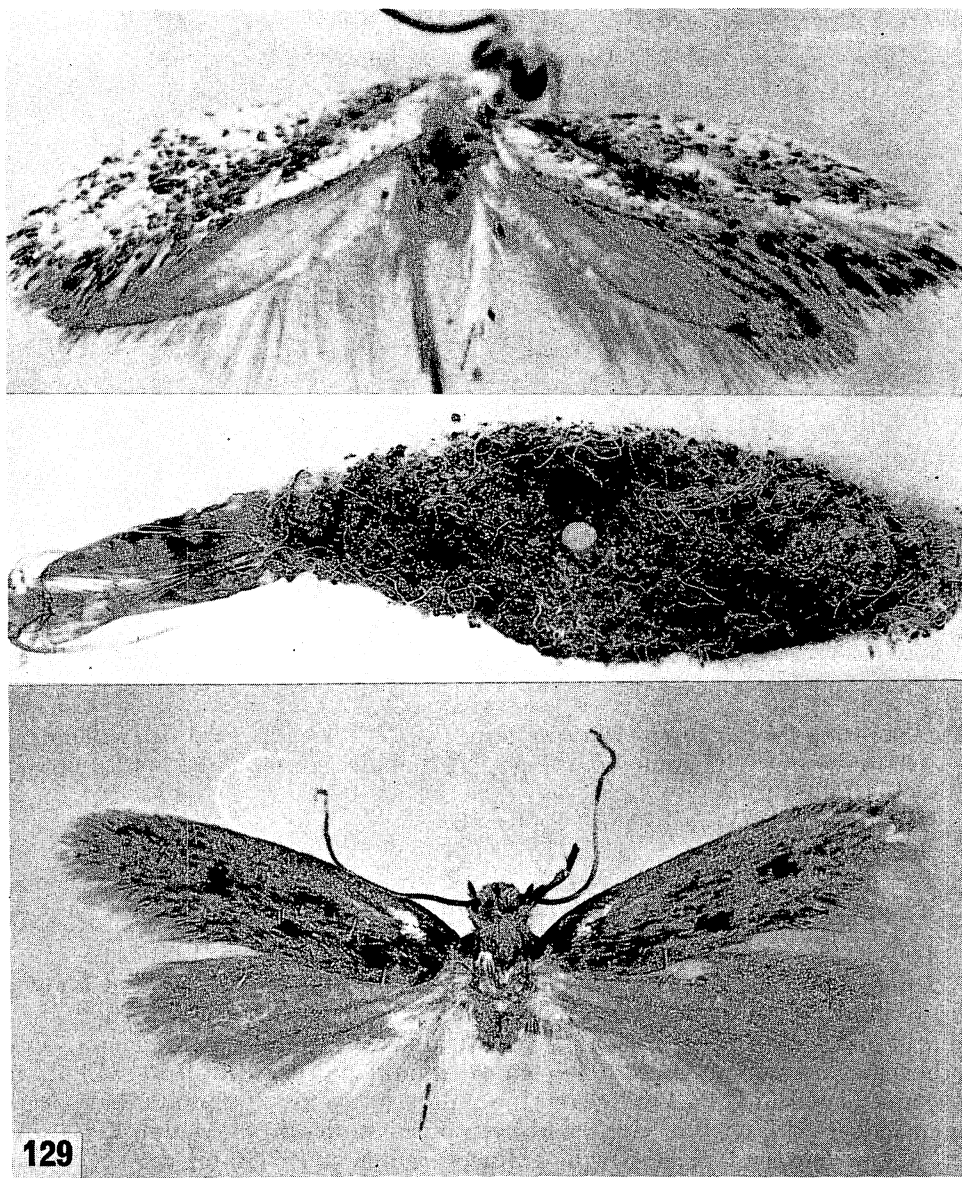
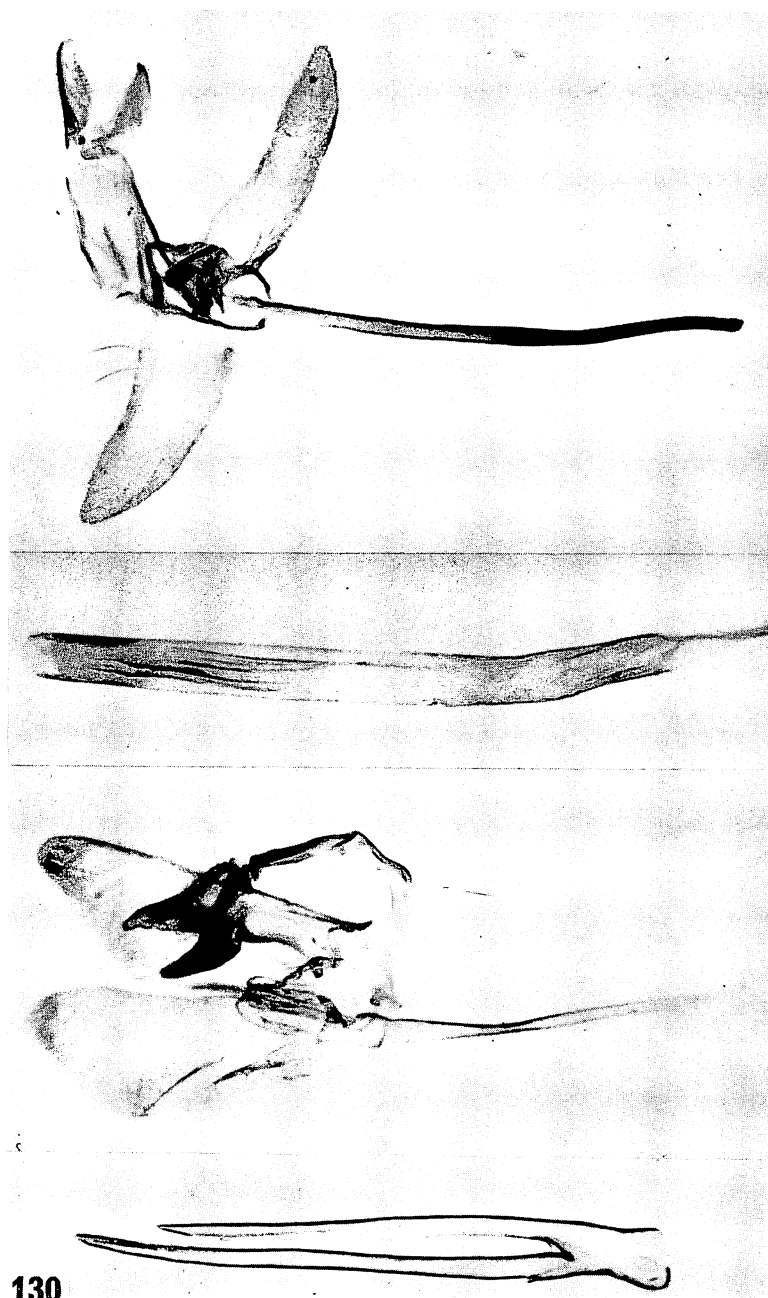


Figure 129—Top, *Praeacedes thecophora* (Walsingham), from the lectotype of the synonym *Tinea despecta* Meyrick; this is a pale example from Guyana; expanse 8.5 mm. Middle, the larval case, with pupal skin protruding, of another example. Bottom, *Tinea pellionella* (Linnaeus), England, expanse 12.5 mm.



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Figure 130—Top two figures, the male genitalia of *Tinea pellionella* (Linnaeus) (the type-species of *Tinea*), from an English specimen (BM slide 2248). Bottom two figures, male genitalia of *Praeaccedes thecophora* (Walsingham), from the lectotype of the synonymous *Tinea despecta* Meyrick from Guyana (BM slide 6630). The unusual forked aedeagus is noteworthy and is diagnostic for this species in Hawaii.

Parasite: *Apanteles carpatus* (Say).

The only record of its habit in Hawaii is that by Swezey (1951:313), who said that it had been "found abundant in fibrous debris in a clothes closet. . . ." It was collected on Laysan Island in mid-June, 1962 by J. W. Beardsley who kindly sent me four specimens for study. The wing venation and the genitalia of these specimens agree with those of the lectotype which I have studied. After this manuscript was in press, Don R. Davis found larvae associated with pigeon dung on Hawaii.

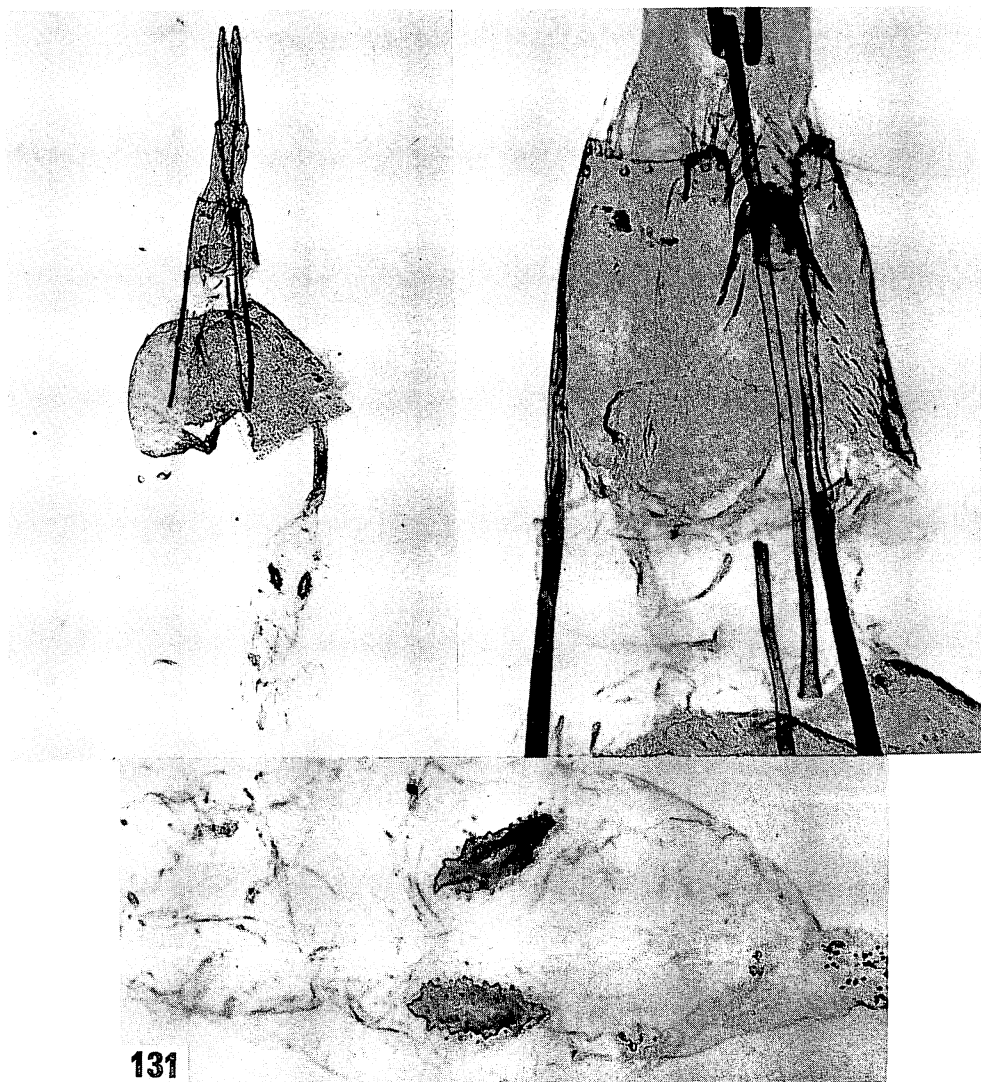


Figure 131—Female genitalia of *Praeaccedes thecophora* (Walsingham), Peru (BM slide 8102).

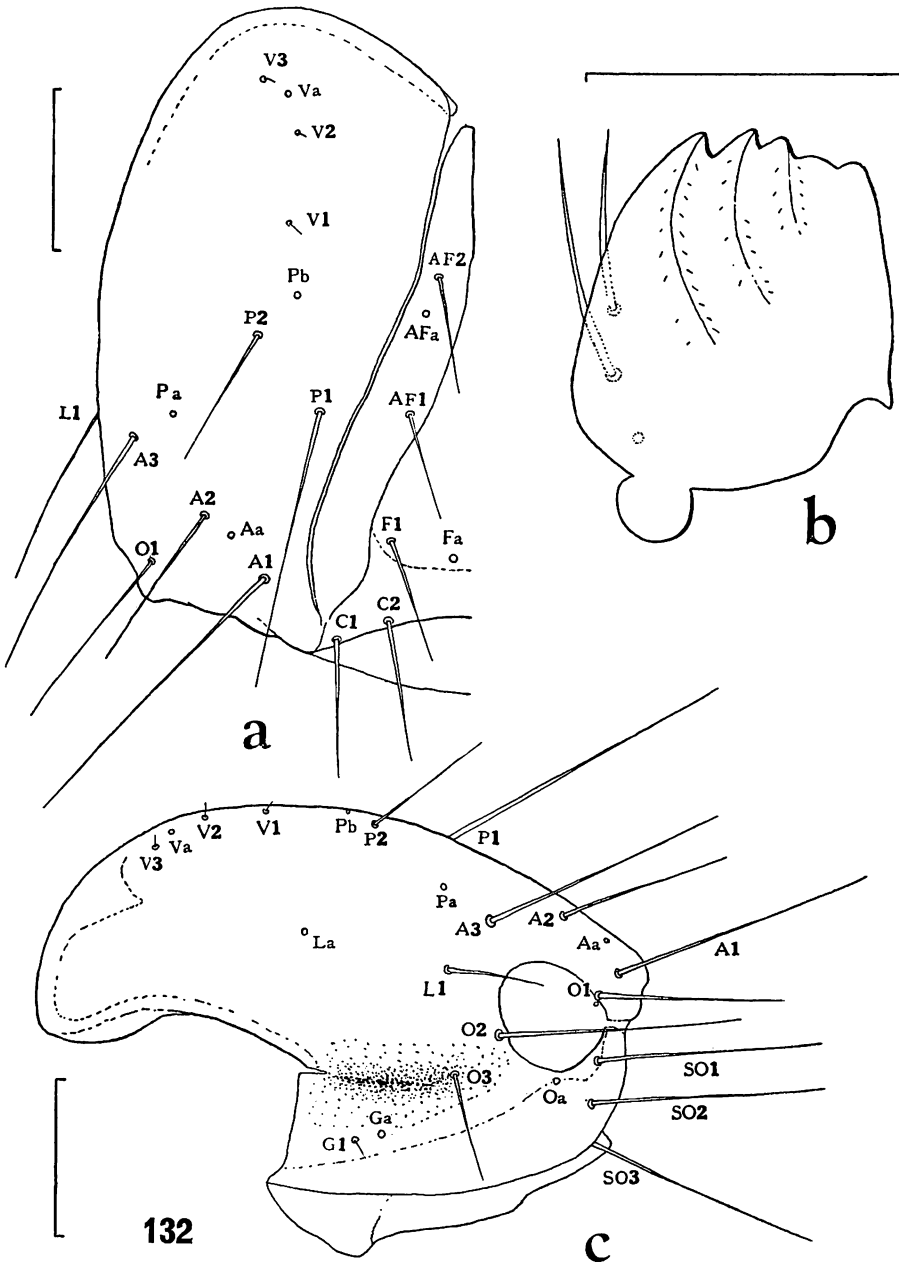


Figure 132—*Praeaccedes thecophora* (Walsingham), details of the head of a mature larva. *a*, frontal aspect of the right side of the head; *b*, ventral aspect of the right mandible; *c*, right side of the head. Scale lines = 0.22 mm. (After Hinton, 1956.)

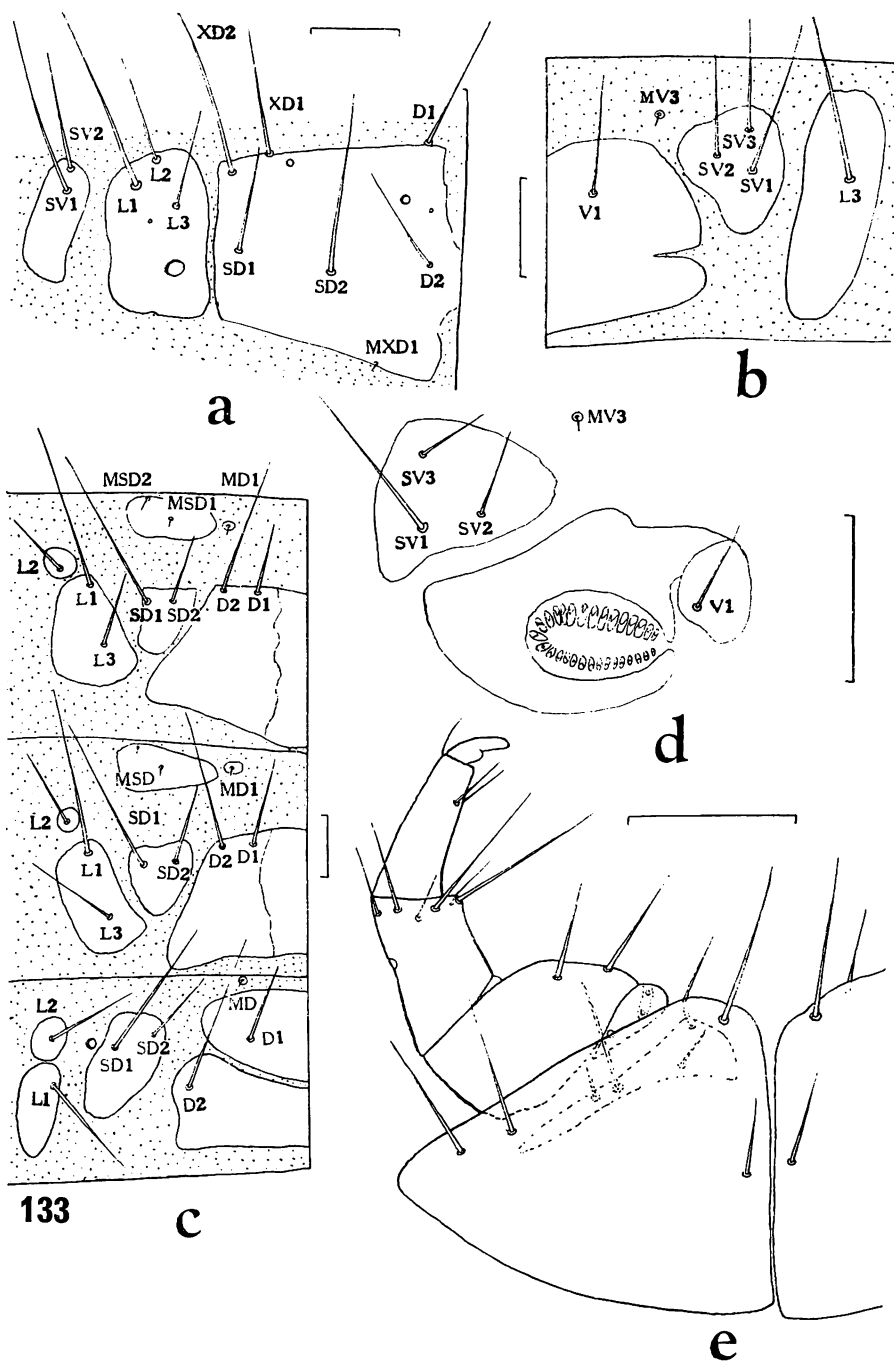


Figure 133—*Praeaces thecophora* (Walsingham), details of a mature larva. *a*, dorsal, lateral, and sub-ventral setae of the left side of the prothorax; *b*, pinacula of setae *V*, *SV*, and *L3* of the right side of the second abdominal segment; *c*, dorsal and lateral setae of the left side of the meso- and metathorax and first abdominal segment; *d*, right proleg of sixth abdominal segment; *e*, subventral aspect of a prothoracic leg; note the contiguous coxae. Scale lines=0.22 mm. (After Hinton, 1956.)

The gnathus is heavily sclerotized and densely pigmented and remains black even after it has been treated with KOH and prepared in a microscope slide mount. Meyrick (1919:274) said: "The only species [of *Tinea*] known to me in which 5 and 6 of hindwings are normally coincident, but in all other respects entirely typical and not needing separation."

"The brown larval cases are not so bulging in the middle area as are those of *Tineola uterella* [probably *Phereoeca allutella* (Rebel)], but yet are wide enough to allow the larva to turn around so that its head may protrude at either end, the same as the larva of *uterella* does. The larva is similar to *uterella*, but the markings on the thoracic segments are not quite the same. Pupation takes place within the case which serves as its cocoon. When the moth issues the pupa is extruded." (Swezey, 1951:313–314.)

The guts of specimens studied by me contained arthropod remains, including the skins of Microlepidoptera.

Walsingham (1908a) found the larvae crawling on walls in houses at Tenerife, and he described the larval case as follows: "Case dust-coloured, elongate, ovate, flattened, very distinct from that of *pellionella* L. or *allutella* Rbl. It is not . . . visibly indented on any part of the margin, and is formed of grains of dust and wooly refuse, but is smooth and dense in texture, and is open at both ends, cleanly cut, evenly rounded, and without ragged edges."

Hinton and Bradley included a modern description of the larva on page 44 of their 1956 report. See also Hinton, 1956:318, figures 192–199.

I am indebted to J. D. Bradley and J. F. Gates Clarke for assistance with details concerning the synonymy and distribution of this species.

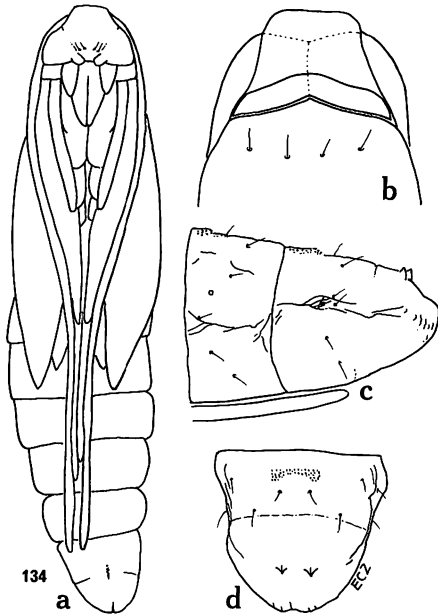


Figure 134—Details of the pupa of *Praeacedes thecophora* (Walsingham); Legon, Ghana; length 5.75 mm. a, ventral aspect; b, dorsal aspect of head and part of thorax; c, left lateral aspect of caudal part of abdomen; d, dorsal aspect of same.

Genus **PHEREOECA** Hinton and Bradley

*Pheroecca* Hinton and Bradley, 1956:45. Type-species: *Tineola uterella* Walsingham, 1897b:165, by original designation. Hinton, 1956:325. G. Petersen, 1957:341. Capuse, 1966:106.

*Pheroecca* is a small cluster of moths which includes several "household" species in various parts of the world. Hinton and Bradley, when they erected the genus, wrote:

The adults may be distinguished from those of *Tineola* by the folded instead of straight maxillary palpus and by the form of vein 2a of the fore wing, which is simple instead of forked at the base. From *Tinea* they may be distinguished by having veins  $M^1$  and  $M^2$  of the hind wing separate and parallel instead of connate or shortly stalked at base.

The larvae are very different from those of *Tineola*: (1) the head has a convex ocellar lens on each side, whereas *Tineola* has no distinct ocellar lenses; (2) the coxae of the front and middle legs are completely fused and those of the hind legs are fused posteriorly and only narrowly separated anteriorly, whereas in *Tineola* the coxae of all legs are widely separated; (3) the spiracles of the eighth abdominal segment are more than twice as broad as those of the seventh instead of equal to them or very slightly larger; (4) the L group [of setae] of the ninth abdominal segment is trisetose instead of bisetose; and (5) the larva lives in a flattened portable case, whereas that of *Tineola* does not construct a portable case.

The species heretofore reported from Hawaii has been called *Pheroecca uterella* (Walsingham), but I have seen no specimens of *uterella* from Hawaii. Although all of the Hawaiian specimens I have examined are *allutella*, I believe it possible that *uterella* may also be in the Islands, or, if it is not there now, it may sooner or later become established, and I have included information concerning it.

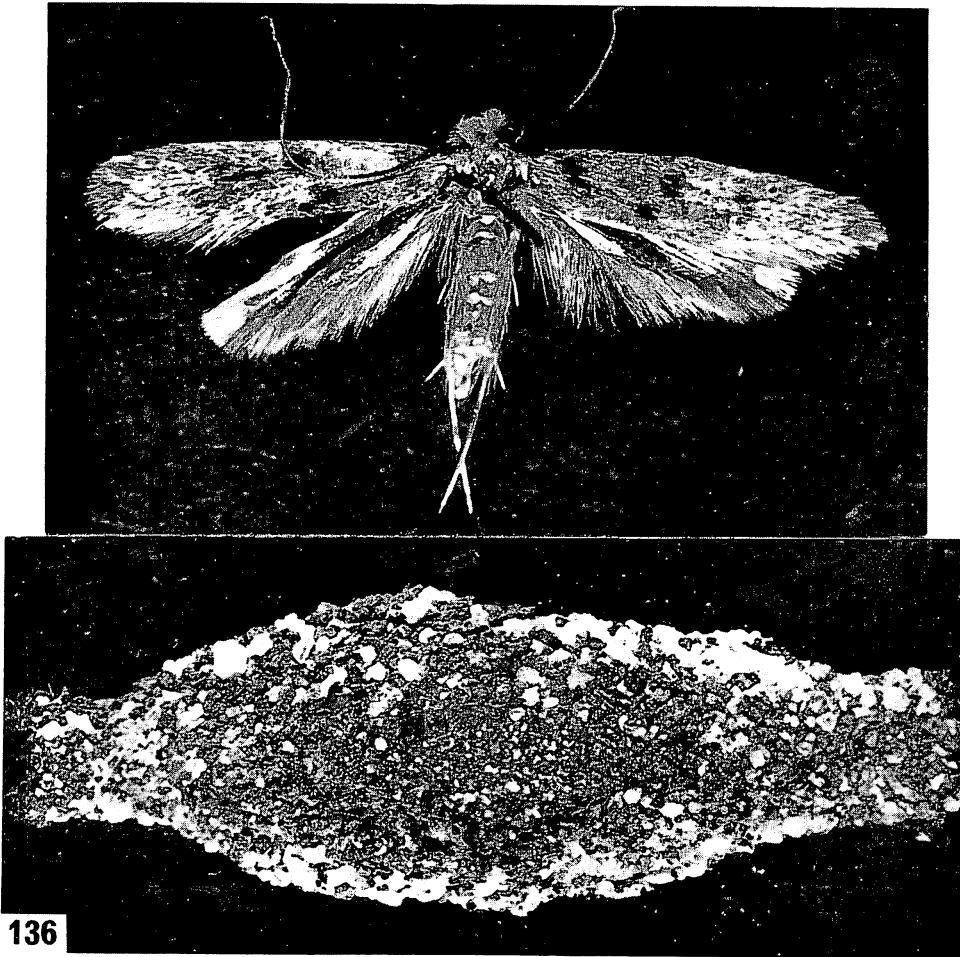
Căpușe (1966:106) erected the subfamily Messiinae for several genera, including *Pheroecca*, but I am not aware that his conclusion that the group deserves full subfamily rank has been widely accepted. Perhaps tribal status might be justified. Căpușe stated that the larvae of Messiinae are lichen-eaters, but he appears to have overlooked the important discussion of Hinton (1956:325–328) in which he demonstrates, and I can confirm from personal experience, that the larval food of *Pheroecca* is normally arthropod remains.



Figure 135—*Pheroecca uterella* (Walsingham), head partly abraded; wing venation from slide BM 4060, Amazon.

KEY TO THE SPECIES OF *Phereoeca* POSSIBLY IN HAWAII

1. Inner basal face of valva of male genitalia with a distinct toothlike lobe as in figures 137–138; female genitalia with the heavily sclerotized caudal part of the ductus bursae shorter than the anterior apophyses of the ovipositor, as in figure 139.....***allutella*** (Rebel).
2. Inner basal face of male genital valva simple, as in figure 138; female genitalia with the heavily sclerotized caudal part of the ductus bursae longer than the anterior apophyses of the ovipositor, as in figure 140...  
.....***uterella*** (Walsingham).



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Figure 136—*Phereoeca alutella* (Rebel), Honolulu, forewing 6 mm. (this specimen was wrongly determined as *uterella* in Honolulu). The bottom figure is of a larval case; note the incorporated grains of sand.



***Phereoeca allutella*** (Rebel) (figs. 135, 136, moth, larval case; 137–138, male genitalia; 139, female genitalia).

*Tineola Allutella* Rebel, 1892:270, pl. 17, fig. 3; 1896:124. Walsingham, 1894:537, 542; 1908*a*:1026.

*Phereoeca allutella* (Rebel) Hinton and Bradley, 1956:46. Hinton, 1956:327 (larva). G. Petersen, 1958:342, fig. 153 (male genitalia).

*Tinea pachyspila* Meyrick, 1905:619 (described from Ceylon); 1927*c*:116 (Samoa). Fletcher, 1914:466, fig. 342; 1921 (1920):191. **New synonym.**

*Tineola walsinghami* Busck, 1934 (1933):188 (described from the West Indies). **New synonym.**

The household case-bearing moth.

Kauai, Oahu, Maui, Hawaii, Laysan, French Frigate Shoal.

Immigrant. Described from Tenerife and heretofore known from Madeira, Canary Islands, Africa, Seychelles, Ceylon, India, Java, and Samoa, but it is probably much more widely distributed and perhaps commonly misidentified. It was first found in Hawaii before 1915.

Mistakenly determined in Hawaii as *Oecia maculata* Walsingham, a member of the Oecophorinae, it was later identified as *Tineola uterella* Walsingham by August Busck during a visit to the Islands. In 1950, Dr. Swezey mistakenly named specimens taken in a cellar and at light traps at several localities on Oahu as early as 1944 as *Crypsithyris pheretropa* Meyrick (1931:105), a species described from Assam. I discovered the error in identification while studying

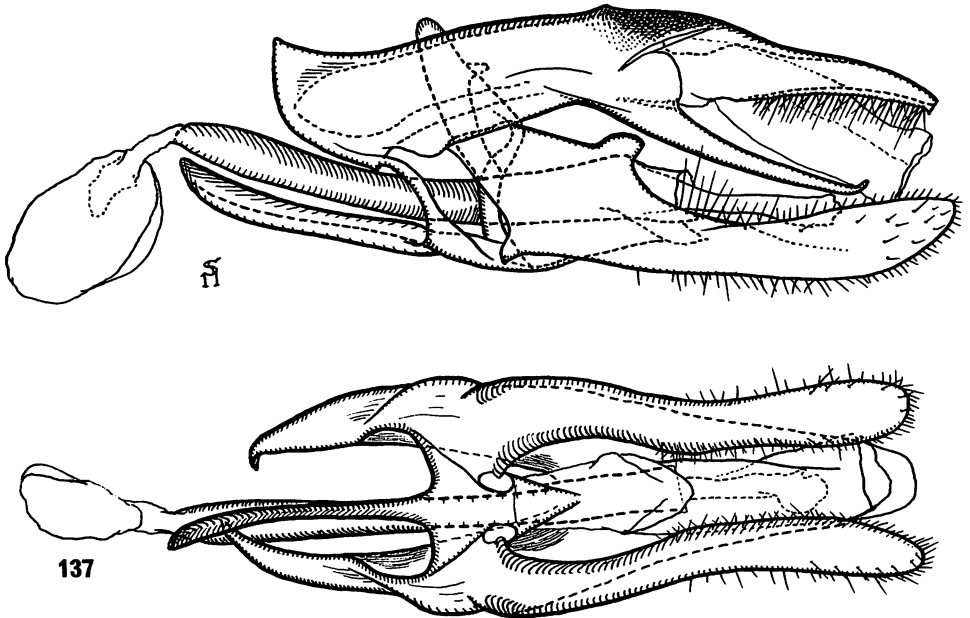


Figure 137—*Phereoeca allutella* (Rebel), lateral and ventral aspects of the male genitalia; Honolulu (slide Z-XII-29-66).

the genitalia of specimens from the original Swezey series kindly sent to me at the British Museum.

Through the courtesy of Don R. Davis of the U.S. National Museum, I was able to examine microscope slide preparations made by August Busck and determined by him as *walsinghami* Busck. I can find no differences between the material named *walsinghami* Busck and *alutella*, and I have found it necessary to place the name *walsinghami* Busck in synonymy.

The habits of this species appear to be similar to those of *Phereoeca uterella*. Walsingham (1908:1026) found the larvae crawling on the walls of houses in Tenerife. Meyrick (1905:619), reporting it as *pachyspila*, said that it was "stated by Mr. Green to be common in every bungalow throughout the island [Ceylon]. Larvae case-bearing, feeding on flannel, fur, etc., all the year round (Green); case relatively large, fusiform-cylindrical, composed of silk

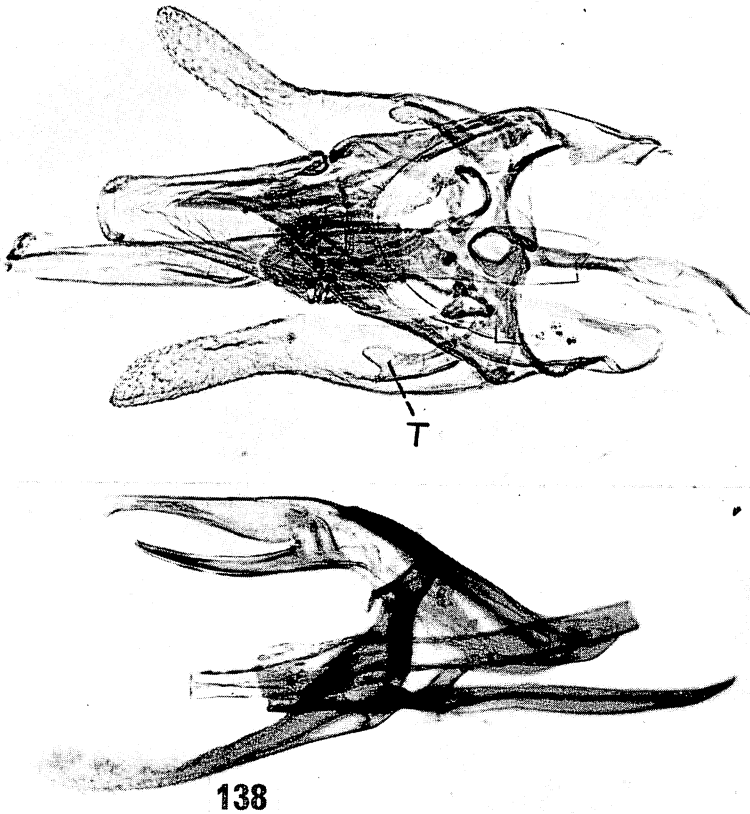


Figure 138—Male genitalia of two species of *Phereoeca*. Top, *alutella* (Rebel), ventral aspect; Honolulu (Busck slide 195 in Bishop Museum); note the "tooth" (T) on the valva. Bottom, *uterella* (Walsingham), lateral aspect; Para, Brazil (BM slide 4060); note that there is no "tooth" on the valva of this species.

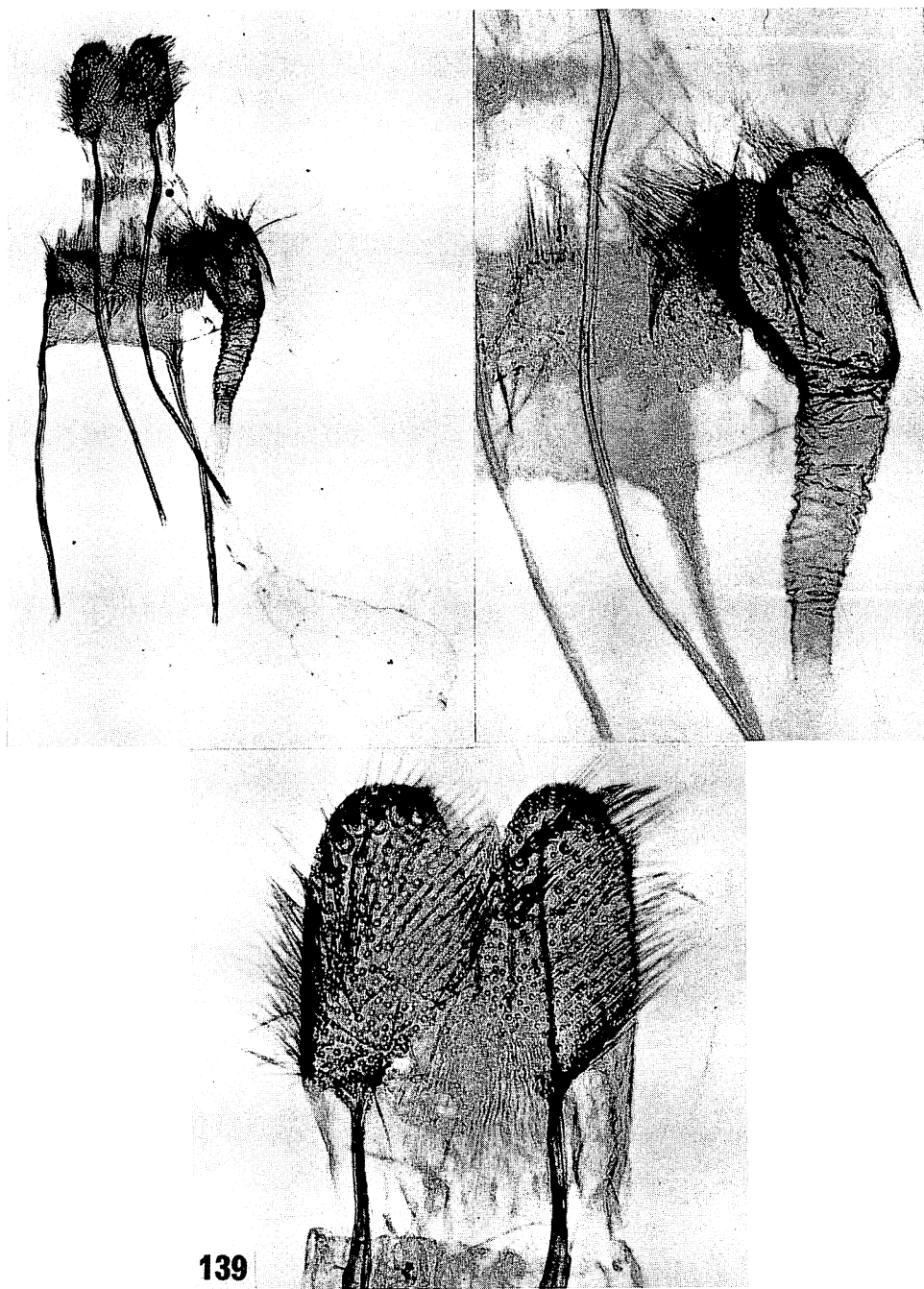


Figure 139—*Pheroeca allutella* (Rebel), female genitalia; Honolulu (slide Z-X-14-65). Note the heavy spines on the ovipositor lobes.

covered with sand and fragments of cinder and brick-dust." The larvae of *allutella* (see Hinton, 1956:325, for a modern, illustrated description; also compare figures 141–142, in this volume) are commonly observed crawling on the walls of rooms and buildings in Hawaii. They make a conspicuous, flattened case which bulges in the midsection and is open at both ends (figure 136). One case examined measured about 15 mm. in length and another measured 11 mm. The larva is able to turn around within its case and emerge from either end. The cases are well camouflaged with bits of detritus incorporated in the silken structure. The larval food consists of arthropod remains and other bits of animal matter gleaned from surfaces inhabited by the larvae. The larvae are most abundant in basements or in darker or damper rooms. Little is known about *Phereoeca allutella*, although the moth is common in Hawaii. Don R. Davis recently reared it from larvae found in association with pigeon dung on Hawaii.

Parasite: *Apanteles carpatus* (Say). Swezey [*Proc. Hawaiian Ent. Soc.* 6(2):244, 1926] reported finding 58 to 70 percent of the larvae parasitized.

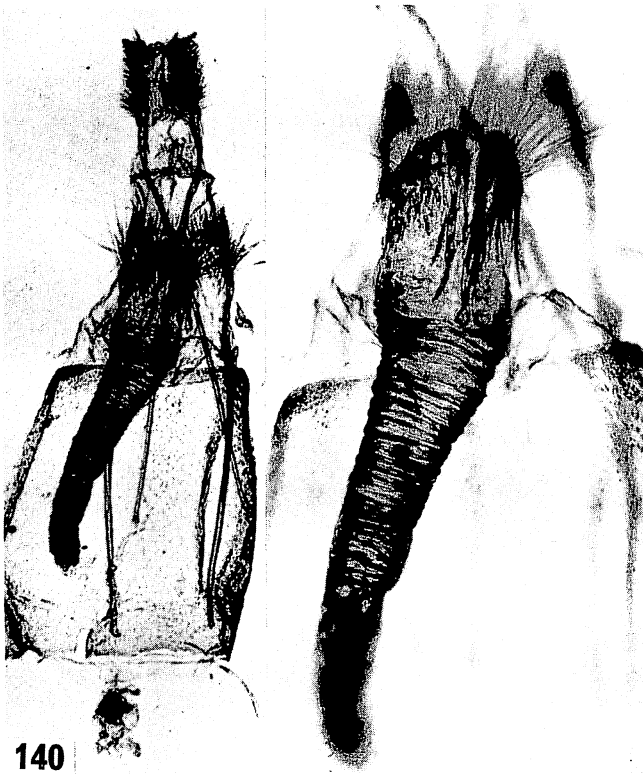


Figure 140—Genitalia of the female holotype of *Phereoeca uterella* (Walsingham); Para, Brazil (BM slide 8138).

Meyrick (1927:116) determined a series of specimens of this species taken in Samoa by Buxton and Hopkins as his *Tinea pachyspila*. I have examined some of those specimens and have found them to be *Phereoeca allutella*. A specimen determined by Meyrick as *pachyspila* from the Seychelles appears not to be the same species as that which he named *pachyspila* from Samoa, and it is different from *allutella*. No specimens under the name *pachyspila* can now be found in Meyrick's collection in the British Museum, but there is a series from Ceylon under the name *allutella* that contains specimens from Meyrick's original series which he used for his *pachyspila*. Meyrick concluded that his name *pachyspila* was a synonym of *allutella*, and he discarded his *pachyspila* label from his collection. He did not publish the synonymy, but J. D. Bradley has shown me Meyrick's notebook in which Meyrick placed his name *pachyspila* as a synonym under *allutella*. In the absence of a male in good condition in the Meyrick collection in the British Museum, I have selected from that material a female bearing the label "Peradeniya, Ceylon, Green. 5.05" as lectotype of *pachyspila*.

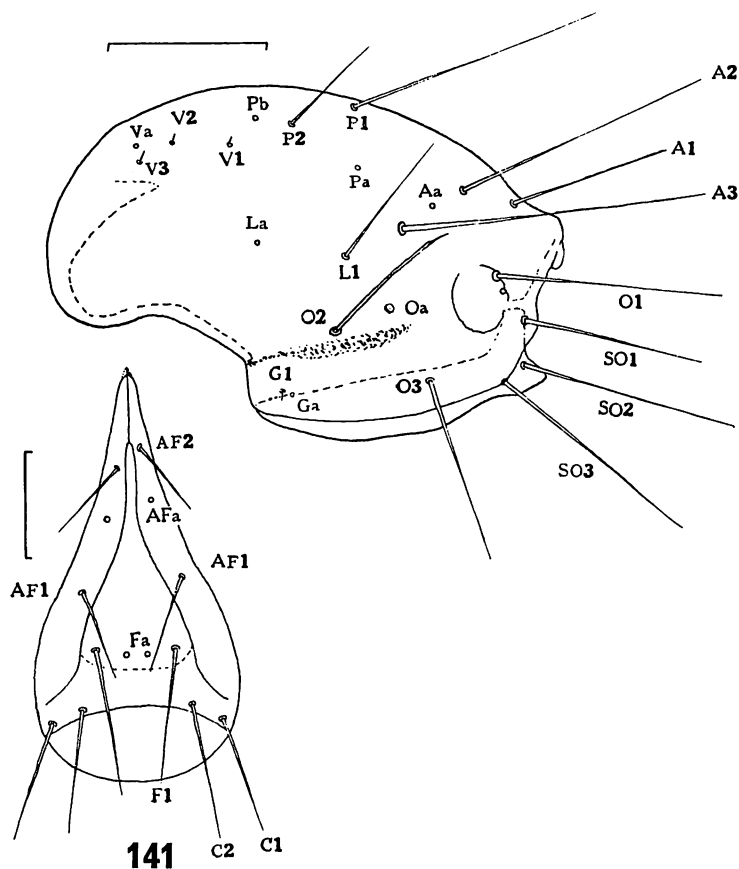


Figure 141—*Phereoeca uterella* (Walsingham), details of the head of a mature larva. Top, right side of head. Bottom, the fronto-clypeal apotome. The scale lines=0.22 mm. (After Hinton, 1956.)



***Phereoeca uterella*** (Walsingham) (figs. 135, head, venation; 138, male genitalia; 140, female genitalia; 141–142, larva).

*Tineola uterella* Walsingham, 1897*b*:165. Swezey, 1916:147. Busck, 1934:187–189.

*Tinea borboropis* Meyrick, 1919:275 (type locality: British Guiana).

*Phereoeca uterella* (Walsingham) Hinton and Bradley, 1956:46, figs. 3, 4. Hinton, 1956:325, figs. 210–216, larva.

Not known to be established in Hawaii.

This species was described from Para, Brazil, and it may be widely distributed. Confusion exists regarding the identifications in literature and collections, and several species may be involved in the records. It was first recorded from Hawaii by Swezey (1916:147), after Hawaiian specimens were determined as *Tineola uterella* by August Busck. However, the determination was incorrect, and the species involved is *Phereoeca allutella*, as noted above. Dr. Swezey, before 1916, had confused the species with the oecophorid *Oecia maculata*. He said (1916:147) that "in Honolulu, *T. uterella* [really *allutella*] is much more common than *O. maculata*, for I have collected but one specimen of the latter in 11 years of collecting; whereas, the former I have collected frequently from many localities in the Islands, and also reared it from the larval case so commonly seen about buildings."

Although I do not know if this species is present in Hawaii, I believe that it might easily be confused with *allutella* if it were there. Its distribution and habits are such that it could be introduced at any time, and I leave these data here to assist workers who may have occasion to be concerned with it in the future.

Meyrick (1930:532) stated incorrectly that *uterella* and *allutella* are the same.



Figure 143—*Trichophaga* details. Head and wing venation of *mormopis* Meyrick, West Africa (BM slide 5189). Below, sketches of the male frenulum of *mormopis* Meyrick, left, and *tapetzella* (Linnaeus), right, drawn to the same scale.

Genus **TRICHOPHAGA** Ragonot

*Trichophaga* Ragonot, 1894:123. Type-species: *Tinea swinhoei* Butler ( = *Trichophaga coprobiella* Ragonot).

T. B. Fletcher, 1929:230. G. Petersen, 1957:127.

*Trichophaga* is a small cluster of Old World species, some of which have become widely dispersed by commerce.

**Trichophaga mormopis** Meyrick (figs. 143, head, venation, frenulum; 144 moth, male genitalia; 145, female genitalia).

*Trichophaga mormopis* Meyrick, 1935*b*::575.

*Trichophaga percna* Corbet and Tams, 1943*b*:131, fig. 5. Synonymy by Gozmány, 1967:7.

Oahu, Maui.

Immigrant. Widely distributed from Africa (type locality: the former Belgian Congo) to India, Ceylon, Malaya, Formosa, and Fiji. First found in Hawaii by D. D. Jensen, who reared specimens in Honolulu in 1944 (*Proc. Hawaiian Ent. Soc.* 12(2):226, 1945). The identification of the Jensen specimens and other earlier records in the *Proceedings of the Hawaiian Entomological Society* by Swezey as the tapestry or carpet moth, *Trichophaga tapetzella*, are incorrect. In 1950, I compared the genitalia of Hawaiian specimens with the collections at the British Museum and found that the species in question is *mormopis* instead of *tapetzella*. It is possible, however, that *tapetzella* may also be present in Hawaii, and determinations should be made with care.

The specimens reported on in Hawaii by Jensen were reared from rabbit fur. The larvae spin a silken tube in their host material. The related *Trichophaga tapetzella* has been bred from owl pellets, and, in the British Museum collection, I found the following note: "Makes galleries in wools, tapestries, furs, etc. Common in fields where the waste of the rabbit-skin industry is used as fertilizer." Hinton (1956:295) said "The larva feeds on hair, wool, and feathers or on materials containing these. It is more common in outhouses and stables than in houses. . . . It is chiefly a pest in temperate regions. . . ." Hinton noted that it has been bred from the fur of dead animals, from the nests of *Sceliphron* wasps, bird dung, hair stuffing in saddles and harness, skins, furs, blankets, etc., and he gives numerous references to other papers on the biology of the species as well as a detailed, illustrated account of the larva. Perhaps the habits of *mormopis* may be closely similar to those of *tapetzella*. Hinton said (1956:328) that "in the Oriental Region, where . . . [*mormopis*] replaces *T. tapetzella* (L.) as a pest of furs, skins, woollen materials and feathers . . . , it has been known as *T. abruptella* (Woll.). In the British Museum there are no specimens of *T. abruptella* from the Oriental region. . . . The latter species is widely distributed in Africa and also occurs in Spain, Iraq, Palestine, Arabia and the Canary Islands." Hinton had not seen the larva of *mormopis* when he wrote his report.



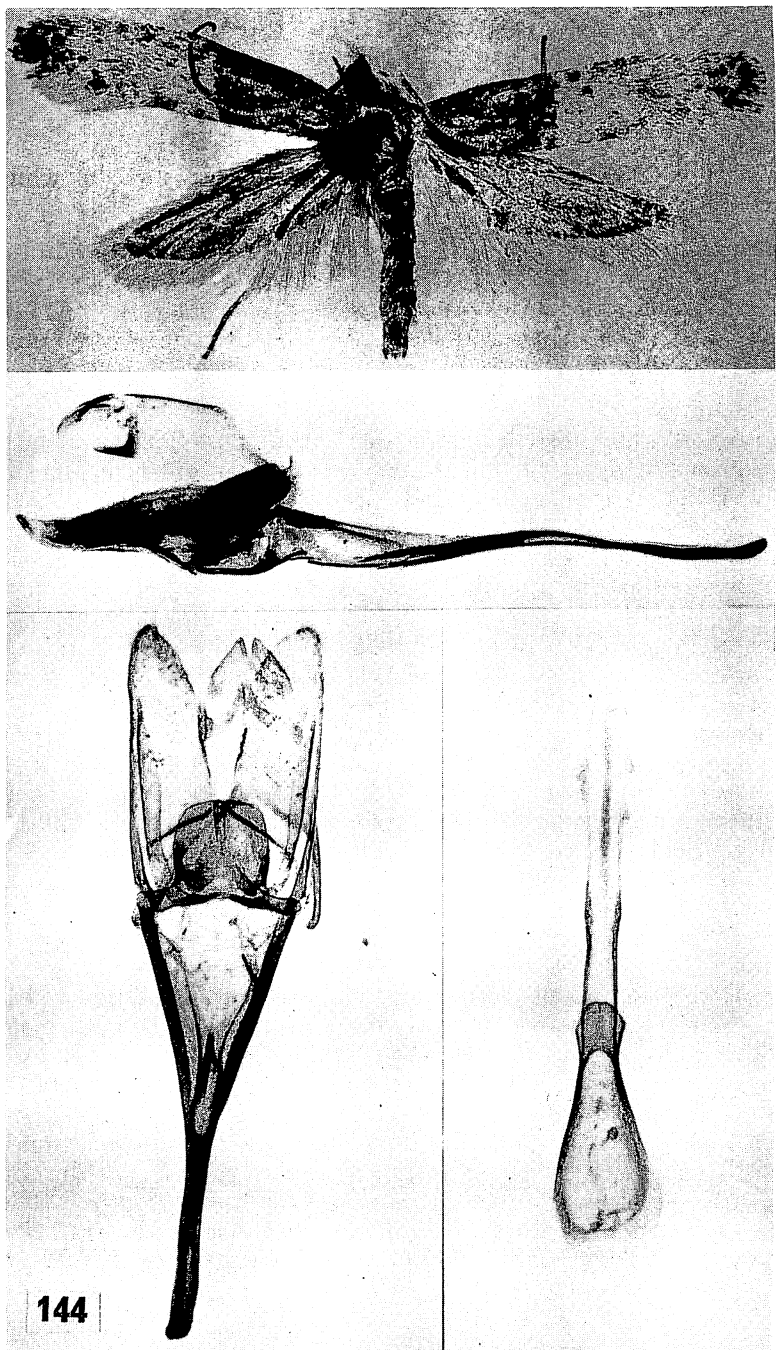
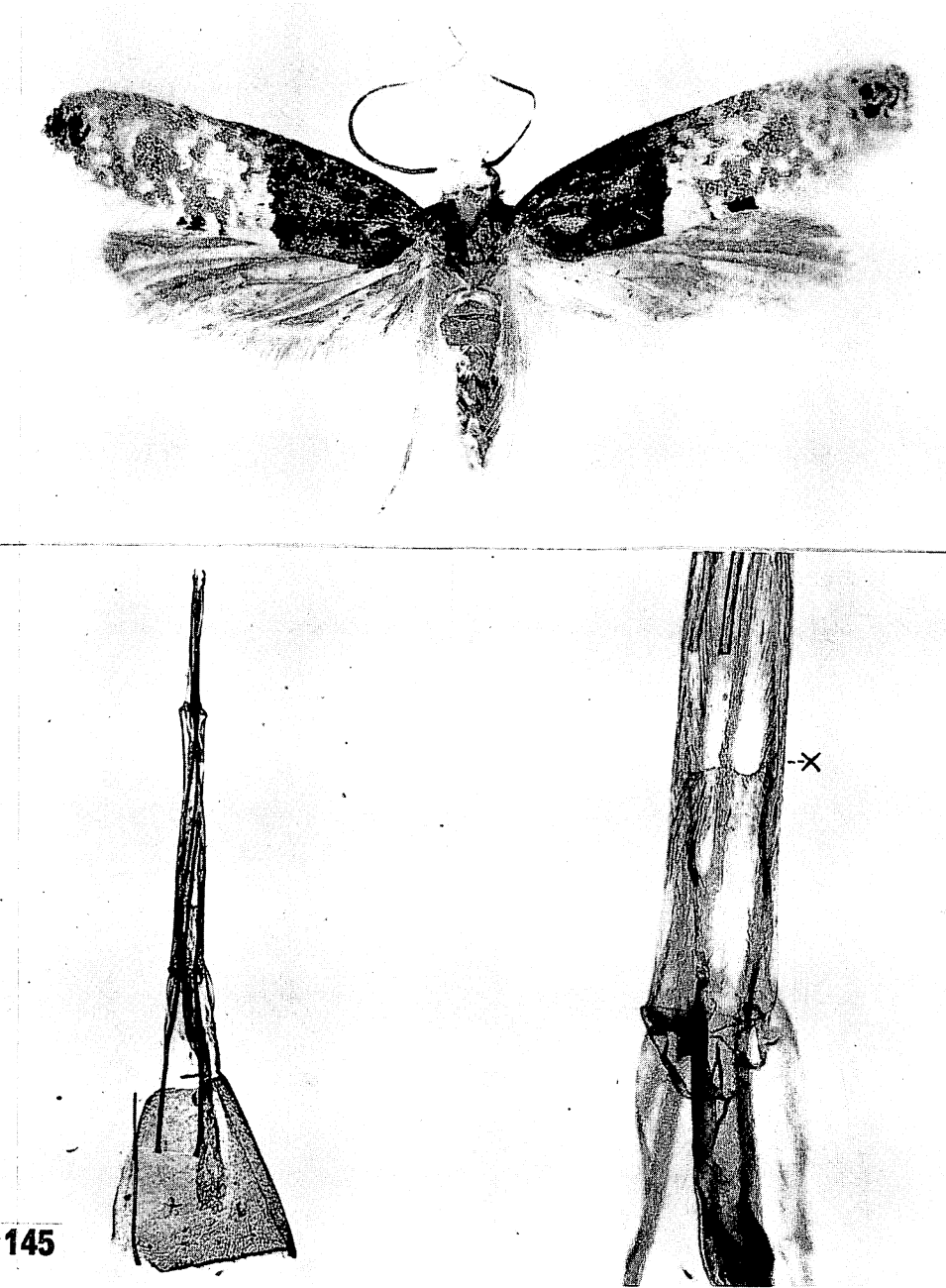


Figure 144—*Trichophaga mormopis* Meyrick. The moth is from Waipio, Oahu; forewing 7 mm. The middle figure of the male genitalia in lateral aspect is from a specimen from West Africa (BM slide 5189). The genitalia at the bottom, in ventral view and with the aedeagus at the right, are from a specimen from Oahu.



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Figure 145—*Trichophaga*. Top, an English (Isle of Wight) specimen of *tapetzella* (Linnaeus), expanse 20 mm. This species is not known to be established in Hawaii but may be there or may become established. The bottom figures are of the female genitalia of a specimen of *mormopis* from Ceylon (BM slide 8137); the ostium bursae is marked by an "X"; the bursa is complete as figured and lies adjacent to the apophysis in the left figure.

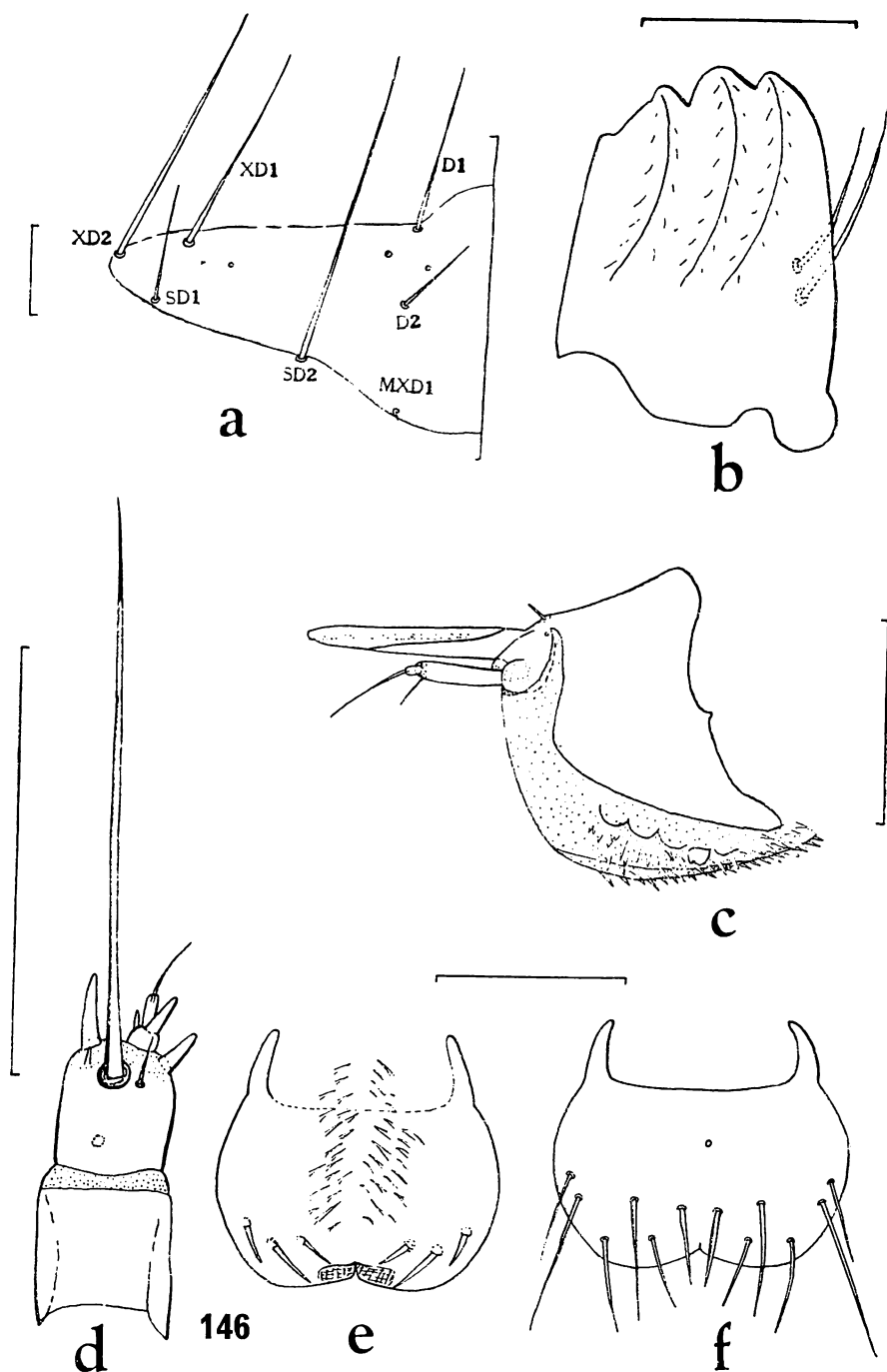


Figure 146—*Trichophaga tapetzella* (Linnaeus), details of a mature larva. *a*, dorsal setae of the left side of the prothorax; *b*, ventral aspect of the left mandible; *c*, right side of the prementum-hypopharynx; *d*, right antenna; *e*, ventral side of the labrum; *f*, dorsal side of the labrum. The scale lines = 0.22 mm. (After Hinton, 1956.)

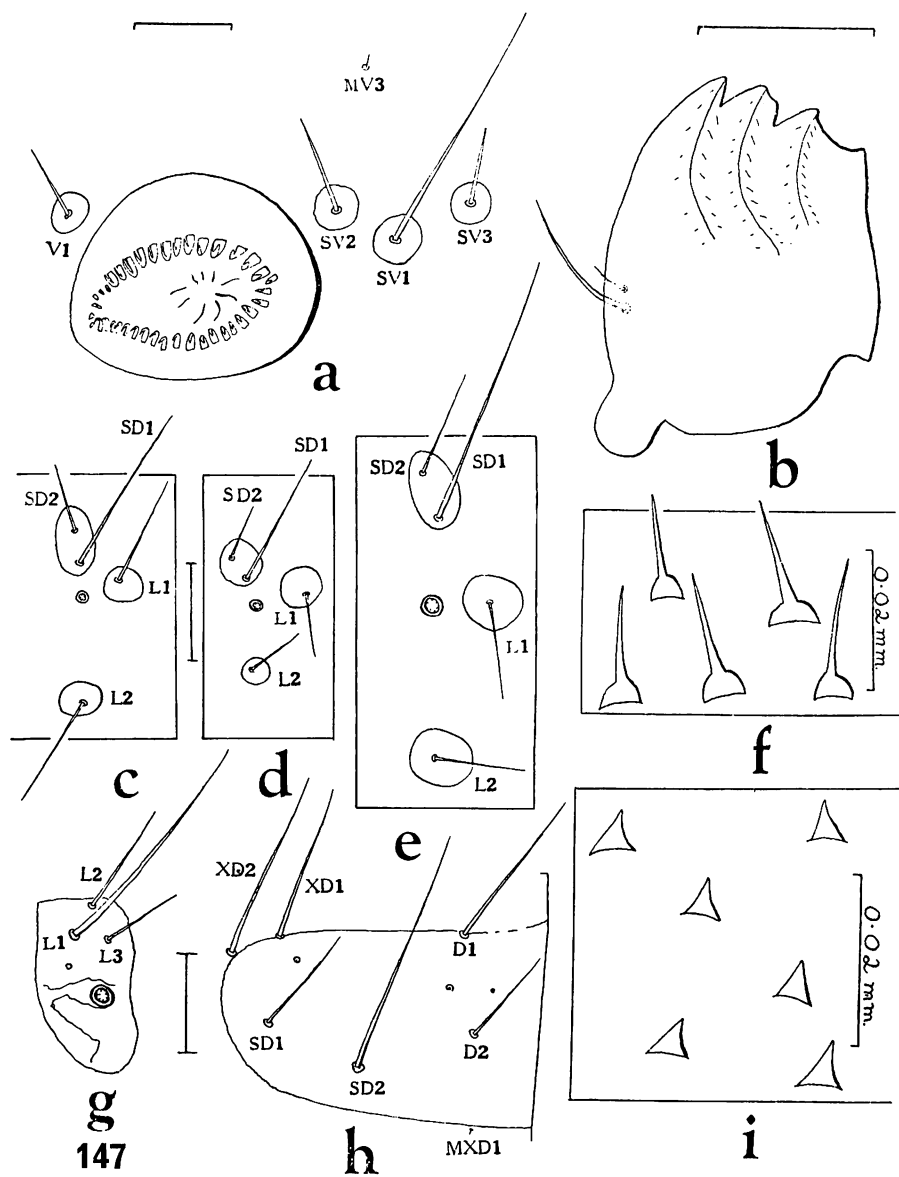


Figure 147—Details of the mature larvae of *Trichophaga* and *Monopis*. *a*, left proleg of fourth abdominal segment of *Trichophaga tapetzella* (Linnaeus). *b*, ventral aspect of right mandible of *Trichophaga swinhoei* (Butler); *c*, spiracle and associated setae on the left side of seventh abdominal segment of *Monopis rusticella* (Clerck); *d*, the same of *Monopis ferruginella* (Hübner); *e*, the same of *Trichophaga tapetzella*; *f*, microtrichia of the eighth abdominal tergite of *Monopis ferruginella*; *g*, spiracle and L group of setae on the prothorax of *Monopis congestella* (Walker); *h*, dorsal setae of the left side of the prothorax of *congestella*; *i*, microtrichia of the eighth abdominal segment of *Trichophaga tapetzella*. The scale lines where not otherwise marked = 0.22 mm. (After Hinton, 1956.) These species are not known to be established in Hawaii—these figures are included for comparative purposes.

Should *tapetzella* be discovered in Hawaii, it and *mormopis* may be distinguished by the following details given by Corbet and Tams (1943b:119):

1. Upperside of forewing with the division between the dark brown basal area and the creamy white distal area oblique, outwardly slightly concave and with the dark brown basal area broader at the costa than along the posterior margin of the wing; expanse: 8.5–12.00 mm.; figure 145.....**tapetzella** (Linnaeus).
2. Upperside of forewing with the division between the dark brown basal area and the creamy white distal area straight and at right angles to the posterior margin of the wing; expanse: 6.0–8.0 mm.; figure 144.....**mormopis** Meyrick.

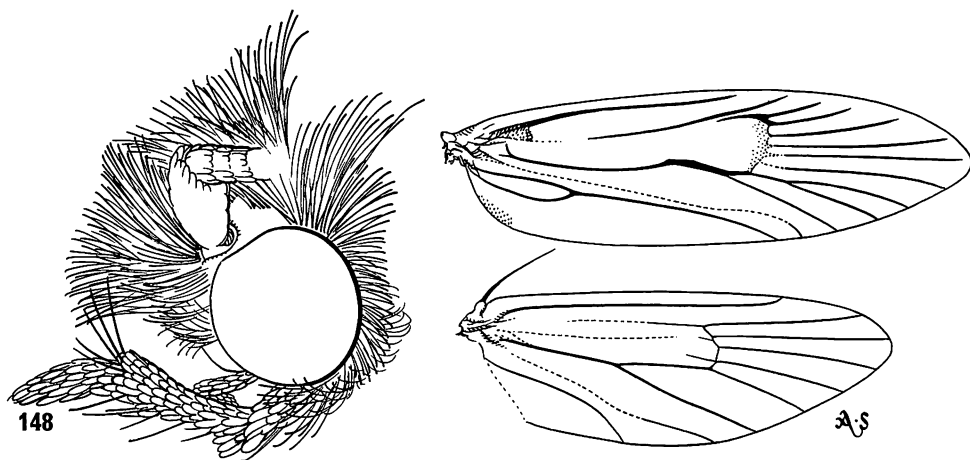


Figure 148—Head and wing venation of *Monopis crocicapitella* (Clemens), Hawaiian specimens (BM slide 4239).

### Genus **MONOPIS** Hübner

*Monopis* Hübner, 1831 (1825):401. Type-species: *Tinea rusticella* Hübner.

*Blabophanes* Zeller, 1852b:100.

*Hyalospila* Herrich-Schäffer, 1853: pl. 10, fig. 14.

*Rhitia* Walker, 1864a:818.

*Eusynopa* Lower, 1903:237.

Dietz, 1905:30, key to the North American species.

Some workers have placed *Monopis* in a separate family, the Monopidae (see Forbes, 1923:131, for example), but the larval and other characters

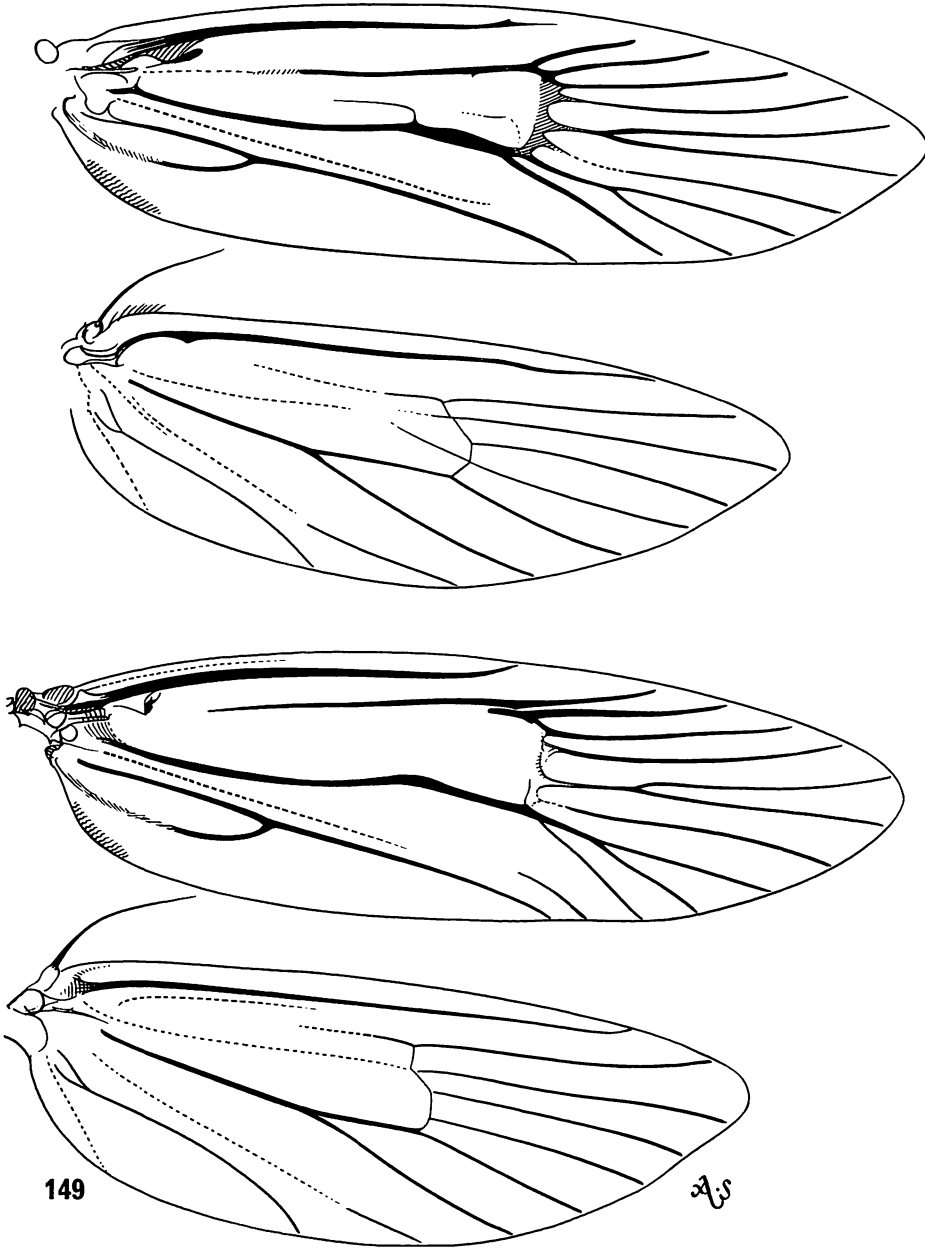


Figure 149—*Monopis* wing venations. Top, *meliorella* (Walker), Toowong, Queensland, Australia (BM slide 8613). Bottom, *monachella* (Hübner) (BM slide 4191); Hawaiian specimen, Blackburn number 81:7.

are tineid. Perhaps the group may eventually be given subfamily or tribal rank. It is of interest that Hinton (1956) did not find characters in the larvae to lead him to separate the group from typical Tineinae, but that does not mean that the group really is equivalent to the typical Tineinae. Obviously, more study is required.

"Some tropical Tineidae (*Monopis*) present a simply baffling biology: they are the only Lepidoptera known that are obligately viviparous (and apparently parthenogenetic), and it even seems likely to me that their eggs must mature and numerous larvae hatch inside a spacious uterus during pre-adult stages of the mother insect (during the pupal or perhaps late larval stage?)" (Diakonoff, 1955a:43-44; see also Diakonoff, 1952:91-96, for an expanded discussion.) Abdomens of adult female *Monopis* have been examined which are densely packed with multitudes of first-stage larvae, but I have not seen any such Hawaiian specimens. Males of the three *Monopis* species which now occur in Hawaii are known, and the ovoviviparous habit has not been observed in any of the Hawaiian species. The original account of the extraordinary ovoviviparity of a species of this group was presented by A. W. Scott to the Entomological Society of New South Wales in September, 1862 (published early in 1863), and his historic observations were reported as follows:

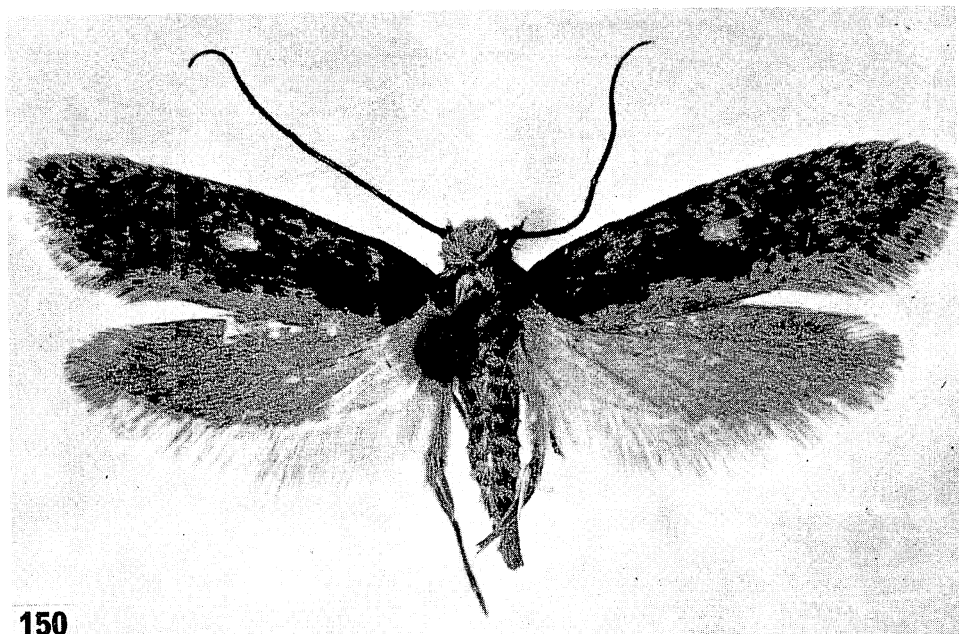


Figure 150—*Monopis crocicapitella* (Clemens), Gainesville, West Virginia. [U. S. National Museum (USNM) photograph supplied by J. F. G. Clarke.]

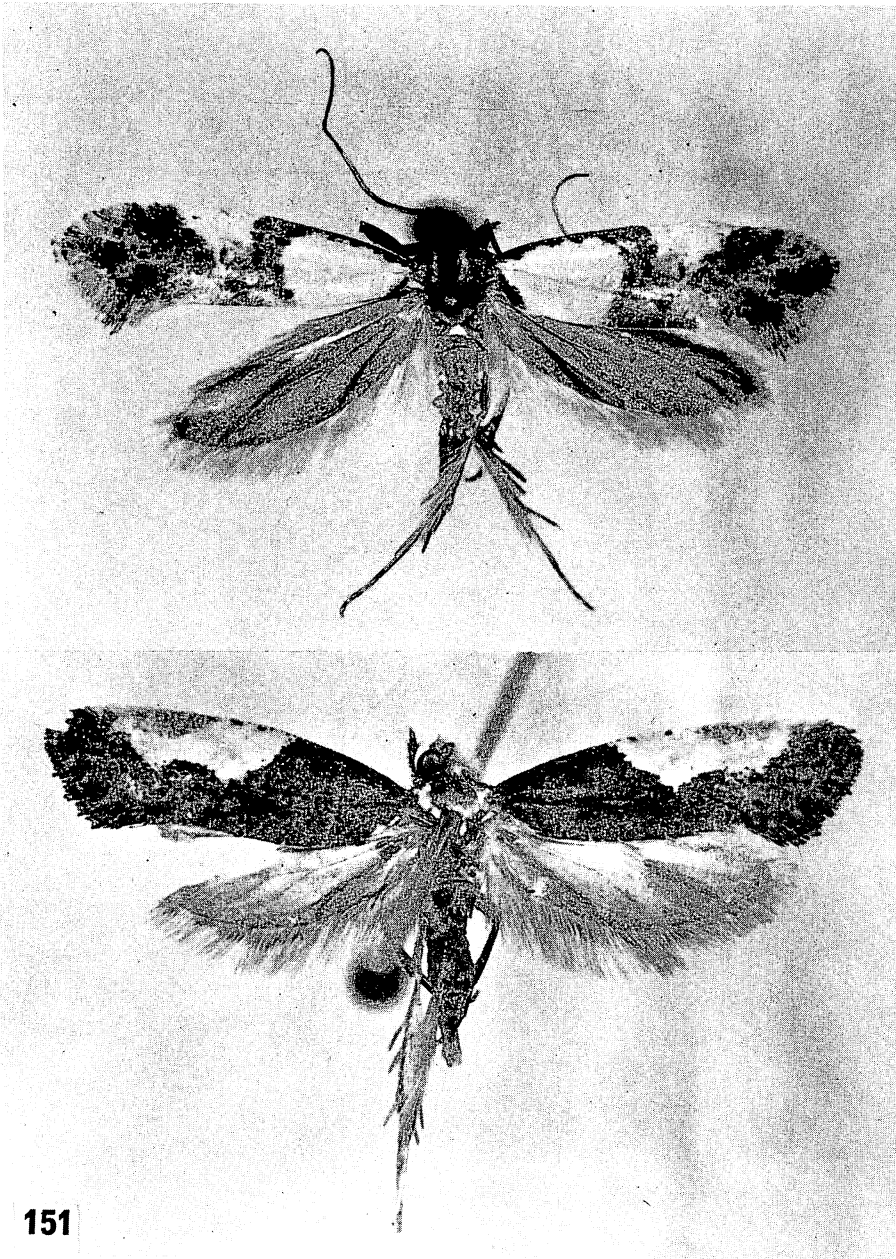


Figure 151—Top, *Monopis meliorella* (Walker); Kaunakakai, Molokai, forewing 8 mm. Bottom, *Monopis monachella* (Hübner), Waipio, Oahu, forewing 7 mm.



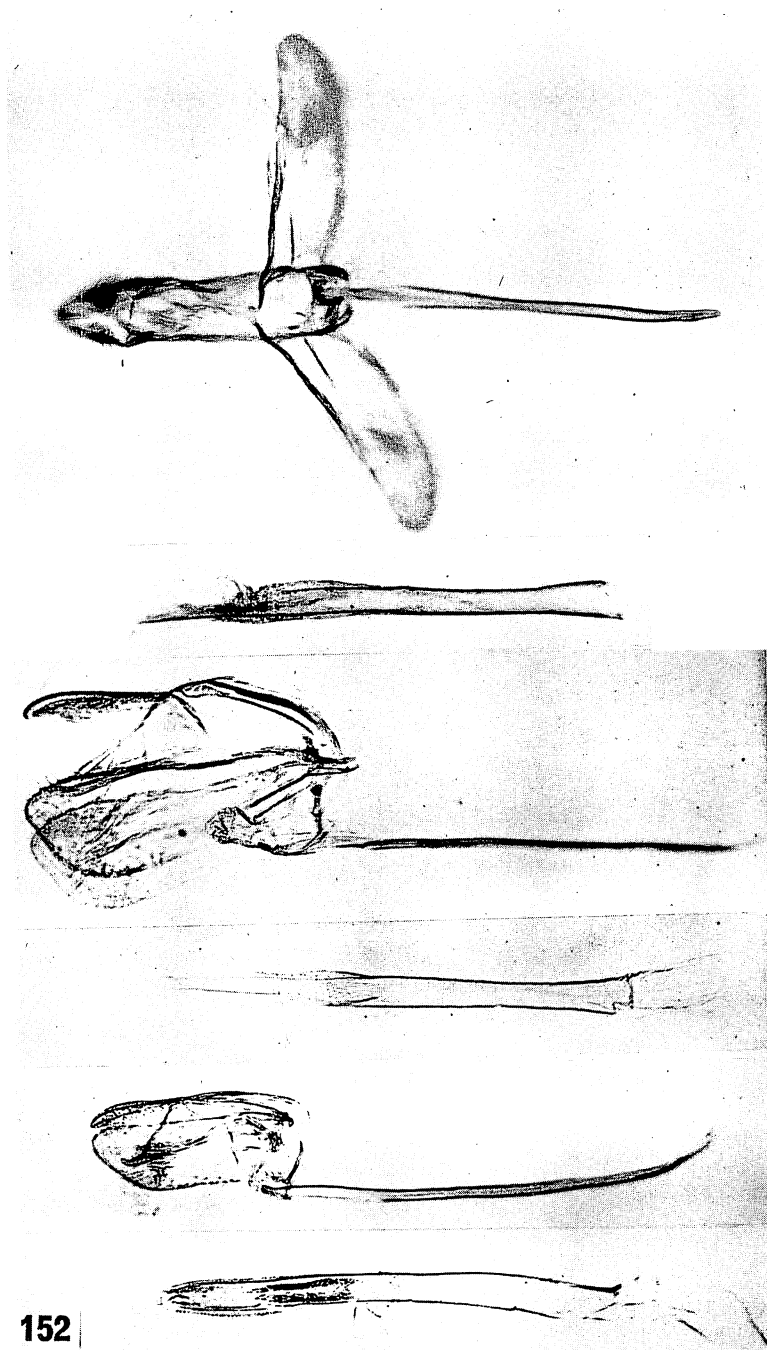


Figure 152—Male genitalia of *Monopis*. Top two, *crocicapitella* (Clemens); Kona, 4000 feet, Hawaii (BM slide 4239). Middle two, *meliorella* (Walker); Hawaiian specimen (BM slide 4190). Bottom two, *monachella* (Hübner); Hawaiian specimen, Blackburn field numbers 81.7 68 (BM slide 4191). There are only slight differences in the male genitalia of these species.

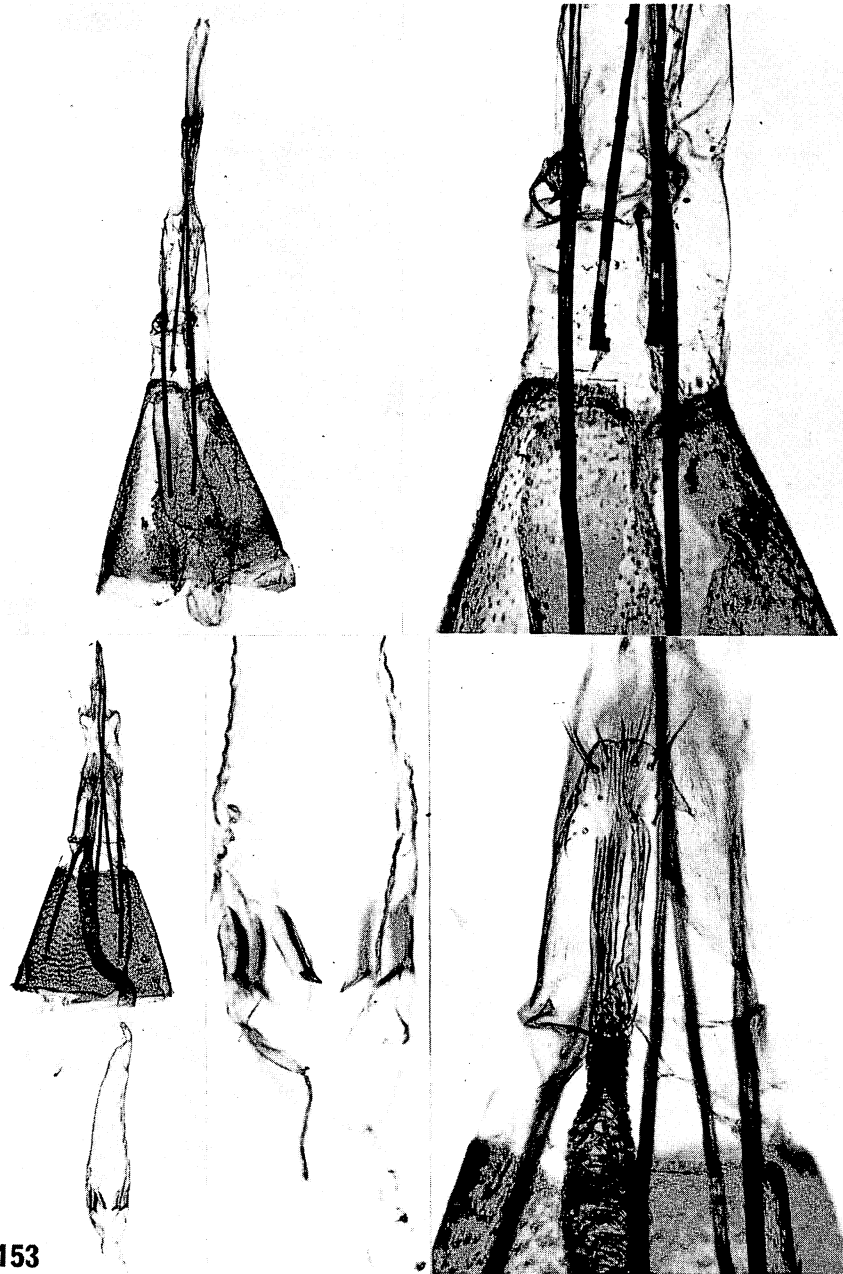


Figure 153—Female genitalia of *Monopis*. Top, *meliorella* (Walker); Toowong, Queensland, Australia (BM slide 8099). Bottom, *monachella* (Hübner); Hawaiian specimen (BM slide 8100).

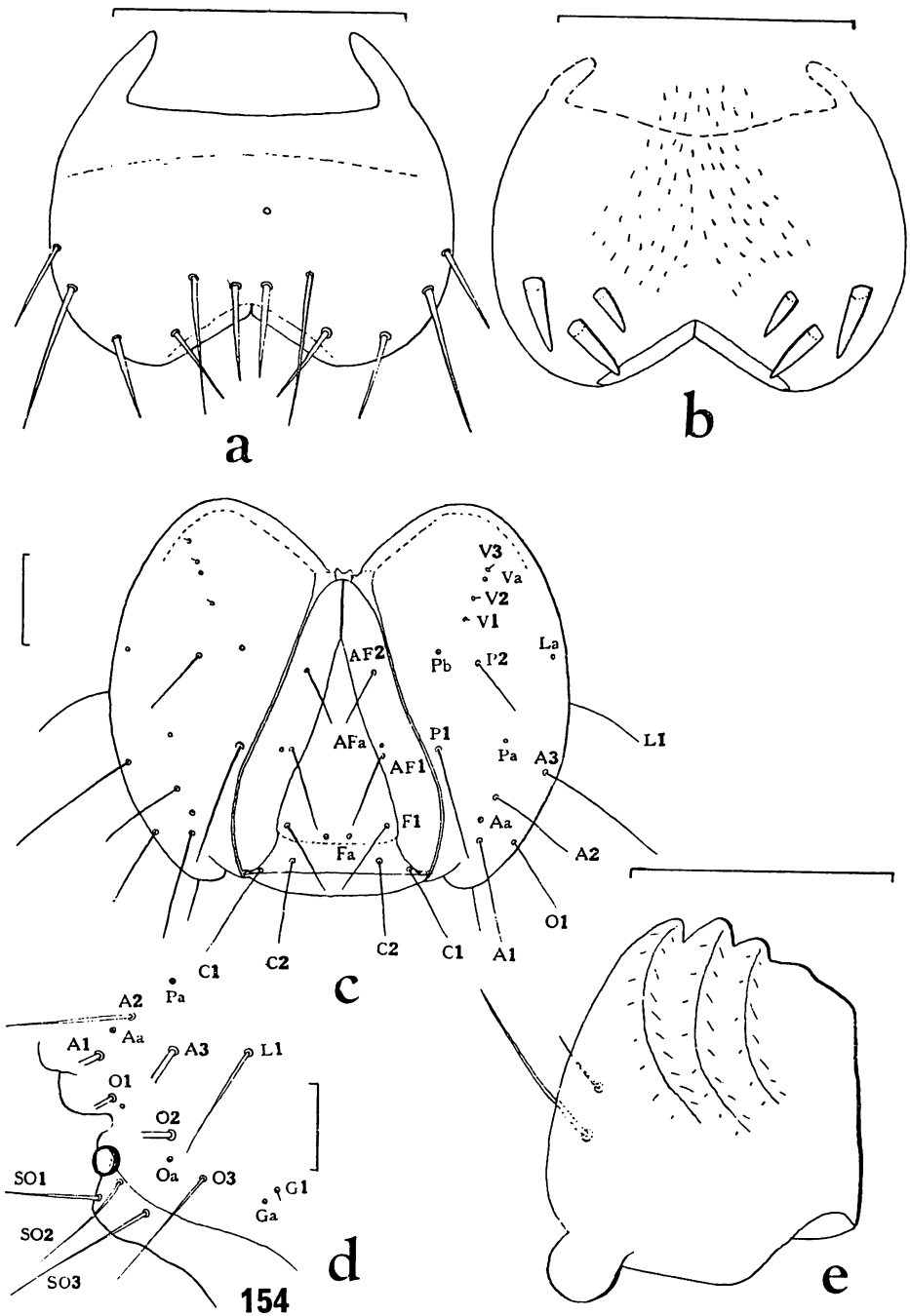


Figure 154—Details of the head of a mature larva of *Monopis rusticella* (Clerck). *a*, dorsal aspect of labrum; *b*, ventral aspect of labrum; *c*, frontal aspect of head; *d*, ocular area of left side of head drawn from a somewhat flattened cast skin; *e*, ventral aspect of right mandible. The scale lines=0.22 mm. (After Hinton, 1956.) For other details on *Monopis* see figures 147, 155, 156.

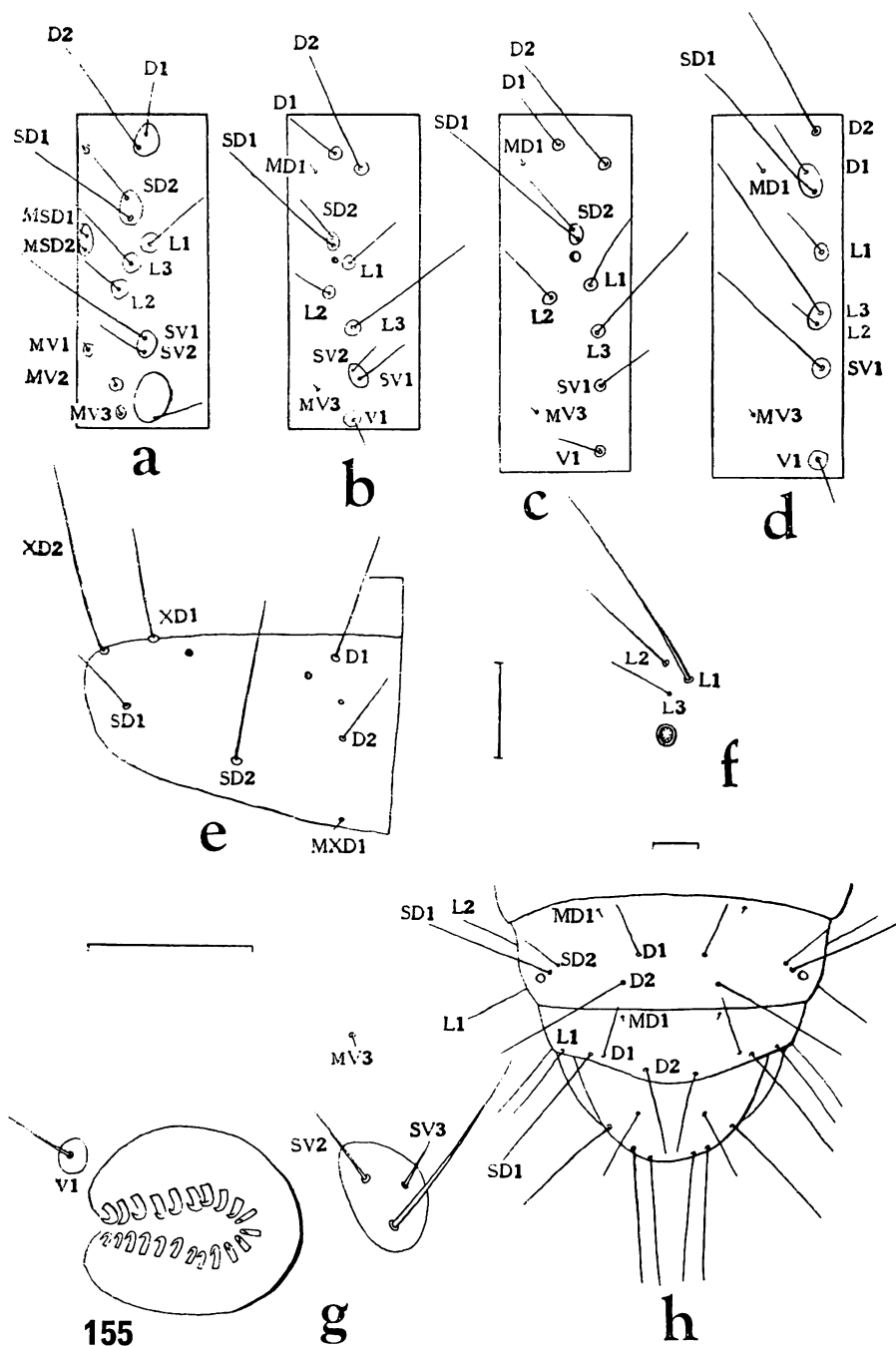


Figure 155—*Monopis rusticella* (Clerck), details of a mature larva. *a*, mesothorax; *b*, *c*, *d*, abdominal segments 7, 8, 9; *e*, dorsal setae of left side of prothorax; *f*, spiracle and L group of setae of right side of abdominal segment, ventral aspect; *g*, right proleg and associated setae of third abdominal segment, ventral aspect; *h*, dorsal aspect of abdominal segments 8, 9, 10. Scale lines = 0.22. (After Hinton, 1956.) For additional details on larval *Monopis* see figures 147, 154, 156.

I am induced from the novelty of the subject to lay before the Society a short description, accompanied by illustrations, of a Moth recently found on Ash Island, which possesses the remarkable and I believe unique quality of being ovo-viviparous; a quality hitherto known to exist only in some few groups of the Insecta, but never attributed to any species of the Lepidoptera. . . .

It was after dark in the early part of the month of October, 1861, that we first captured a specimen with the hand, being attracted at the moment by its elegant coloring, and wishing to secure it for the cabinet. Fearful that the plumage might be injured by the struggles of the Moth while endeavouring to escape, it was gently compressed, and on opening the hand we observed numbers of minute but perfect larvae being ejected from the abdomen in rapid succession and moving with considerable celerity, evidently in search of suitable shelter and food. This incident so singular and new to us, required further confirmation and consequently many more of a similar kind (of course all females) were caught and attached to corks previously covered with black paper and subjected to the closest scrutiny. These Moths shortly commenced to deposit

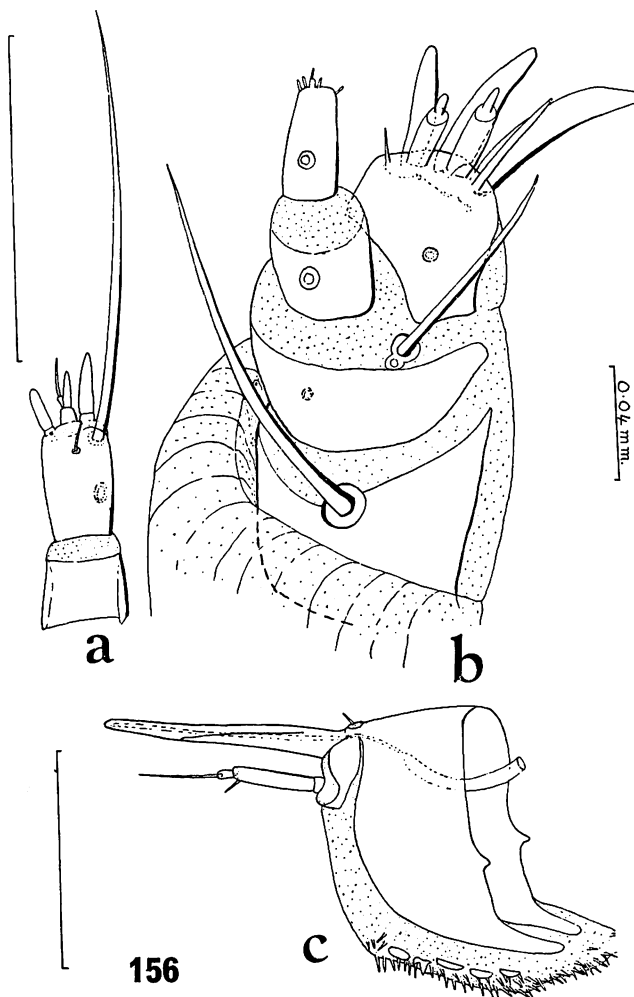


Figure 156—Details of a mature larva of *Monopis rusticella* (Clerck). *a*, antenna; *b*, ventral aspect of right maxilla; *c*, right side of prementum-hypopharynx. Scale lines=0.22 mm. (After Hinton, 1956.) For other details on larval *Monopis*, see figures 147, 154, 155.

their living progeny with rapidity, the small white fleshy larvae being seen with great distinctness on the black surface of the paper; thus affording clear and satisfactory proof that this Insect, the only one of its order at present known, is unquestionably ovo-viviparous, and will represent in future this peculiarity among the Lepidoptera; similarly to those few species existing in the Hemipterous and Dipterous orders. This fact having been ascertained, our attention was incited to the care of the little strangers and to procure suitable shelter and food for them, in the hope that we should be able to rear them and thus to supply a correct account of their metamorphoses. In this we were guided by the form of the perfect insect, and accordingly placed before them grains of maize, pieces of flannel and woollen cloth, shreds of partially decayed paper, some fungus and lichen, and other materials known to be the food of caterpillars belonging to the genus "Tinea" and neighbouring genera. Unfortunately they turned with distaste from all these supplies with the exception of the cloth and flannel, and even to these they attached themselves with reluctance. We however persevered and put them in a dark and roomy box, aware of the marked dislike to light of larvae possessing predatory habits, and left them undisturbed for a week; at the end of which we were pleased to find that small silken tunnels or tubes had been constructed on the surface of the brown cloth and that the denuded appearance of several places exhibited signs of their ravages. From this cloth they shortly afterwards transferred themselves to the flannel, where they fabricated small portable cases, composed of two separate pieces of an irregular oval form, joined at the sides, but leaving apertures at each end, and being thus comfortably housed, we entertained sanguine hopes of rearing them. These hopes, however, were not to be realized, for towards the end of November (nearly two months from their birth) they ceased to thrive, and eventually all perished.

It is unfortunate that Scott did not add some fur and feathers to the items of food which he provided for his larvae, because it is probable that the larvae might then have been reared with success.

Little is known about the three species of *Monopis* now established in Hawaii, and it would be worthwhile to make detailed studies on the biology of each of them. We may ask if those species known to be ovoviviparous really belong to *Monopis* and if both oviparous-bisexual forms and ovoviviparous-parthenogenetic forms occur in the same genus.

Because I cannot now provide illustrations and details of the larvae of the *Monopis* in Hawaii, I have included Hinton's figures of the larva of *Monopis rusticella* (Clerck) for comparison (figures 154–156).

#### KEY TO THE SPECIES OF MONOPIS IN HAWAII

1. Forewings with about the basal third mostly conspicuously pale colored (figure 151) . . . . . **meliorella** (Walker).  
Basal area of forewings mostly or entirely dark colored . . . . . 2
2. Forewings with a large pale macula occupying most of costal area from beyond basal third and extending into cell; posterior margin of forewing dark; pronotum mostly dark (figure 151) . . . . . **monachella** (Hübner).  
Forewings without such a large pale costal area and posterior margin of forewing yellow or yellowish white; pronotum mostly yellow (figure 150) . . . . .  
. . . . . **crocicapitella** (Clemens).

**Monopis crocicapitella** (Clemens) (figs. 148, head, venation; 150, moth, 152, male genitalia).

*Tinea crocicapitella* Clemens, 1859:258, 260. Busck, 1903a:184.

*Monopis crocicapitella* (Clemens) Dietz, 1905:33.

Hinton, 1956:328 (food of larvae). G. Petersen, 1957:168, figs. 139, 140 (male and female genitalia). See Walsingham, 1907*b*:728, for detailed synonymy and notes, and Banks, 1912:39–40, pl. 4, fig. 3.

Oahu, Molokai, Lanai, Hawaii.

Immigrant. Nearly cosmopolitan; described from the eastern United States. First recorded from Hawaii by Walsingham (1907*b*:728, 737) from specimens collected by Perkins on Oahu, Molokai, Lanai, and Hawaii.

The larvae have been found in debris, in a dead rat, and in "textile stuffs", and Don R. Davis has recently found the larvae associated with pigeon guano on Hawaii.

**Monopis meliorella** (Walker) (figs. 149, venation; 151, moth; 152, male genitalia; 153, female genitalia).

*Tinea meliorella* Walker, 1863:483 (type locality: Moreton Bay, Australia).

*Tinea oecophoroides* Walker, 1864*a*:1005.

*Tinea adjunctella* Walker, 1864*a*:1006.

*Blabophanes insularis* Felder and Rogenhofer, 1875: pl. 140, fig. 21.

*Blabophanes meliorella* (Walker) Meyrick, 1893 (1892):527.

I have not verified the above synonymy, and it may not all be correct. *Tinea vivipara* Scott, 1863(1862):33, pl. 4 (described from Ash Island, Australia) has been listed as a synonym, but I believe that to be an error. I have discussed the problem with Ian Common, of Canberra, and he shares the opinion that two species are involved.

Necker, Kauai, Oahu, Molokai.

Immigrant. First collected in Hawaii in 1920 by Swezey in Honolulu, it is known also in Australia and New Zealand.

No information concerning the habits of this species in Hawaii is known to me.

**Monopis monachella** (Hübner) (figs. 149, venation; 151, moth; 152, male genitalia; 153, female genitalia).

*Tinea monachella* Hübner, 1796: pl. 21, fig. 143.

*Tinea longella* Walker, 1863:479.

*Blabophanes longella* (Walker) Butler, 1881:395. Meyrick, 1883*a*:36. Walsingham, 1897*a*:65.

*Monopis monachella* (Hübner) Meyrick, 1895:785. Walsingham, 1897*a*:63; 1907*b*:727, detailed synonymy and commentary. G. Petersen, 1957:171, figs. 145, 146 (male and female genitalia). Diakonoff, 1968 (1967):282, fig. 779.

Kauai, Oahu, Lanai, Hawaii.

Immigrant. Widespread in Eurasia, Africa, India, Ceylon, Burma, Sumatra, Java, Philippines, Formosa, Japan, New Guinea, Samoa, and the Americas. First found in Hawaii by Blackburn in Honolulu (Butler, 1881:395).

In Hawaii, the larvae have been reared from debris, litter in birds' nests, a dead cat, a dead rat, and from skins.

Subfamily **DRYADAULINAE** Bradley

*Dryadaulinae* Bradley, 1966:218.

Bradley proposed the group name *Dryadaulinae* as a subfamily within the *Lyonetiidae*, and he said (1966:218): "The precise affinities of the *Dryadaulinae* as a subfamily are uncertain and may lie with the *Tineidae*; the systematic position requires further study." The group is tineid and does not belong to the *Lyonetiidae* (which is a misunderstood group of moths to which various genera have been incorrectly assigned by many authors).

The segregation of *Dryadaula* and its associates as a separate group is fully justified, but whether it should be given subfamily or tribal rank is a question to be answered when a more accurate classification of the *Tineidae* is prepared. In addition to the Australasian *Dryadaula* Meyrick [1893 (1892):559] (the only

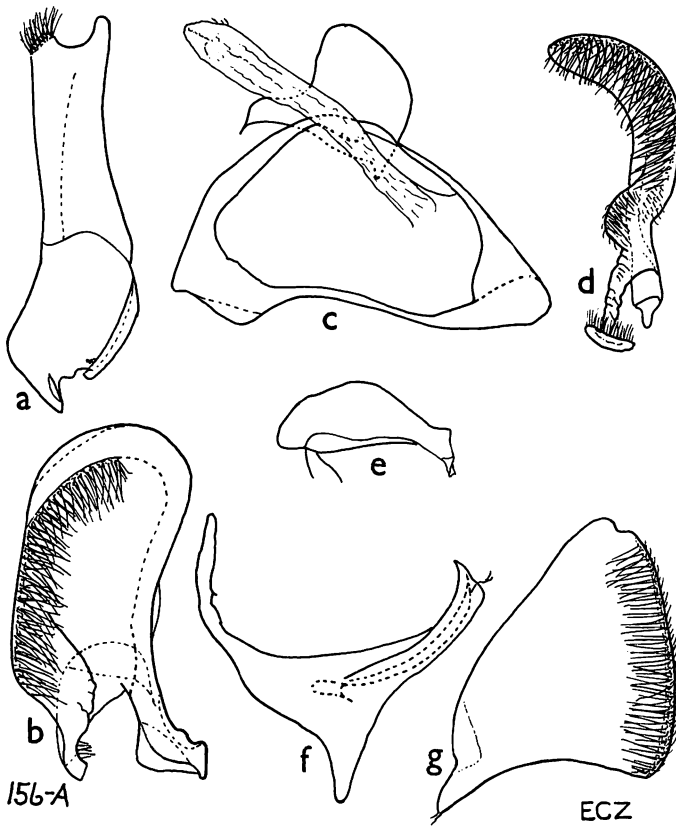


Figure 156-A—Details of the male genitalia of *Choropleca advena* Zimmerman, new species. *a, b*, inner faces of the dorsal and ventral elements of the left valva; *c*, tegumen (ventral aspect, flattened) showing the anal tube and the eighth tergum (?); *d*, inner face of right valva; *e*, aedeagus, lateral aspect; *f*, vinculum and saccus (?), ventral aspect, flattened; *g*, inner aspect of eighth sternum (?).



genus originally included by Bradley), *Choropleca*, which occurs as an immigrant in Hawaii, belongs to the Dryadaulinae. The male genitalia are unusual, asymmetrical, complex and unlike those of any other group of moths that I have examined. The paddlelike labial palpi are also distinctive. The larvae of *Choropleca*, also support the segregation of the group (see figures 160-A—160-B).

#### Genus **CHOROPLECA** Durrant

*Choropleca* Durrant, 1914:366 (in Walsingham and Durrant, 1909–1915).

Type-species: *Cyane visaliella* Chambers (fig. 158).

*Cyane* Chambers, 1873 (homonym, not Felder, 1861). Type-species: *Cyane visaliella* Chambers.

*Diachalastis* Meyrick, 1920:363. Type-species: *Choropleca terpsichorella* (Busck)

Durrant (= *Diachalastis tetraglossa* Meyrick). Synonymy by Clarke, 1971:221.

As *Choropleca* is now constituted in literature, it contains about 15 or more species distributed from the southern United States to South America, and one from the mid-Pacific, but the taxonomy is confused and it is not known how many of the assigned species are true *Choropleca*.

*Choropleca* is a distinctive genus. Its terminal labial palpal segment is broad, flat, slightly concave on one side, and rather paddlelike in shape, and in this character it resembles the structure of the labial palpi of *Mecomodica*, an unrelated genus. In Hawaii, the strange male genitalia serve immediately to distinguish it.

For many years one widely distributed immigrant species represented *Choropleca* in Hawaii. On the eve of this manuscript being sent to the Press, Dr. John W. Beardsley sent me representatives of another immigrant species



Figure 157—*Choropleca terpsichorella* (Busck); head and wing venation from Hawaiian specimens (BM slide 5214). Note the unusual position of vein 2 in the hindwing. There is individual variation in some of the veins. The antenna bears no pecten.

which has become established in the Islands in recent years. I have, at the "last minute", inserted details of this species in the text.

### KEY TO THE SPECIES OF CHOROPLECA IN HAWAII

1. Forewing less than 4.0 mm. long and with one or two narrow, longitudinally slightly oblique, white lines edged with brown from costa opposite a point before end of cell, the most basal of these vittae beginning near middle of costa; another rather similar white line from costa beyond a point costad of apex of cell and this macula entirely costal, with brown edging only inward, and the brown line extending subapically around wing apex; scales at bases of the submetallic scales beyond cell apex not obviously raised; the dark costal scaling marginal and not filling most of the area from costa to middle of length of cell; hindwings noticeably pale; as in figure 159.... **terpsichorella** (Busck).
2. Forewing 4.5 to 5.0 mm. or longer and with costal area lacking any oblique white lines basad of a point opposite end of cell, but with one slightly oblique white line from costa distad of cell apex; with two clusters of specialized, enlarged and somewhat raised squamae basad of the submetallic maculae just beyond cell apex; the extensive dark scaling beyond about middle of length of cell filling most of the area between costa and the longitudinal concavity in middle of cell; hindwings extensively infuscated; as in figure 481-A.....  
..... **advena** Zimmerman.

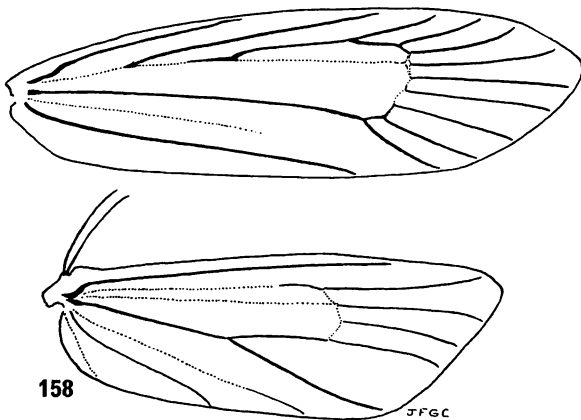


Figure 158—*Choropleca* ("Cyane") *visaliella* (Chambers); wing venation of the type-species of *Choropleca*.

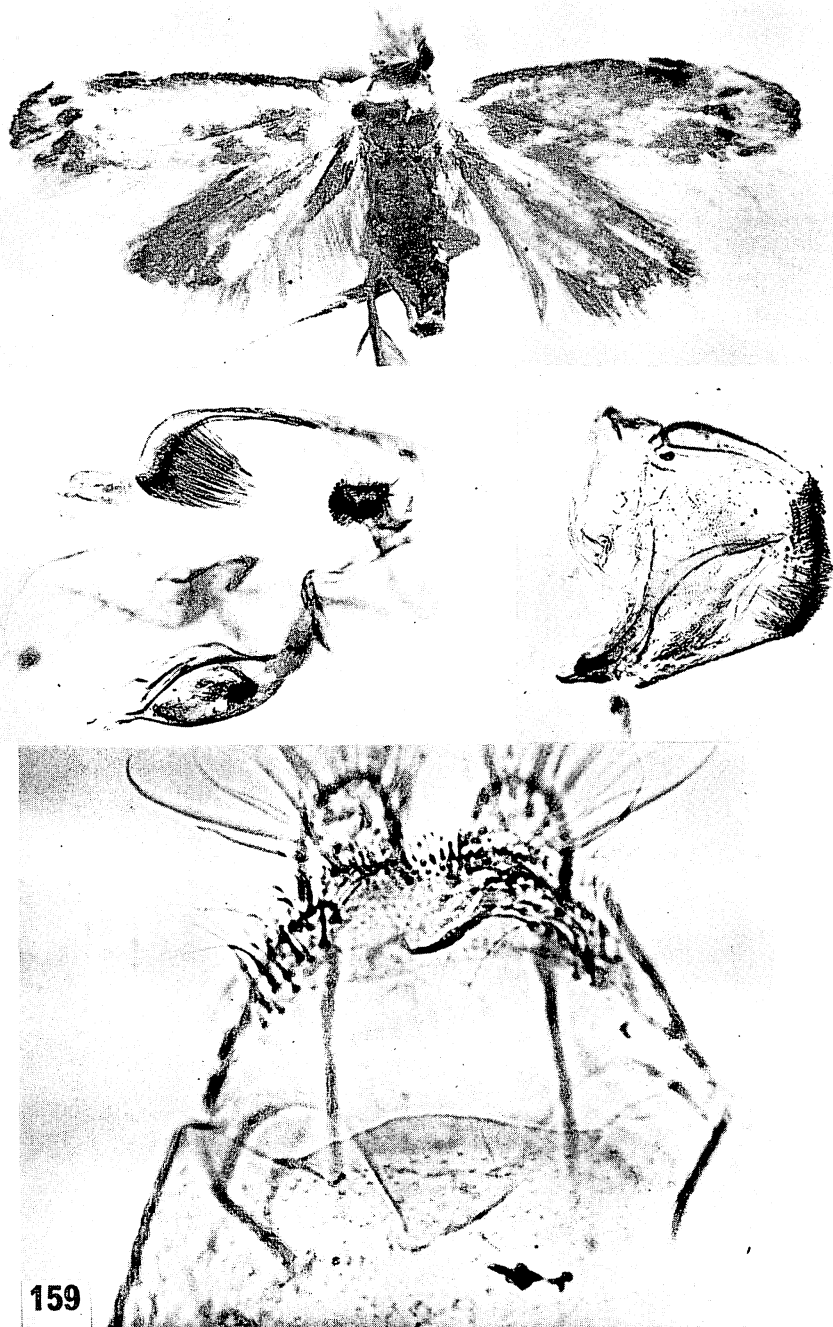
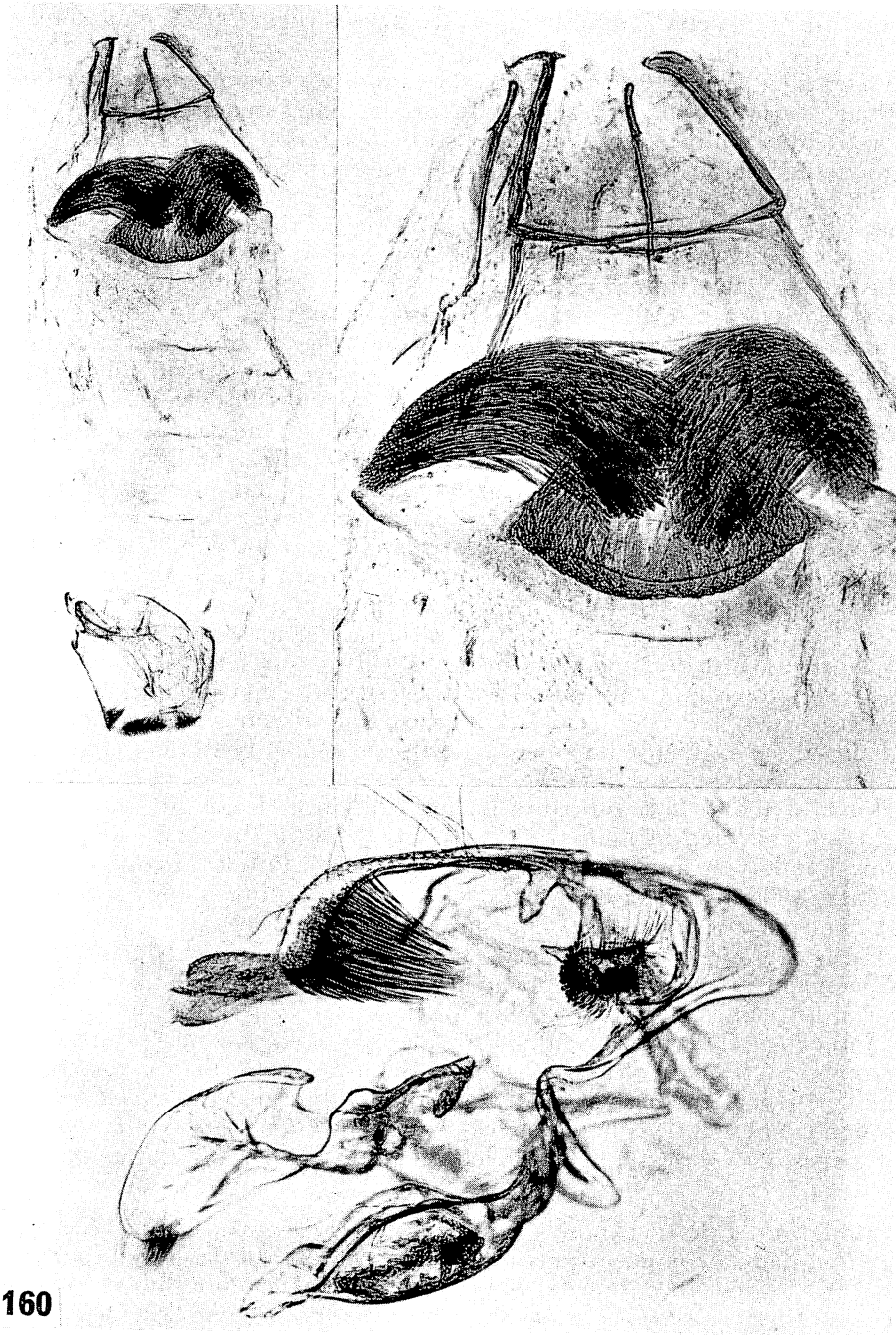


Figure 159—*Choropleca terpsichorella* (Busck). Top, a specimen from Manoa Valley, Honolulu; forewing = 3.5 mm. Middle left, male genitalia, right lateral aspect (BM slide 5214) from a Hawaiian example; compare figure 160 which is an illustration of the same subject shown at a different focus. Middle right, apex of the male abdomen. Bottom, ovipositor and adjacent areas of a Molokai example (Busck slide 261, Bishop Museum).



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Figure 160—*Choropleca terpsichorella* (Busck). Top two figures are of the abdomen of a male from Rapa (slide USNM Clarke 11399), which have kindly been supplied by J.F.G. Clarke. Bottom, male genitalia of a Hawaiian specimen (BM slide 5214), right lateral aspect; compare figure 159. No other moth in the Hawaiian fauna has such unusual structures on the abdomen.

***Choropleca advena* Zimmerman, new species** (figs. 156–A, male genitalia; 481–A, moth).

Male: Head with vestiture pale yellow or straw-colored; antennae straw-colored; variably and irregularly fusco-maculate; maxillary palpi straw-colored; labial palpi externally darker straw-colored and with the penultimate segment normally bearing one to three dark bristles from outer side near dorsal edge. Thorax with scaling mostly white and straw-colored with a mixture of brown-tipped squamae. Forewings with dorsal pattern as illustrated, basically cream- or straw-colored above with a mixture of brownish to brown squamae from base to apex of cell and from posterior wing margin to costal margin of cell; costal margin from base to a point opposite about middle of cell mostly brownish or alternating pale and dark, but at about the middle of the length of the cell the dark scaling expands to fill the entire area between costal margin and the cell; at apex of cell there are two mostly dark brown, prominent patches of slightly raised, modified squamae, the distal ends of many of which appear submetallic when the light strikes them from some directions, thus the scale patches make a pair of submetallic maculae immediately distad of the dark maculae at apex of cell; the area distad of cell apex with a strong admixture of dark squamae and the wing thus appearing conspicuously dark-tipped with a short white costal vitta between about the apices of veins 8 to 10; undersides brownish fuscous with strong reflections in some light. Hindwings mostly colored as undersides of forewings, that is, brownish fuscous, but paler inwardly on ventral surfaces. Abdomen mostly straw-colored with the caudal and genital vestiture somewhat darker and more brownish. Legs pale straw-colored with the tibiae and tarsi darkened externally and the tarsal segments narrowly pale tipped. Male genitalia as illustrated.

Length of a forewing: 4.5–5.5 mm.

Holotype male (to be stored in Bishop Museum, Honolulu) and four male paratypes collected in light traps on Oahu, Hawaii, by J. W. Beardsley, as follows: holotype and one paratype taken in a Public Health light trap, January, 1966 and three paratypes collected in Wailupe Valley, one in April and one in December, 1960 and one on May 6, 1962. The specimens are variously abraded and damaged. No female specimens have been seen.

Specimens of this species appear at first sight to be large *Choropleca terpsichorella*, but, externally, *advena* is a darker species with a different pattern on the forewings. The male genitalia are notably different, as the illustrations demonstrate. *Choropleca terpsichorella* has a conspicuous pair of large coremata which arise near the base of the third abdominal tergite, but *advena* lacks such coremata. There is revealed upon dissection, however, a small tuft of modified, stiff, persistent yellow setae on the left side only of the sixth abdominal tergite on *advena*.

Immigrant. I do not know whence *Choropleca advena* has come. Although I have not made a comparative study of their genitalia, I have seen the types of most of the described species of *Choropleca*, but I cannot suggest to which species, other than *terpsichorella*, *advena* may be most closely allied. It appears probable that the native land of *advena* is the same as that of *terpsichorella*, and that might be Central or South America. Strangely, however, we do not know

*terpsichorella* from any locality outside of the mid-Pacific where it is widely dispersed. Don R. Davis, Smithsonian Institution, has kindly examined *advena*, and although he has in progress a study of many of the American species of *Choropleca*, he reports that he has not seen *advena* from any American locality. A number of American insect species became established on various Pacific islands many years ago during the age of sailing ships, and some of these species may not yet be known in their homelands.

Hosts: unknown.

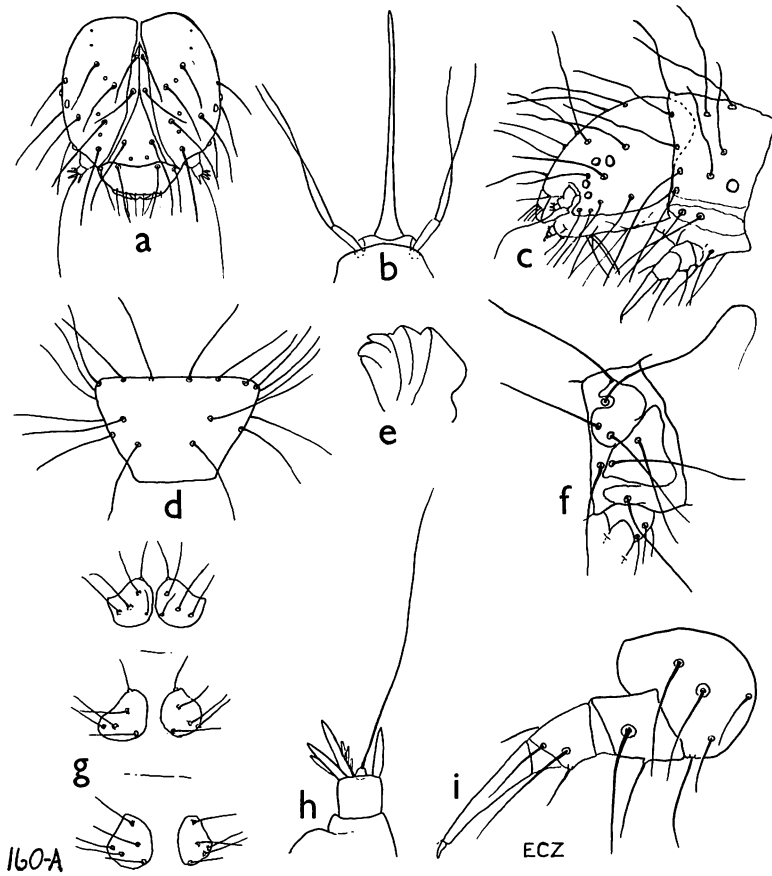


Figure 160-A—Details of the larva of *Choropleca terpsichorella* (Busck). *a*, frontal aspect of head; *b*, frontal aspect of distal part of prementum; *c*, left lateral aspect of head and prothorax; *d*, dorsal aspect of prothorax; *e*, left mandible, ventral aspect; *f*, left lateral aspect of mesothorax, leg omitted; *g*, ventral aspect of thorax to show arrangement of the coxae and their setae (shapes of coxae optically distorted); *h*, ventral aspect of right antenna; *i*, ventrolateral aspect of left prothoracic leg. The ventral proleg crochets are arranged in uniordinal circles. The VI setae on abdominal segments 9, 8, 7, and 6 are subsequently separated. Length of larva about 6.0 mm. Larva found on banana fruit from Hawaii and preserved in the collection of the U. S. National Museum. Figures *a*, *c*, *d*, *f*, and *g* are drawn to the same magnification. Figures *b*, *e*, *h*, and *i* are enlarged.

***Choropleca terpsichorella*** (Busck) (figs. 157, head, venation; 159, moth, male, female genitalia; 160, male genitalia; 160-A, 160-B, larva; 160-C, pupa; 219, moth, larva, pupa).

*Cyane terpsichorella* Busck, 1910b:134.

*Choropleca terpsichorella* (Busck) Durrant, 1914:367.

*Diachalastis tetraglossa* Meyrick, 1920:363 (type locality: Fiji). Synonymy by Clarke, 1971:222.

Swezey, 1909d:20, pl. 3, figs. 6, 7, 8.

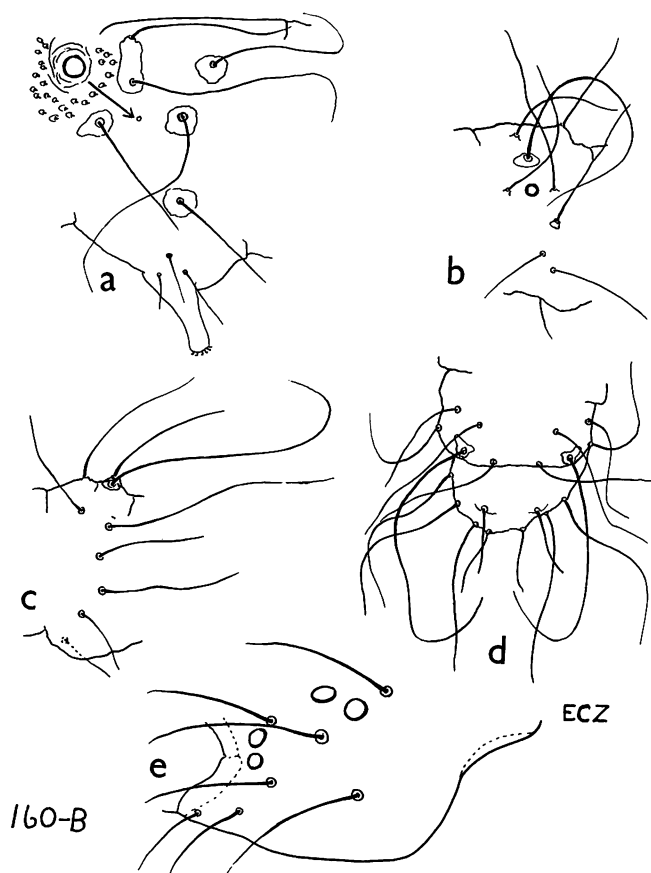


Figure 160B—Further details of the larva of *Choropleca terpsichorella* (Busck), continued from previous figure. *a*, left lateral aspect of fourth abdominal segment with an enlarged sketch of the area of the spiracle to show the nature of the dermal spicules; *b*, left lateral aspect of the eighth abdominal segment; *c*, left lateral aspect of the ninth abdominal segment; *d*, dorsal aspect of the ninth and tenth abdominal segments; *e*, an enlarged view of the ocellar area on the left side of the head. Note the unusually long SD1 setae, especially on *c* and *d*. *a-d* are drawn to the same scale and to the same scale as figure *a* in the previous plate; *e* is drawn to a much larger scale.

The dancing moth.

Oahu, Molokai, Hawaii, and probably the other main islands.

Immigrant. Described originally from Honolulu but known also from Southeastern Polynesia, Samoa and Fiji and probably widely dispersed in the Pacific. It may be an American species, and it has been carried by commerce. It appears to have been collected first in Hawaii by Perkins who captured specimens in Honolulu in 1901, although the species was not included in *Fauna Hawaiiensis* and was not described until 1910.

Hostplants: found among dead leaves and on other parts of banana, *Costus spicatus*, ferns, *Pandanus*, pineapple, sugarcane, and other plants.

The name "dancing moth" is derived from the characteristic dancelike gyrations this little moth (about 4 mm. long) goes through when it alights, and which, once seen, are not easily forgotten. The larva is supposedly a "scavenger" thought to feed on dead plant matter, but I have no knowledge of what its food really is. It may feed upon the remains of arthropods.

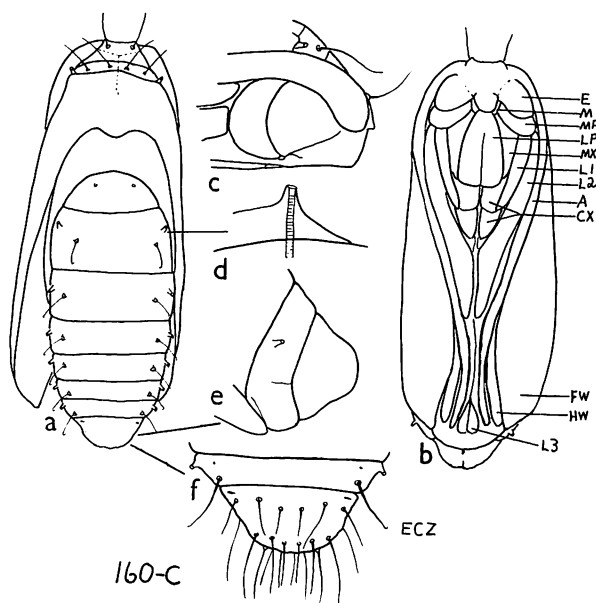


Figure 160-C—Details of the pupa of *Choropleca terpsichorella* (Busck); same field data as for figure 160-A. *a*, dorsal aspect (setae of cauda omitted); the derm of the abdomen is microscopically denticulate. *b*, ventral aspect (setae of cauda omitted): *E*, eye; *M*, mandible; *MP*, maxillar palpus; *LP*, labial palpus; *MX*, maxilla (proboscis); *L1*, *L2*, *L3*, legs 1, 2, and 3; *A*, antenna; *CX*, coxae; *FW*, forewing; *HW*, hindwing; *c*, right lateral aspect of cephalic region; *d*, enlarged right lateral aspect of spiracle; *e*, enlarged left lateral aspect of caudal area, setae omitted; *f*, enlarged dorsal aspect of caudal area. Length of pupa: 4.0 mm.



Dr. Swezey (1909*d*:20, pl. 3, figs. 6, 7, 8) gave it the name "The Dancing Moth" before the species was described, and he published the following details on the early stages:

The full-grown larva (Plate III, Fig. 8) is about 9–10 mm., cylindrical, head and following segment slightly narrower than rest of body; very dark brown, also two brownish spots on each side of segments three and four; rest of body somewhat fuscous but usually appearing blackish on account of the contents of the alimentary canal; tubercles quite conspicuously prominent, slightly darkened, hairs long, dark, those of tubercles i [D1] and ii [D2] curved forward; tubercles i [D1] and ii [D2] in a straight (?) longitudinal line; tubercle iii [SD1] just above spiracles; iv [L1] and v [L2] separate, below spiracle, v [L2] anteriorly and somewhat lower than iv [L1].

The larva does not spin much silk for its protection, and does not make a cocoon for pupation. The pupa (Plate III, Fig. 7) is formed in an irregular network of silk, made on the inner side of the leaf-sheath where the larva has lived. It is 3.5 mm. long by a little over 1 mm. wide . . . ; medium brown, pale on ventral side; slightly flattened and widest in middle portion; wing- and antenna-cases extend to apex of sixth abdominal segment, which is nearly to extremity of body, for the first four abdominal segments are large, and the remainder are very small; spiracles raised on slender projections which widen out broadly at base; hairs conspicuous, those on the back . . . fastened into the network of silk above it; apex of abdomen blunt, rounded, with numerous scattered straight hairs; head with two blunt protuberances between the eyes. The pupal period lasts seven to nine days.

The moth "is mainly creamy white with some delicate brown, the tips of the forewings are margined with a blackish line that is outwardly edged with white, while there is some silvery (*sic*) where these wings buckle down near the apex." (Williams, 1931:157.)

Swezey also said in 1909 that "this is probably a somewhat recently introduced moth and at present remains undetermined. Dr. Perkins collected it in Honolulu in 1901, but it is not included in . . . 'Fauna Hawaiiensis' . . . It is already abundant on Oahu, but I do not know whether it occurs on the other islands or not. Its larvae are often found in sugar cane associated with larvae of the bud moth, and I have sometimes found them quite numerous although never enough so to do any noticeable injury. They are also to be found on pineapples amongst dead leaves, and the dead bracts at the base of the fruit; and among dead or dying leaves of banana and *Pandanus*. The moth is often seen amongst ferns in the mountains."

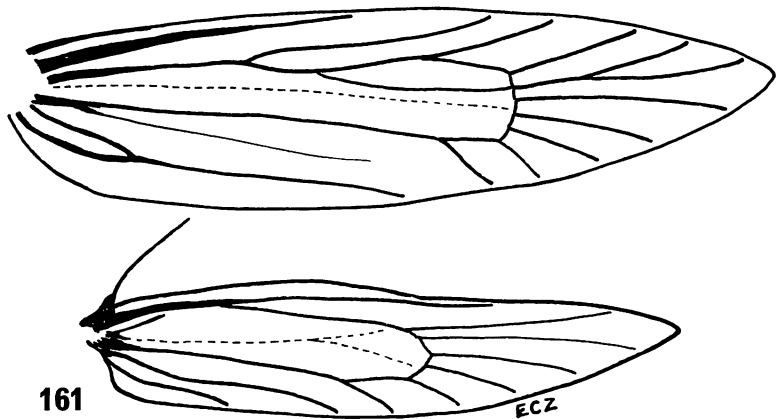


Figure 161—Wing venation of *Nemapogon granellus* (Linnaeus); from a European specimen (BM slide 781).

The tarsi of the thoracic legs of the larva are distinctive among its allies in Hawaii. They are unusually long, slender, and acuminate, and they are longer than the tibiae. The prolegs are also elongated. The body setae are long and dark, the D2 setae are only slightly more distantly separated than the D1 setae, and the pinacula are dark and conspicuous. Other details of the larva and pupa are outlined on figures 160-A—160-C.

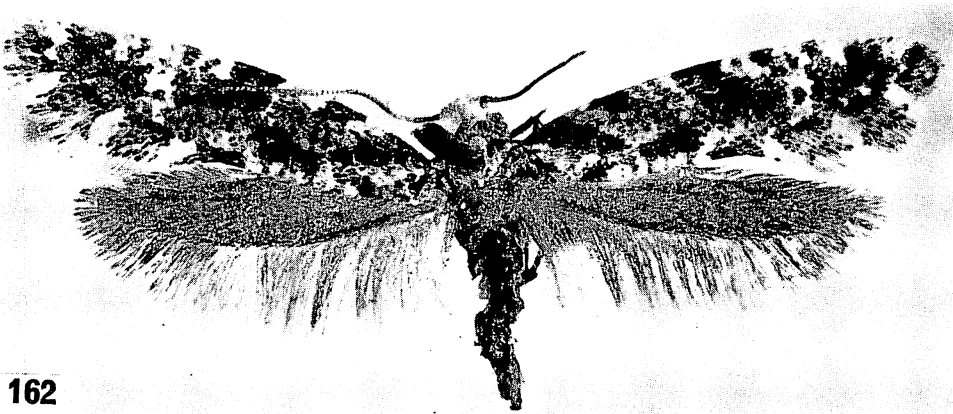
Subfamily **NEMAPOGONINAE** Zagulyaev (?)

*Nemapogoninae* Zagulyaev 1954 (not seen), in a thesis?; published? Hinton, 1955:228; 1956:253. Diakonoff and Hinton, 1956:31.

There is a question as to whom credit should be given as the authority for the subfamily name *Nemapogoninae*. Various workers believe that Hinton or Diakonoff and Hinton were the first to consider the group as a subfamily. Diakonoff, however, has written to me that Zagulyaev should be credited with the name. At this time, I am unable to determine whether the Zagulyaev work was issued in a form acceptable under the International Code of Zoological Nomenclature. See the discussion under "Tineidae" above.

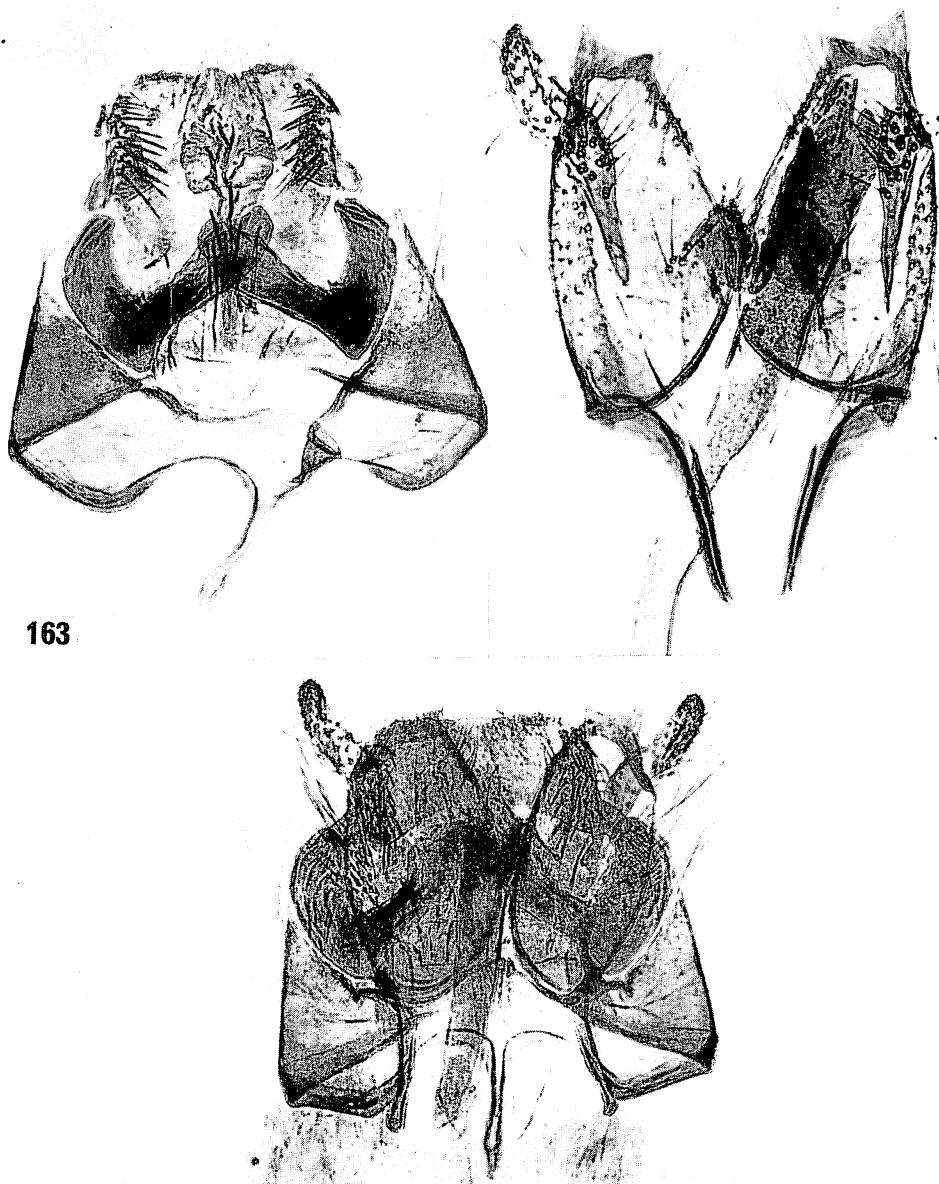
Although the larvae of the *Nemapogoninae* and the peculiar genitalia of the adults are diagnostic and easily distinguished from those of the *Tineinae*, no one, to my knowledge, has published an acceptable summary of external features of the adult moths which will permit an easy and definite separation of the *Nemapogoninae* from the *Tineinae* to be made by an external examination alone. This does not mean that such characters do not exist, but they remain to be determined.

The *Nemapogoninae* are well-represented in Eurasia and America where many are common moths whose larvae feed in fungi such as "bracket fungi" or "shelf fungi", and several species are well-known as pests of economic importance. Only one immigrant species has been reported from Hawaii.



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Figure 162—*Nemapogon granellus* (Linnaeus); expanse 13 mm.; a Silesian female from the Zeller collection in the British Museum.



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Figure 163—*Nemapogon granellus* (Linnaeus), male genitalia: Bottom, genitalia intact (BM slide 8204; Cannes, France). Top, the valvae and aedeagus (at right) separated from the remainder of the genitalia (at left) (BM slide 8203, Zurich, Switzerland). The long setose process on the right valva has been broken and its apex lost. In the left figure, the crossed L-shaped objects are arms of the gnathus; the setose areas above them are the socci.

Genus **NEMAPOGON** Schrank

*Nemapogon* Schrank, 1802: 167. Type-species: *Phalaena Tinea granella* Linnaeus.  
*Diaphthirusa* Hübner, 1825: 404.

G. Petersen, 1957: 67. Hinton, 1956: 269–280, larvae.

This group includes perhaps 20 or more Holarctic species, some of which have been widely dispersed by commerce, and one of these has been found on occasion in Hawaii. It is:

**Nemapogon granellus** (Linnaeus) (figs. 161, wing venation; 162, moth; 163, male genitalia; 164, female genitalia; 66, 165–166, larva; 167, pupa).  
*Phalaena Tinea granella* Linnaeus, 1758: 537.  
 Hinton, 1943: 171, figs. 118–119; 1956*a*: 276, figs. 72–88, larva.  
 Corbet and Tams, 1943*c*: 107, 123, figs. 222, 226, 253, 281; pl. 5, fig. 25.

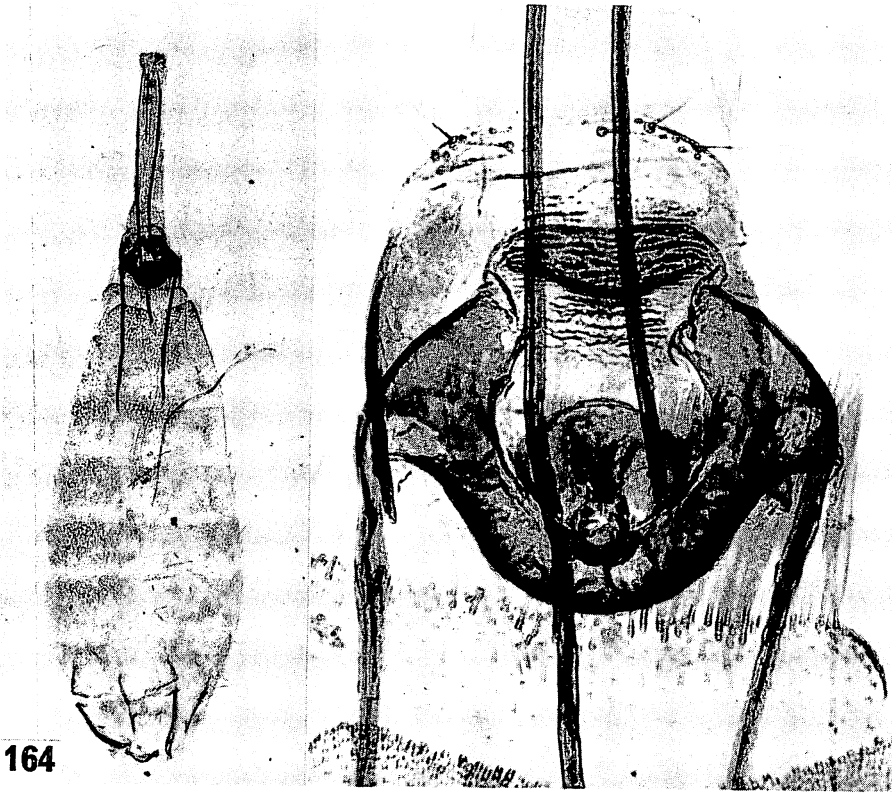


Figure 164—*Nemapogon granellus* (Linnaeus), female genitalia. Left, the entire abdomen. Right, enlargement of the ostium. Bône, Algeria (BM slide 8155). This is from an old slide mount which was not well made. The genitalia should have been removed from the abdomen so as to display the ductus bursae and the bursa copulatrix. The abdomen was not adequately cleaned.

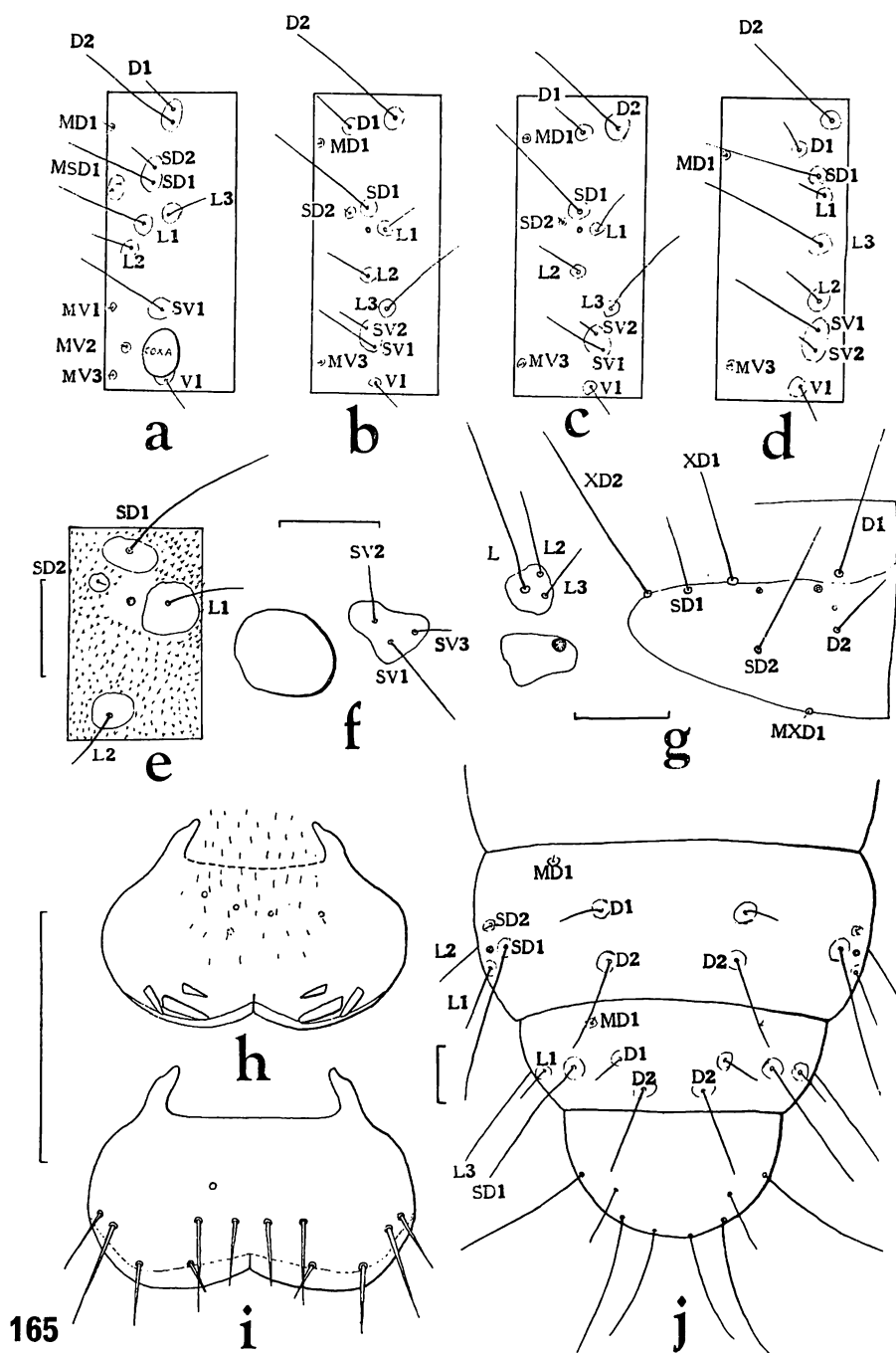


Figure 165—Details of the mature larva of *Nemapogon granellus* (Linnaeus) (from Hinton, 1956). *a*, mesothorax; *b*, *c*, *d*, seventh, eighth, and ninth abdominal segments, left lateral aspects; *e*, spiracle and surrounding area on left side of sixth abdominal segment; *f*, the SV setal group adjacent to the proleg of the same segment; *g*, dorsal and lateral setae of left side of prothorax; *h*, ventral, and *i*, dorsal aspects of labrum; *j*, dorsal aspect of abdominal segments eight, nine, and ten. Scale lines=0.22 mm.

Silvestri, 1943:106, figs. 120, 128-134.

G. Petersen, 1953:578, fig. 3, pl. 6, fig. 2, pl. 7, fig. 1, pl. 8, fig. 1; 1957:68, figs. 1, 2.

Because the suggested synonymy for this species requires study and confirmation, it has been omitted here.

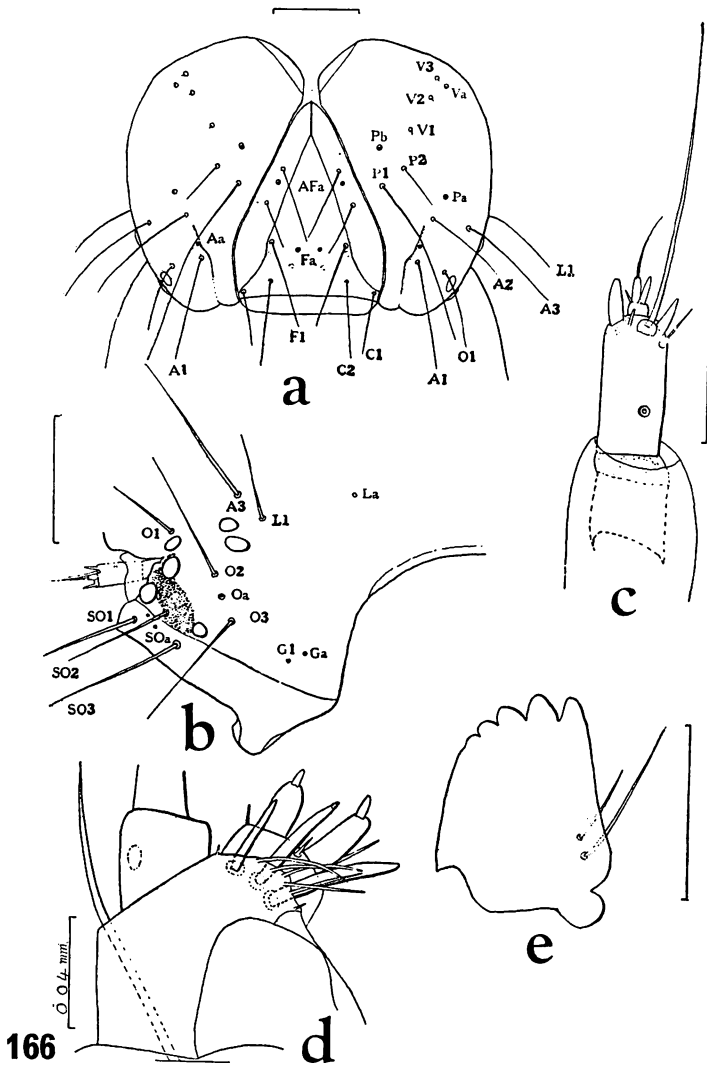


Figure 166—Further details of the mature larva of *Nemapogon granellus* (Linnaeus) (after Hinton, 1956). *a*, frontal aspect of head capsule; *b*, left ocellar area; *c*, antenna; *d*, dorsal aspect of left maxillary lobe; *e*, ventral aspect of left mandible. Scale lines=0.22 mm. For figures of the mentum and maxilla see figure 66.

The corn moth.

Oahu (established?).

Immigrant. The first record of the occurrence in Hawaii of this widely spread, variable, Eurasian species is that by Adachi and Swezey who found it in dried Japanese mushrooms in Honolulu in 1950 (*Proc. Hawaiian Ent. Soc.* 14:221–222, 1951). This moth also has been intercepted at Honolulu on various occasions by plant quarantine officers who have found it in dried mushrooms from Japan. It is occasionally found in Hawaii, but I have no information to indicate that it maintains continuously breeding populations there.

Hostplants: The only host record I have seen for Hawaii is for dried Japanese mushrooms. In England it commonly infests fungi such as *Polyporus* and *Polystictus* in the field (Hinton, 1956:277–278) and, according to Hinton, “it is best known as a pest of grain and other stored cereals, particularly when the moisture content is high.” It also infests a wide variety of material in addition to fungi and cereals, and it has been reported from such items as stored seeds and many kinds of nuts, dried roots, dried fruits of various kinds, rice, wheat, rye, maize, and other similar materials; it even damages wine corks and may become a pest in wine cellars.

Adachi and Swezey, in the 1951 reference cited above, noted that 436 moths emerged from 25 dried mushrooms, and they stated that “examination of the 25 mushrooms . . . showed that the larvae fed inside the tissues . . . without cases or silken tunnels, except that in some instances they had fed on

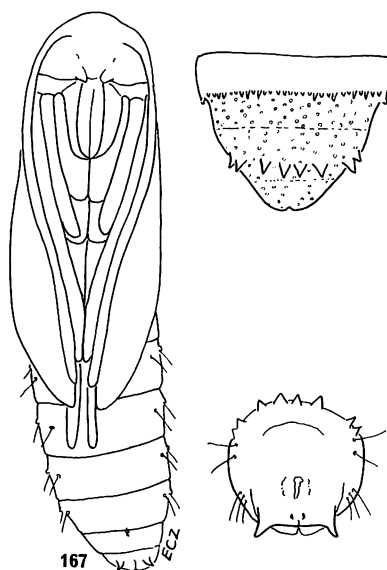


Figure 167—Details of the pupa of *Nemapogon granellus* (Linnaeus). Left, ventral aspect of a pupa reared from Japanese mushrooms in Honolulu. Top right, dorsal aspect of the caudal abdominal segments of an English specimen. Bottom right, direct caudal aspect of same.

the upper surface beneath a slight webbing. The pupae were found in the tunnels without cocoons, and were extruded upon emergence of the moths, often protruding from the margin of a mushroom."

There are several Eurasian species of *Nemapogon* which easily may be confused with *N. granellus*, because they are externally closely similar. Pierce and Metcalfe, 1934:217, gave a key to some of these species.

#### Subfamily **ERECHTHIINAE** (Meyrick)

*Erechthiadae* Meyrick, 1881a:206; 1886:290.

*Erechthiades* Meyrick, 1893 (1892):479.

*Erechthianae*: Walsingham, 1897b:155.

The taxonomy of the tineids associated with *Erechthias*, *Ereunetis*, and *Decadarchis* is confused. These tineids were called originally the "Erechthiadae" by Meyrick, but later were assigned by him to the "Lyonetiadae" (in 1928a:505, for example). Meyrick (1893 [1892]:477) said that he had in 1881 created his "Erechthiadae" for tineids with upturned apices of the forewings and had restricted the "Lyonetiadae" to rough-headed genera with antennal eye-caps, but in 1893 (1892):477 he stated that the Lyonetiidae includes smooth-headed genera with eye-caps. Walsingham (1897b:155) placed this group in the "Erechthianae", but in *Fauna Hawaiiensis*, in 1907, he included them in the Tineidae and did not mention the "Erechthianae".

It is not possible to establish a firm systematic foundation for the included genera and species based upon the immigrant Hawaiian representatives alone.

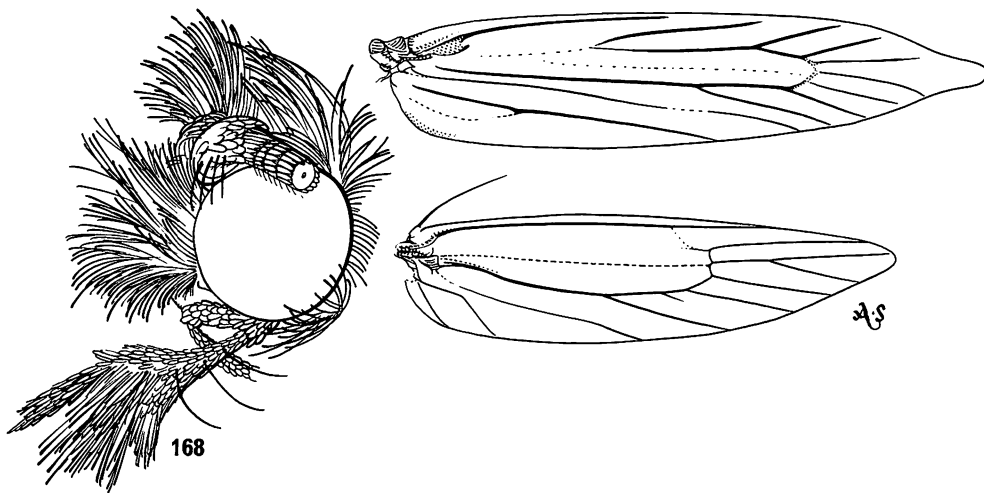


Figure 168—*Neodecadarchis flavistriata* (Walsingham), head and wing venation of a specimen from Honolulu (BM slide 3992).



The group must be studied worldwide before a reasonable understanding can be attained. The literature, too, does not reveal which genera and species belong to the complex. The task of revision will be long and difficult indeed. Some present-day authors continue to place these moths in the Lyonetiidae where, obviously, they do not belong. The larvae will run to the Nemapogoninae in Hinton's larval keys, but I do not consider the groups to be equivalent. The genitalia are very different. A revised classification may someday place the two groups in different tribes within the same subfamily, but I shall now tentatively treat them as separate subfamilies.

Much confusion exists in the generic assignments of the Hawaiian species. Six of our species have been listed in *Ereunetis*, but none of them appears to belong there. In *Fauna Hawaiiensis*, Walsingham (1907b:714) listed *Decadarchis* as a synonym of *Ereunetis*, but that appears to be an erroneous conclusion. Meyrick, in *Exotic Microlepidoptera*, (1915a:367) said that "the genus *Ereunetis* was originally a confused conception, but the type is *iuloptera*, and it differs essentially from *Decadarchis* by the cell of the hind wings open between 3 and 4. . . ." See my figure 193 for the wing venation of *Ereunetis iuloptera*. None of the Hawaiian species agrees with Meyrick's definition of *Ereunetis*; they all have the apex of the cell in the hindwings closed. In *Insects of Samoa*, Meyrick listed *zebrina* in *Erechthias*, and he placed *minuscule* and *simulans* in *Decadarchis* (1972c:111). He also described in that report seven new Samoan species in *Decadarchis*. I have not examined those species in detail and cannot comment upon their generic assignments. In 1928a:505, Meyrick listed *flavistriata* in *Erechthias*, where it does not belong. Swezey described *kerri* and *penicillata* in *Ereunetis*, but they belong to two other genera.

As I previously mentioned, we have six species, in addition to *Mecomodica fullawayi* (Swezey), to treat in Hawaii. These are *flavistriata*, *kerri*, *minuscule*, *penicillata*, *simulans*, and *zebrina*. Of these, *zebrina* may first be removed to *Erechthias*, as noted in the key to genera of Tineidae. I have left it in *Erechthias*

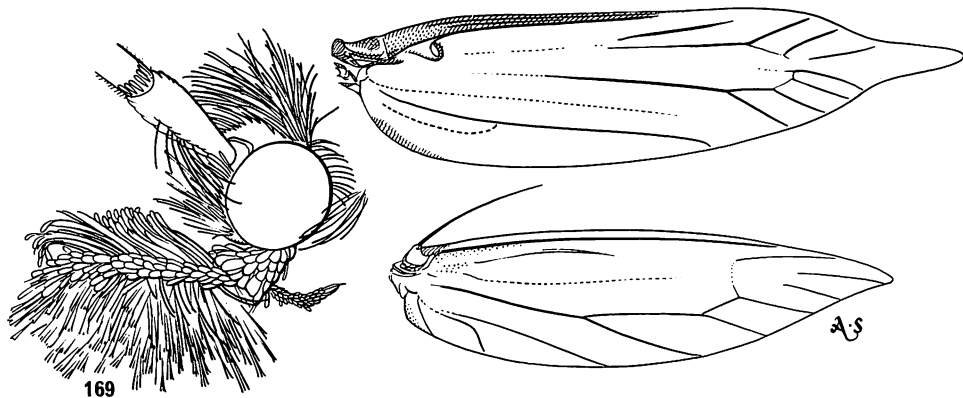


Figure 169—*Lepidobregma minuscule* (Walsingham), head of the male holotype from St. Thomas, Virgin Islands West Indies. The wings are on BM slide 5240.

to where Meyrick transferred it, but I am not sure that it belongs there. The division of the remaining five species is more difficult at first sight. They may be divided into two groups, because three of them (*flavistriata*, *minuscule*, and *penicillata*) have strongly developed pectens on the basal antennal segments, and two (*simulans* and *kerri*) have either weak or no pectens. The shapes of the wings are also different in these two groups, but those of *penicillata* are more or less intermediate. In those species in which the antennal pectens are either not present or are weak (*kerri* and *simulans*), the first antennal segment is subapically strongly "notched" in the male. However, on the three which have strong antennal pectens, two (*flavistriata* and *minuscule*) have the first antennal segment simple in both sexes. The third species (*penicillata*) has a strong "notch" on the male. The males of *minuscule* and *penicillata* have a subcostal brush on the hindwing, but those of *flavistriata* lack such a brush. The male of *penicillata* has an unusual "sex patch" on the underside of the cell of the forewing which is unique in this group in Hawaii. Unhappily, I do not know the female of *penicillata*. One of the characteristics of most of the species of this group is the conspicuously upturned tips of the forewings. An exception to this is the forewings on *kerri* which species, excepting for color pattern, otherwise appears rather similar to *simulans*. These two species, although not close allies, have rather similar wing shapes and venation, and, as my illustrations show, each has an accessory cell or areole at the apex of the cell in the forewing. The posterior delimiting vein (chorda) of the areole may be weak in

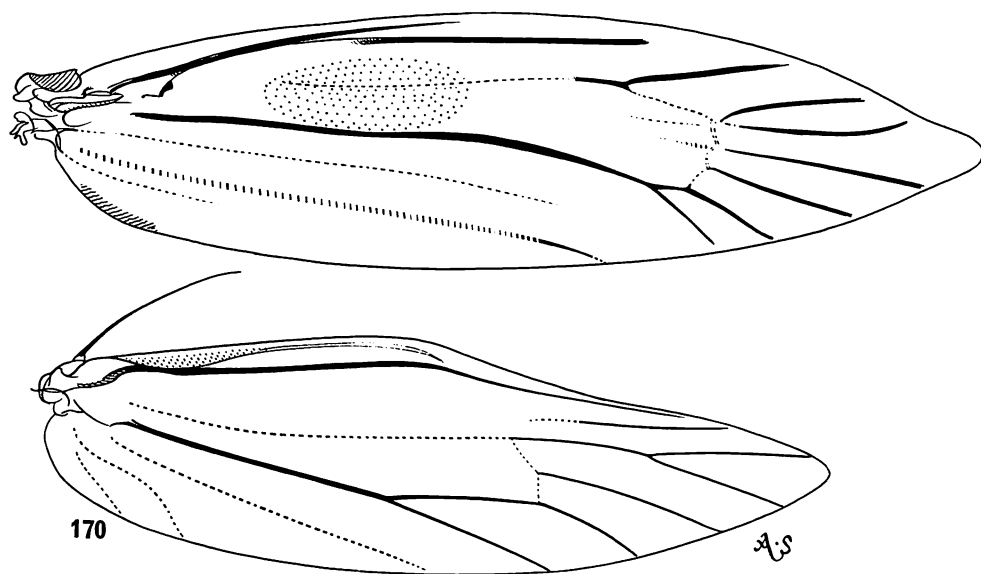


Figure 170—Wing venation of *Pantheus penicillata* (Swezey). In the forewing, vein 11 is forced costad because of the development of the "sex patch" of the male. (Slide Z-IV-1-60-1.)

some examples, however, and this may confuse the entomologist. I have been unable to study series of specimens to ascertain the stability or variability of this feature. If the presence or absence of the accessory cell is a stable character, such a character could be used to separate these two forms from the others in Hawaii which lack the chorda and accessory cell.

I have not seen the larvae of *fullawayi*, *penicillata*, or *zebrina*, but I have seen the larvae of the other species of the group and I believe that a complex of genera is involved.

My studies suggest the following arrangement for the Hawaiian Erechthiinae:

*Neodecadarchis flavistriata* (Walsingham)  
*Lepidobregma minuscula* (Walsingham)  
*Pantheus penicillata* (Swezey)  
*Decadarchis simulans* (Butler)  
*Decadarchis kerri* (Swezey)  
*Erechthias zebrina* (Butler)  
*Mecomodica fullawayi* (Swezey)

Most of these are widely dispersed, "tramp species" that have come to Hawaii from diverse parts of the world. None, therefore, is a close ally of any of the others.

My work has been handicapped by lack of material and time for extended study, and the many problems involved warrant much more detailed investigation. Under the circumstances existing at this writing, including my inability

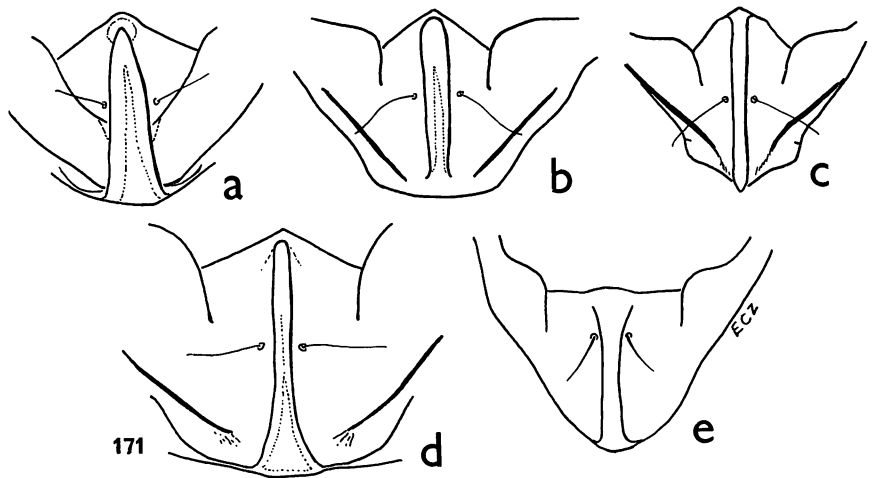


Figure 171—Dorsal aspects of the medial crests on the crowns of the pupae of species of Erechthiinae. a, *Lepidobregma minuscula* (Walsingham); b, *Pantheus penicillata* (Swezey); c, *Decadarchis simulans* (Butler); d, *Decadarchis kerri* (Swezey); e, *Neodecadarchis flavistriata* (Walsingham). Not drawn to same scale.

to return to Hawaii to study the moths in detail in the field, my study must be considered as only a preliminary investigation.

It is obvious, however, that many genera are involved in the *Erechthiinae* complex, and several of the species represented in Hawaii should be separated generically from the groups to which they have been assigned heretofore.

Genus **NEODECADARCHIS** Zimmerman, **new genus**

In general features rather similar to *Decadarchis*, but with a well-developed basal antennal pecten and wings differently shaped, with narrow tips and lacking an accessory cell. Head and appendages as in figure 168; front of head clothed with erect, sharp-pointed vestiture; proboscis rudimentary; maxillary palpi long and folded; labial palpi with vestiture strongly expanded below; antennae about three-fourths as long as a forewing. Metanotum bare. Wings as in figure 168; tip of forewings abruptly upturned; forewings with 10 veins, all veins arising from cell and free (evidently veins 4 and 5 and also 7 and 8 coalesced), vein 2 leaving cell at a point far distant from origin of 3 (more than twice as far from 3 as vein 4 is from 3); hindwing lacking a subcostal brush and with a subbasal, bare, transparent area; costa and vein 8 very slightly arcuate; veins 4 + 5 and 6 long stalked. Genitalia as in figures 177, 179.

Type-species: *Ereunetis flavistriata* Walsingham.

Unlike *Decadarchis*, *Lepidobregma*, and *Pantheus*, the pupae of *Neodecadarchis* lack the large, transverse, dorsal, abdominal pit found between tergites 7 and 8 in the female and 8 and 9 in the male of those genera (see figures 172–174). The ventral setae on abdominal sternites 8 and 9 of the larvae of *Neodecadarchis* are much more approximate than are those of the known associates in Hawaii; see the key to the larvae of the Tineidae for details.

**Neodecadarchis flavistriata** (Walsingham), **new combination** (figs. 168, head, wing venation; 171e–172, pupa; 175–176, moth; 177, male genitalia; 179, female genitalia; 180 egg, larva, pupa, moth; 181–182, larval damage).

*Ereunetis flavistriata* Walsingham, 1907b: 716, pl. 25, fig. 18. Swezey, 1909d: 9, pl. 2, figs. 1–6.

*Erechthias flavistriata* (Walsingham) Meyrick, 1915c: 233; 1928a: 505.

*Decadarchis euophthalma* Meyrick, 1924: 83. Synonymy by Bradley, 1961: 163.

The sugarcane bud moth.

Kauai, Oahu, Molokai, Maui, Lanai (type locality: 2,000 feet), Hawaii.

Immigrant. It was described from Hawaii, but its original home is unknown. It has been found in the Marquesas, Rapa, Fiji, New Hebrides, Kermadec Islands, Solomons, Ontong Java, Java, and Malaya, and it is much more widely dispersed than the known records indicate. It has been spread widely by man and probably has traveled to many islands throughout much of the Pacific in the canoes of the native peoples.

Hostplants: banana, coconut and other palms, *Pandanus*, pineapple, sugarcane.



Figure 172—*Neodecadarchis flavistriata* (Walsingham). Dorsal, lateral, and caudal aspects of a female pupa from Grove Farm, Kauai. Only fragments of a pupa were available for study.

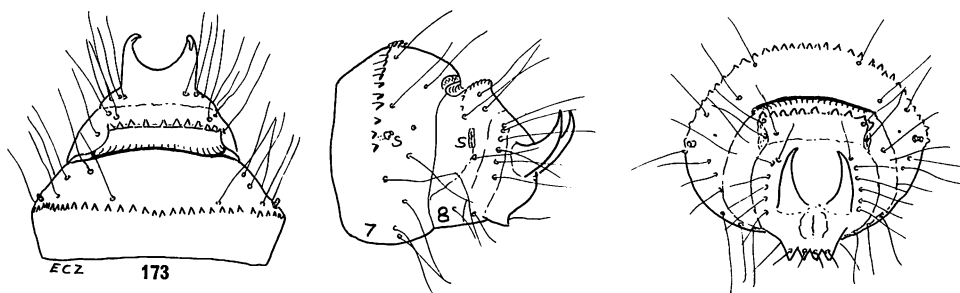


Figure 173—*Lepidobregma minuscula* (Walsingham). Dorsal, lateral, and caudal aspects of the caudal end of the abdomen of a female pupa from Manoa, Honolulu. The wing cases extended to the apex of the fourth abdominal segment, and the hindleg cases extend to about the middle of the fifth abdominal segment. S=spiracles of abdominal segments seven and eight.

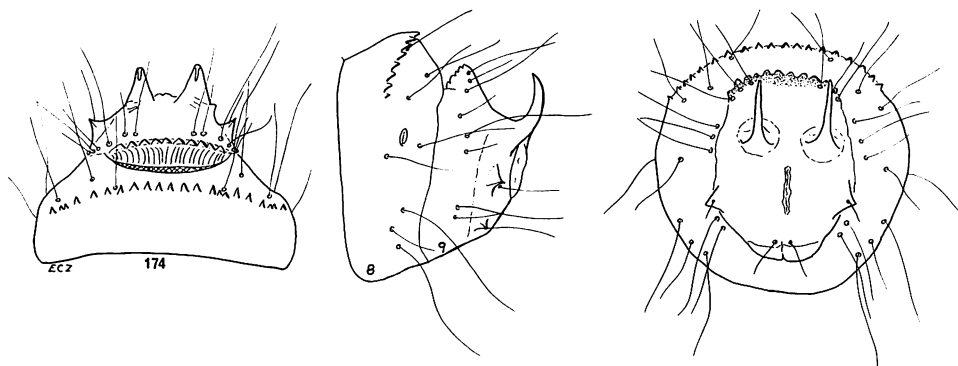


Figure 174—*Pantheus penicillata* (Swezey). Dorsal, lateral, and caudal aspects of the caudal end of a male pupa from Kilauea, Kauai. The wing cases extend onto the fifth abdominal segment; the hindleg cases extend beyond the apices of the wings near to the apex of the sixth abdominal segment. The antennae are shorter than the wings. Note that the dorsal cavity is between segments eight and nine on the male; compare *Lepidobregma* and *Decadarchis*.

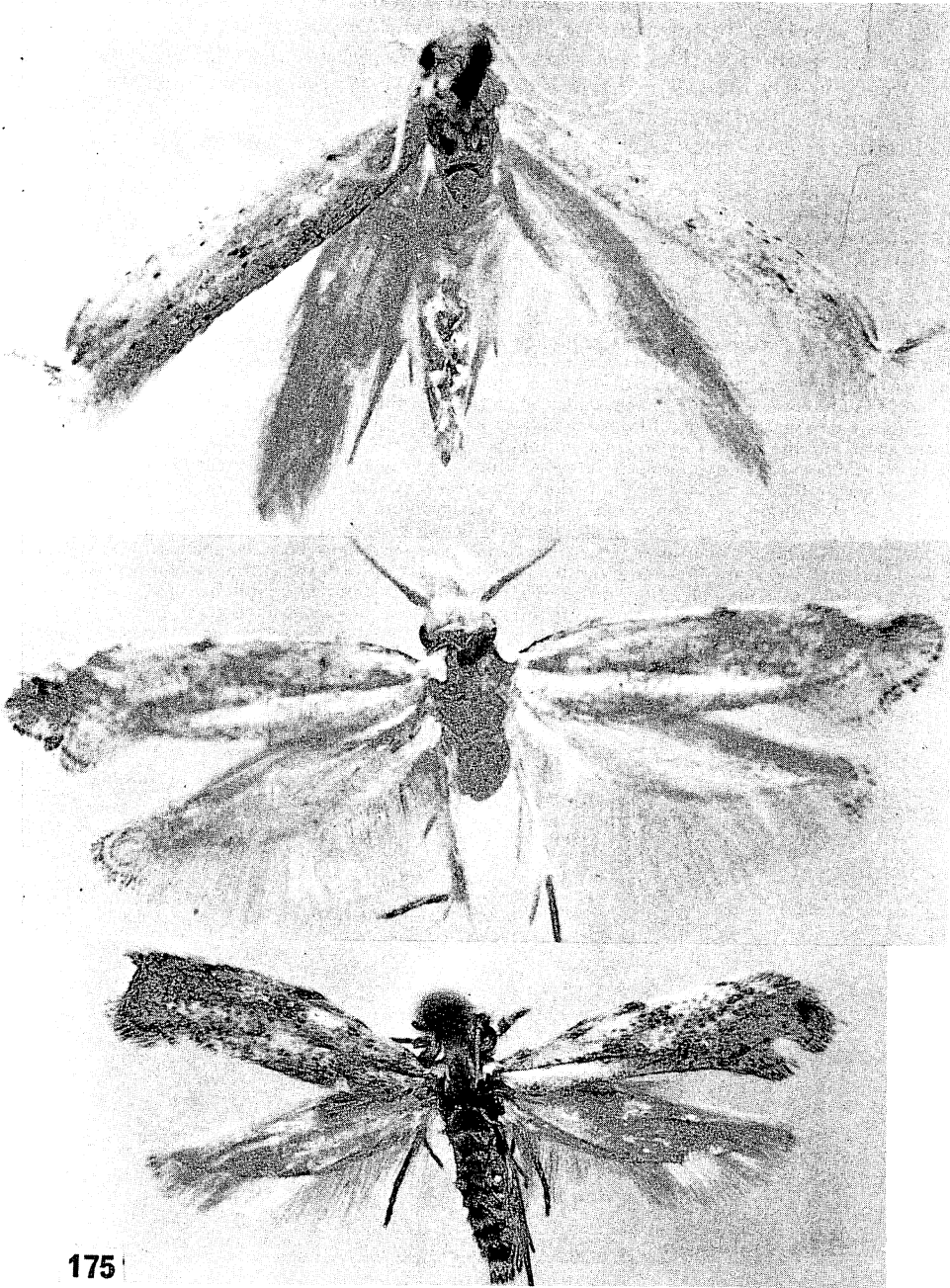


Figure 175—Top, *Neodecadarchis flavistriata* (Walsingham), holotype female, Lanai, 2,000 feet; right forewing = 6 mm.; note the upturned tips of the forewings; compare figure 176. Middle, *Lepidobregma minuscula* (Walsingham), holotype male (BM slide 4177), St. Thomas, Virgin Islands, West Indies; forewing = 4.25 mm. Bottom, *Pantheus penicillata* (Swezey), holotype male, Kilauea, Kauai, forewing = 5.5 mm.; the left wing tip is upturned, the right flattened by the mounting process; note subcostal hairbrushes on hindwings.

Parasites: *Agathis hawaiiicola* (Ashmead), *Melittobiopsis ereunetiphila* Timberlake (as much as 90 percent parasitism of the pupae; the parasite originally was misidentified as *Melittobia hawaiiensis* Perkins; for details on this parasite, see Swezey, 1940b:457), *Sierola acuta* Fullaway, *Sierola molokaiensis* Ashmead?, and "unidentified chalcid".

Predator: *Conocephalus saltator* (Saussure) (Orthoptera).

This moth is variously known as the "bud moth," "budworm," or "sheath moth" of the sugar cane. It is very abundant in all cane fields throughout the Hawaiian Islands. The larvae are always to be found beneath the leaf-sheaths of the older leaves which are partially or completely dead and dried. They are most abundant where no stripping has been done or where there is more or less of a tangled mass of leaves. They normally feed upon the dried leaf-sheaths themselves, also on the leaves. On the sheath they feed on the inner side towards the cane stalk, eating out between the strands of fibers, often burrowing into the substance of the leaf-sheath (Plate I, Fig. 1). Besides their normal feeding, however, they often eat off the surface of the rind for considerable areas, particularly at or just above the nodes where it is apt to be softer; but they sometimes eat off the surface from the whole internode. This eating of the surface is most likely done while the rind is yet growing, before it becomes hardened.

Besides all this, the worst damage is done when they eat out the buds or "eyes," which they sometimes do for several in succession, or for from one to three feet of the cane stalk (Plate I, Fig. 2). The eating of the leaf-sheaths and the leaves does no apparent injury to the cane, as the eating is done on the dead or nearly dead leaves; but the eating of the rind may be considered as injurious in the extent to which it may allow an entrance for fungus spores, etc. The eating of the "eyes" is a serious injury, however, not alone from its producing a condition, or an opportunity for the admission of fungus spores; but chiefly by its rendering the cane valueless for "seed." This would not apply of course where only "top-seed" is used for planting, as usually this is higher than where the "bud worms" are accustomed to feed; but where, as is often the case, short ratoons are used for seed, and the whole of the stick used, the cuttings from the lower part, or even the whole stick, may be quite worthless for planting on account of the number of "eyes" which have been eaten by this insect. The eating is often done in such an obscure way as to be readily overlooked. Usually the larva eats a tiny hole through the outer scales of the bud and consumes the inner soft portion.

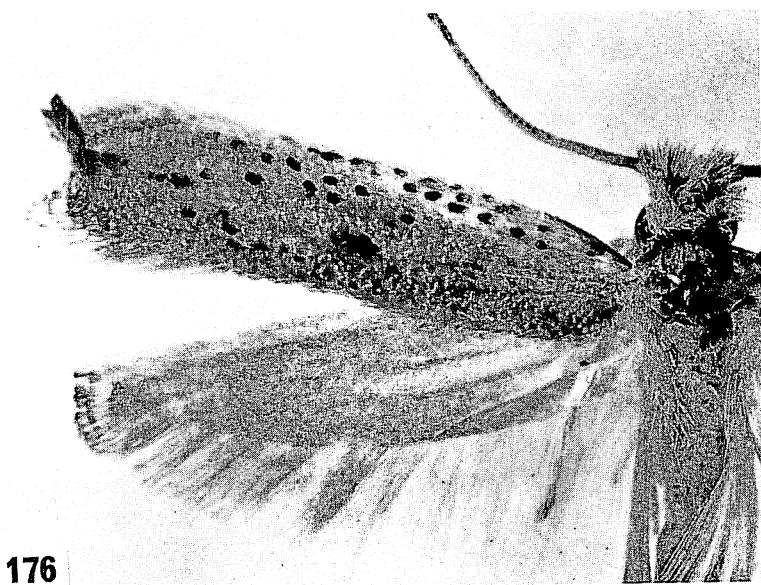


Figure 176—*Neodecadarchis flavistriata* (Walsingham). This is a well-marked, well-mounted specimen collected by Clarke on Rapa Island. Compare this with the paler holotype illustrated in figure 175. (USNM photograph supplied by J. F. G. Clarke.)

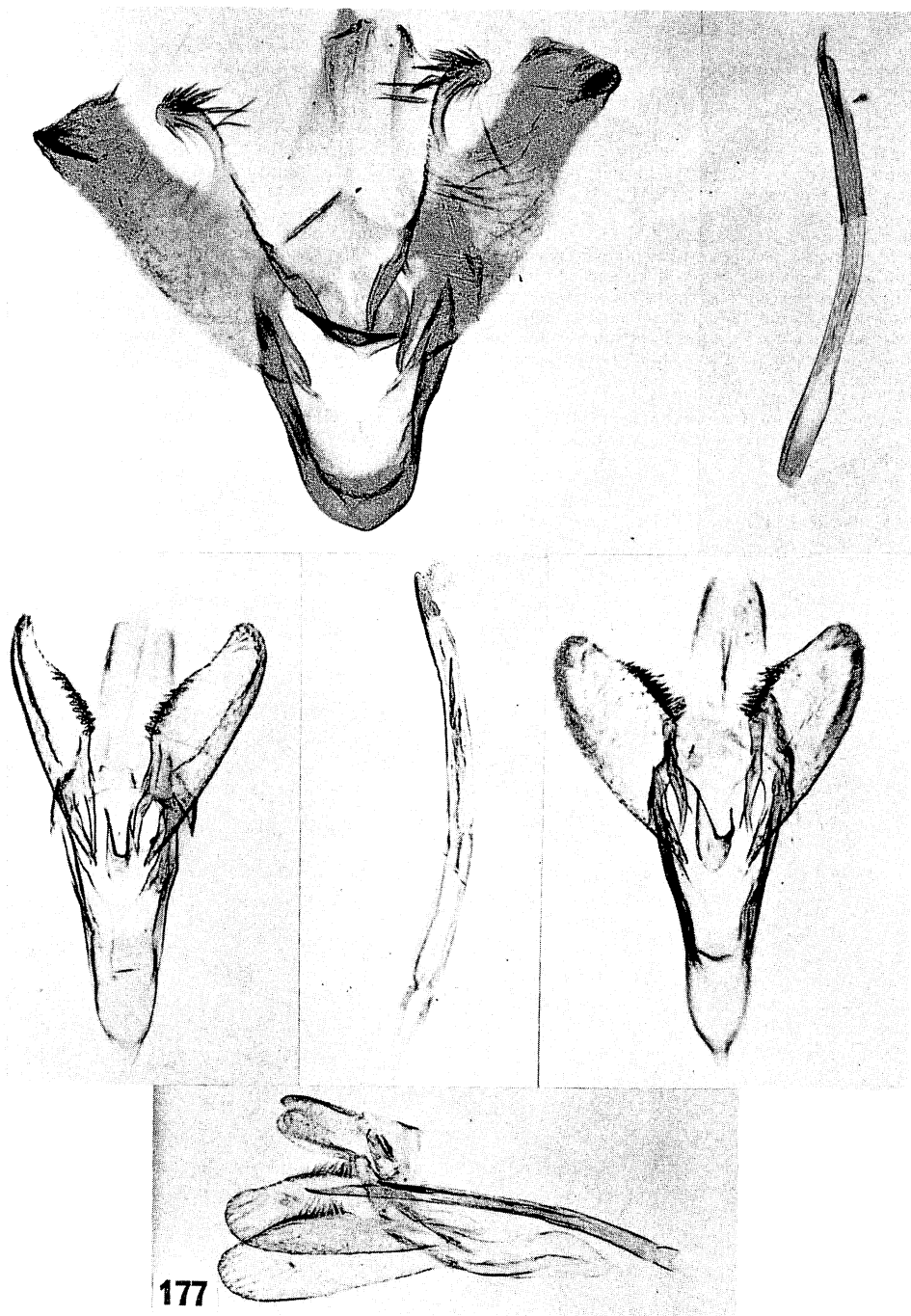


Figure 177—*Neodecadarchis* and *Lepidobregma* male genitalia. Top, left and right, *Neodecadarchis flavistriata* (Walsingham); Honolulu (BM slide 3992); note the conspicuous costal processes on the valvae. Middle, *Lepidobregma minuscula* (Walsingham); the left figure and the aedeagus are from the West Indian type (BM slide 4177) (the valvae are not properly spread); the specimen on the right is from Oahu (BM slide 5240). Bottom, lateral aspect of another specimen from Oahu (Busck slide 124), aedeagus in situ.



This entrance hole may be made at the base of the bud, or behind it, where not readily seen; hence, the extent of the injury is not always conspicuous, but thorough examination should be made of any doubtful cuttings where the larvae are noticed in abundance. Their presence is made known (even though not seen themselves), by the silken web by which they partially conceal themselves and endeavor to protect themselves from enemies, and also by the numerous tiny pellets of excrement which are always present where they have been feeding, whether at the base of leaves, or on the outside or inside of the leaf-sheaths.

The larvae of this moth also feed on dead leaves of palms, bananas, pineapples, and *Pandanus*; and amongst the bananas on the bunch eating dead tissues and sometimes the skin of the fruit. They are also often numerous amongst the fibrous material at base of palm leaves; and frequently amongst the bracts at base of pineapples. . . .

The eggs (Plate II, Fig. 3) are laid singly, or often a few near together, on the inner surface of the leaf-sheath, sometimes on the outer surfaces as well, deposited lengthwise in the slight longitudinal grooves of its surface. I have counted as many as twenty-three on one sheath, sixteen of which were within a distance of an inch and a half. When deposited on the inner surface of the leaf-sheaths, of course, it is only on those which have separated at the top to allow the entrance of the moth. An egg is oval-oblong, about 0.75 mm. long and 0.25 mm. wide, upper surface convex, finely reticulated, and with three to seven nearly parallel longitudinal carinae; whitish, or more or less pearly iridescent . . . The length of the larval period is quite long considering the size of the larva. One which I reared became full-grown in eight weeks from time of hatching.

The full-grown larva (Plate II, Figs. 4, 5) is about 12 to 15 mm. It is cylindrical, with the head and the anterior segments about the same width as the rest of the body. It is of a dirty whitish color; head pale reddish-brown and eyes dark. The head is horizontal and somewhat retracted into the segment behind it, which is somewhat infuscated; there are also some fuscous spots on the sides of this, and the next segment. Tubercles fuscous-centered at the base of hairs; tubercle ii [D2] about twice as far from dorsal median line as tubercle i [D1]; iii [SD1] just above spiracle; iv [L1] posterior to spiracle and lower; v [L2] below spiracle and anterior of it. Spiracles circular, pale yellowish, minute.

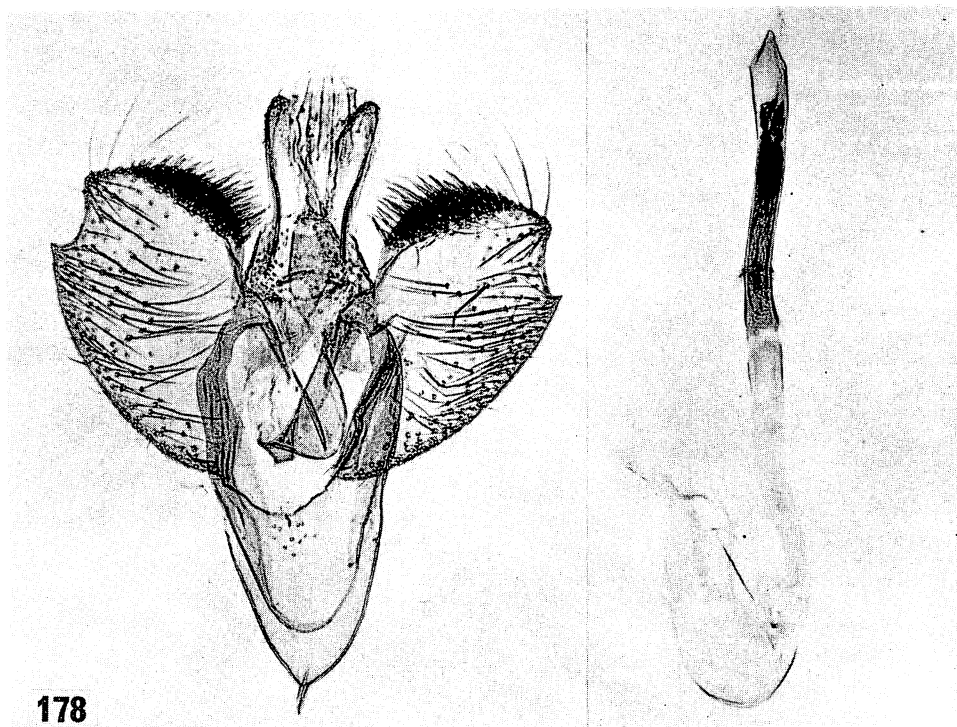


Figure 178—Male genitalia of *Pantheus penicillata* (Swezey), Kauai (slide Z-IX-21-65); note the excavated apices of the valvae, and compare *Neodecadarchis flavistriata* and *Lepidobregma minuscula* in figure 177.

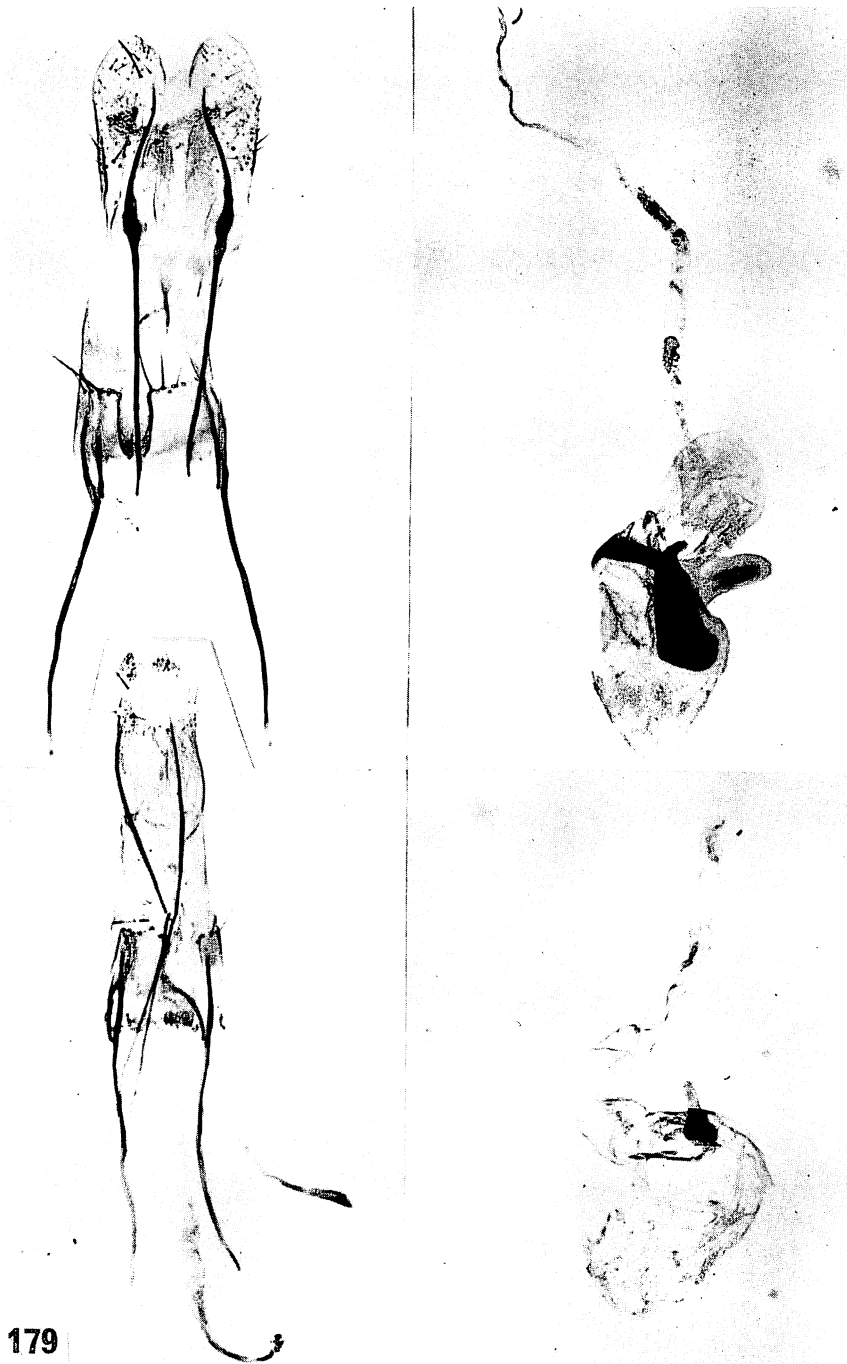


Figure 179—Female genitalia of *Neodecadarchis* and *Lepidobregma*. Top, *Neodecadarchis flavistriata* (Walsingham), Waipio, Oahu (slide Z-IV-4-60-1). Bottom, *Lepidobregma minuscula* (Walsingham), Manoa Valley, Oahu (slide Z-IV-4-60-2). Note the protuberant parts of the signa in these species.

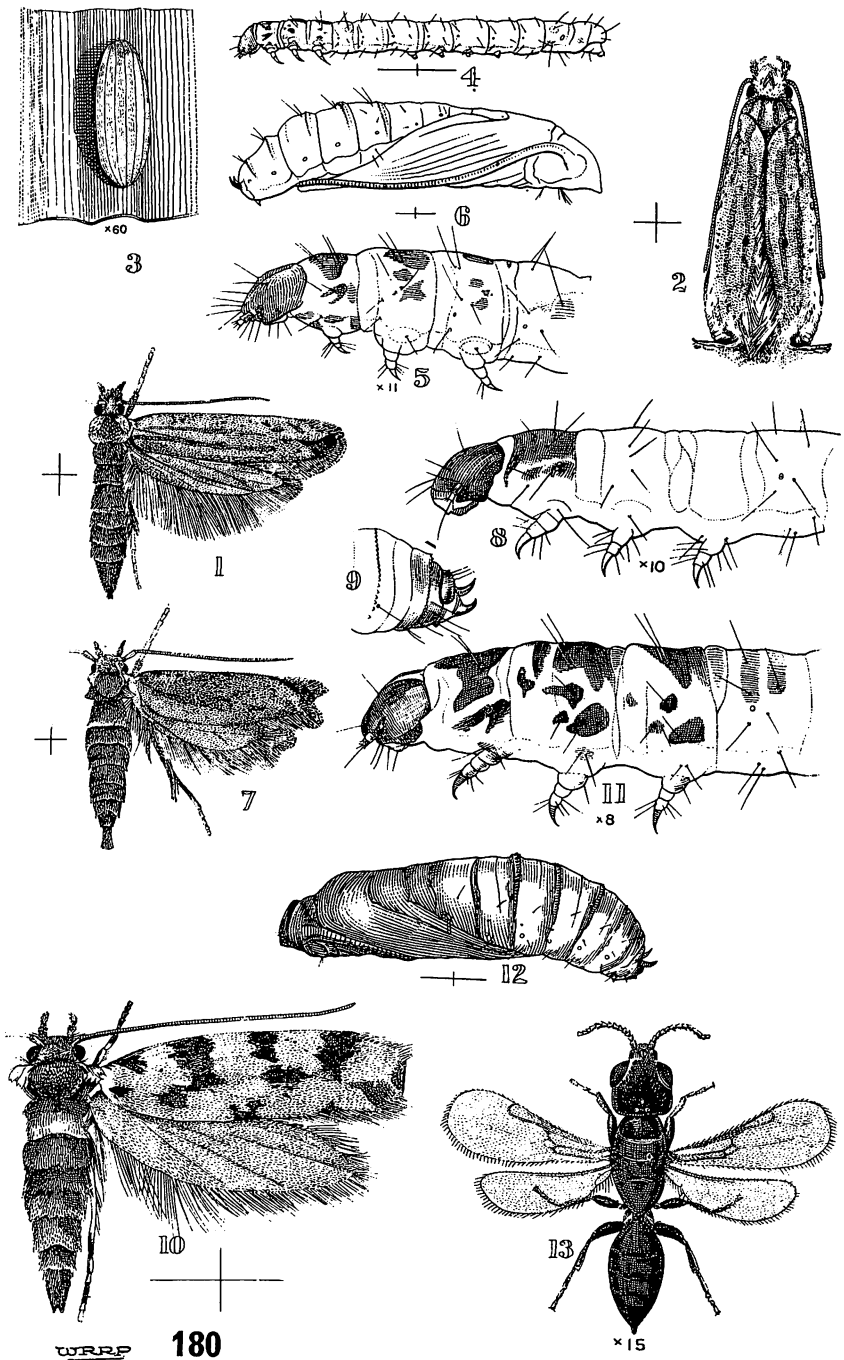


Figure 180—*Decadarchis*, *Neodecadarchis*, and *Lepidobregma*. 1, *Neodecadarchis flavistriata* (Walsingham); 2, the same, at rest; 3, egg of same on surface of sugarcane leafsheath; 4, larva of same with anterior segments enlarged in 5; 6, pupa. 7, *Lepidobregma minuscula* (Walsingham); 8, anterior part of the larva of same; 9, cauda of pupa of same. 10, *Decadarchis simulans* (Butler); 11, anterior part of larva of same; 12, pupa of same. 13, *Sierola* species, a bethylid parasite. The chaetotaxy may not be accurately drawn and should be used with caution. (After Swezey, 1909.)

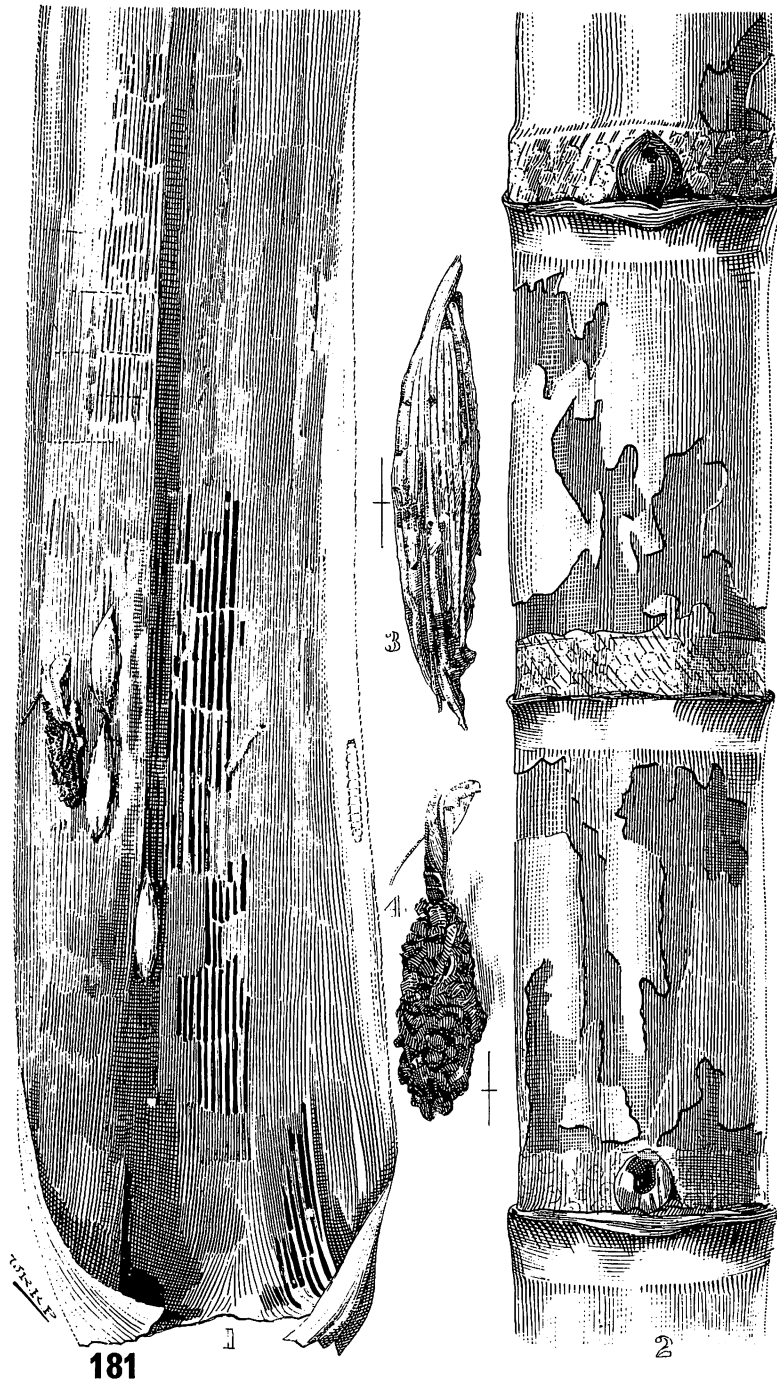


Figure 181—The sugarcane bud moth, *Neodecadarchis flavistriata* (Walsingham). 1, view of the inside of a sugarcane leafsheath; the darkened streaks show where the larvae have eaten away the substance between the fibers; some cocoons and larvae are also shown. 2, a section of cane showing destroyed buds and areas of rind eaten by larvae. 3, a cocoon covered by fibers from a cane leaf. 4, a cocoon covered with frass and with the empty pupal case protruding. (After Swezey, 1909.)



Figure 182—Damage to pineapple by the larvae of *Neodecadarchis flavistriata* (Walsingham). Top left, larva in blossom cup surrounded by frass and areas eaten by the larva and invaded by rot. Top right, feeding scar (*S*) and deep hole (*H*) made by a larva; two masses of gum (*G*) protrude from the hole. Bottom, two larval feeding scars (*S*) and numerous frass pellets; there is a fine silken webbing over the area which is not evident in the illustration. (Photographs kindly supplied by K. Sakimura, Pineapple Research Institute.)

The pupa (Plate II, Fig. 6) is 5.5 to 6 mm.; very pale yellowish-brown, eyes darker; head with a compressed protuberance in front which is rounded above, but with a sharp angle below, this is darker than rest of pupa; fine hairs situated same as on caterpillar; all of abdominal segments except first and second movable; near basal dorsal margin of segments four to eight is a slight transverse ridge armed with a row of numerous short spines which probably assist in emerging from cocoon; cremaster has two short, stout spines on dorsum, slightly curved forward, and two short conical ones ventrally, wide apart; wing-cases extend to about apex of fifth abdominal segment, free beyond third segment; antenna- and leg-cases extend about two segments farther.

The pupa is formed within a cocoon made in the same location in which the larva has been feeding (Plate I, Figs. 3, 4). It is 6 to 10 mm. long and usually has an outer layer of fibrous material from the leaf-sheath where the larva fed; sometimes it is covered with a layer of pellets of excrement instead, and if the larva has fed on the outside of the leaf-sheath of a variety of cane having numerous bristles on the leaf-sheaths, the cocoons will be covered with these, the latter and the fibers are laid on lengthwise of the cocoon and make it spindle-shaped, one side of cocoon is made onto the surface of leaf-sheath or whatever it is attached to. The moth emerges in about two or three weeks.

The adult moth is about 12 mm. with the wings spread; with them folded at rest on the back the insect is 5 mm. It is not conspicuous when at rest, on account of its pale color and the fact that it rests so close to the object it is on, usually the under side of the cane leaf, and often in the hollow next to the midrib. They may often be seen flying when the cane is disturbed. They are of a yellowish-white color (sometimes greyish-white) with a few yellower streaks and numerous black [or brown] dots on forewings. There is a black streak at apex of wing which is sharply upturned. (Swezey, 1909*d*:9-12, pls. I and II.)

F. X. Williams (1931:154) said that "the forewings, which are sharply upturned at the end and with blunted effect, are yellowish white with some indistinct yellow streaks and scattered black [or brown] dots, while at each upturned tip there is an oblique dark dash. The hind wings, except for a few dark scales at their tip, are nearly white. When the moth is at rest with the wings held alongside the body the tips of the wings protrude earlike from either side."

The hindwings of the males are translucent or mostly transparent. There is a scale-free, clear area between the base of the cell and vein 1 similar to that of *Lepidobregma minuscula*. The male genitalia are conspicuously different from any other moth in Hawaii, as figure 177 demonstrates. The separate, thumb-like protuberance on the "costa" of the valva is noteworthy. The denticulations on the vesica (internal sac of the aedeagus) are minute and inconspicuous.

Linford (1940:437-445, figures 1-6) gave an account of the attack of this species upon the fruits of pineapple. Although the feeding of the caterpillars upon the fruits is widespread, and in some localities almost every fruit may be attacked, the damage is usually of minor nature. Linford (1940:445) said that the "larvae feed in the crevices between fruitlets on protected surfaces of fruits ranging from less than half grown to fully ripe. On green fruits the wounds, which vary from shallow pits to rounded holes, heal with wound cork. Wounds on ripe fruits, however, do not heal but are attractive to insect vectors of microorganisms that accelerate deterioration of ripe fruits." See figure 182.

### Genus **LEPIDOBREGMA** Zimmerman, **new genus**

Generally similar to *Neodecadarchis* but with the vestiture on the front of the head unusual, and, except laterad, the front is clothed with prostrate or subprostrate, broad-tipped, dorsally directed squamae (not hair or setaelike vestiture). Head, wing shape, wing venation, and genitalia as illustrated. Basal antennal segment of male not "notched". Forewings with the origin

of vein 2 not farther from vein 3 than vein 6 is from 3; wing tips strongly produced and upturned. Hindwings with costa and vein 8 gently arcuate and not sinuous; with a conspicuous subcostal brush in male; with a bare transparent area near base.

Type-species: *Ereunetis minuscula* Walsingham.

The generic name is feminine in gender and refers to the "squamosae face" which is unusual in the normally "rough-headed" tineids.

The larvae have the ventral setae of abdominal segments 8 and 9 widely separated, as described in my general key to larvae, and thus they are different from those of *Neodecadarchis*. Also, the pupa has a transverse pit between abdominal tergites 7 and 8 (female) or 8 and 9 (male) which is lacking on *Neodecadarchis* but present on *Decadarchis* and *Pantheus*. Additional details are given under the species heading below and in the key to the genera of Tineidae.

I find considerable significance in the upward-directed squamae on the face when considered in the light of such upward-directed squamae on the faces of the Tortricidae and Cossidae; it is a detail which warrents investigation throughout the Tineidae.

**Lepidobregma minuscula** (Walsingham), **new combination** (figs. 169, head, wing venation; 171a, 173, pupa; 175, moth; 177, male genitalia; 179, female genitalia; 180, moth, larva, pupa.)

*Ereunetis minuscula* Walsingham, 1897b: 155; 1907b: 716, 737, pl. 25, fig. 17. Swezey, 1909d: 12, pl. 2, figs. 7-9.

*Decadarchis minuscula* (Walsingham) Meyrick, 1915a: 367; 1927c: 111; 1928: 505.

Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii.

Immigrant. Widespread: Africa, Ceylon, Java, Australia, Caroline Islands, Fiji, Samoa, Marquesas, West Indies (type locality), and other areas. The species was first found in the Hawaiian Islands on Oahu and Hawaii by Dr. Perkins in 1892.

Hostplants: *Acacia koa*, *Acacia koaia*, banana, *Calotropis*, *Cassia*, eggplant, fig, *Lantana*, palms, *Pandanus*, papaya, pineapple, *Pipturus*, *Sapindus oahuensis*, *Sicana odorifera*, old tamarind pods. The caterpillars are scavengers in dead plant materials and may be found in dead tree trunks, stems, leaves, fruits, and seed pods. I have been told by Dr. Swezey that the caterpillars, although commonly found in dry leguminous pods, do not eat the seeds.

Parasites: *Agathis hawaiiicola* (Ashmead), *Trathala flavo-orbitalis* (Cameron).

Dr. Swezey found the habits of the larvae to be similar to those of *Opogona*, but they are usually found in drier situations than are the larvae of *Opogona*.

The ground color of the moth is mostly cream or pale straw-colored. The forewings, which are strongly upturned at the tips, are variably and extensively marked with pale to dark brown scales. The scales over most of the upper sides of the hindwings of the male are individually thicker and semierect. In the female they are thinner and closely appressed to the membrane, and the whole wing is more shiny than in the male. There is a scale-free, translucent

patch at the base of the hindwing between the first vein and the posterior margin of the base of the cell, and, because of the more opaque scaling on the wing of the male, the patch is more obvious on the male. The male genitalia resemble those of *Pantheus penicillata* much more than those of *Neodecadarchis flavistriata*. The apices of the valvae of *Lepidobregma minuscula* are continuously rounded with no indication of a concavity as is found in *Pantheus penicillata*. The armature of the vesica of the aedeagus appears to be a long, slender, thornlike process.

This moth is closely related in habits to the preceding [*Neodecadarchis flavistriata*], except that I have never yet found its larvae feeding in cane, though I have taken the moth in cane fields. It is more common to find them feeding on the dead leaves of palm, banana, pandanus, etc., and in the dry and decaying pods of various legumes, as tamarind and various *Cassias*. I have also found them in decaying stems of various woody plants. They are also usually to be found among the dead bracts at the base of pineapples, not injurious to the pineapples, however; in fact, I do not at present know of any injuries caused by them, as they habitually feed on dead plant substances. . . .

The larva (Plate II, Fig. 8) is very similar to that of the preceding species [*flavistriata*], but paler, of a whitish appearance; tubercles not fuscous and no fuscous markings behind cervical shield. The pupa (Plate II, Fig. 9) differs by having four teeth close together ventrally on cremaster, instead of two, wide apart; there is also a sort of transverse dorsal pit between segments six and seven [error—7 and 8 in female or 8 and 9 in male]; and the frontal protuberance on the head is wider and bounded by two carinae which converge dorsally, less sharply pointed ventrally. The cocoon is similar to that of *flavistriata*. (Swezey, 1909d: 12–13, pl. 2, figs. 7, 8, 9.)

### Genus **PANTHEUS** Zimmerman, **new genus**

With most characters as in *Neodecadarchis*. Head, wing shape, venation, and genitalia as illustrated (figures 170, 175, 178). Head with front clothed with erect, blunt-tipped or emarginate-tipped, hairlike vestiture. Basal antennal segment of male strongly “notched”. Forewings with tips only moderately produced; male with a conspicuous mat of dense, specialized squamae on the underside of the cell; veins 4 + 5 and 6 obviously diverging distad (not so in *Neodecadarchis* and *Lepidobregma*); origin of vein 2 subequal in distance from vein 3 as vein 4 is from 3. Hindwings with costa and vein 8 strongly sinuous, with a strong subcostal brush in male; lacking a bare, transparent area near base (present in *Neodecadarchis* and *Lepidobregma*).

Type-species: *Ereunetis penicillata* Swezey.

*Pantheus* is the name of a classical character and is masculine in gender.

The wing shapes are obviously different from *Decadarchis*, *Neodecadarchis*, or *Lepidobregma*. The sinuous hindwing costa and the course of the posterior margin of the cell in the forewing (convex toward the costa) are distinctive. Vein 11 in the forewing, at least in the male (female unknown to me), is very different from that in the allied genera (see figure 170). The pupa has the large transverse pit on the dorsum of the abdomen which is characteristic of *Decadarchis* and *Lepidobregma* but such a pit is lacking on *Neodecadarchis*. I have not studied the larva. Other details are given in the generic key and in the discussion of the species below.



***Pantheus penicillatus*** (Swezey), **new combination** (figs. 105*d*, antenna; 170, venation; 171*b*, 174, pupa; 175, moth; 178, male genitalia).  
*Ereunetis penicillata* Swezey, 1909*d*: 13.

Kauai (type locality: Kilauea).

Immigrant; source unknown, but presumed to be from the Pacific region.

Hostplant: *Pandanus*; the caterpillars feed in the dead leaves.

Dr. Swezey (1909*d*: 13) originally described the species as being "very similar to *E. minuscula*, but the male has an elongate, oval, yellowish-brown patch of modified scales in cell of forewing below; and a strong, yellowish-brown costal hair-pencil on hind wing; while the transparent spot near base of cell in hind wing of *minuscula* is lacking." He noted that "the pupa is similar to *minuscula* also, except that it has a short conical tooth on each side of cremaster instead of the four ventral ones in *minuscula*; the frontal protuberance more prominent, with the two carinae contiguous."

This small species (a little over a centimeter in expanse) is pale straw-colored with darker scales scattered variably over the forewings. The tips of the forewings are conspicuously turned up at right angles to the wing. The basal antennal segment of the male is strongly "notched" and bears a well-developed pecten of six or seven setae on unabraded specimens. I have seen three males but, most unfortunately, no females.

An unusual feature of this species is its strong development of secondary sexual characters: the strongly developed, dense, elongate, ovate patch of modified orange scales in the cell on the underside of the forewing and the strong, yellow brush of the subcostal area of the hindwing. In the Hawaiian fauna the male genitalia are most similar to those of *Lepidobregma minuscula*, but they may immediately be distinguished by the arcuate emargination in the apical margin of the valva. The vesica of the aedeagus bears numerous, well-defined, thornlike sclerotizations (cornuti). The wings of the male diverge

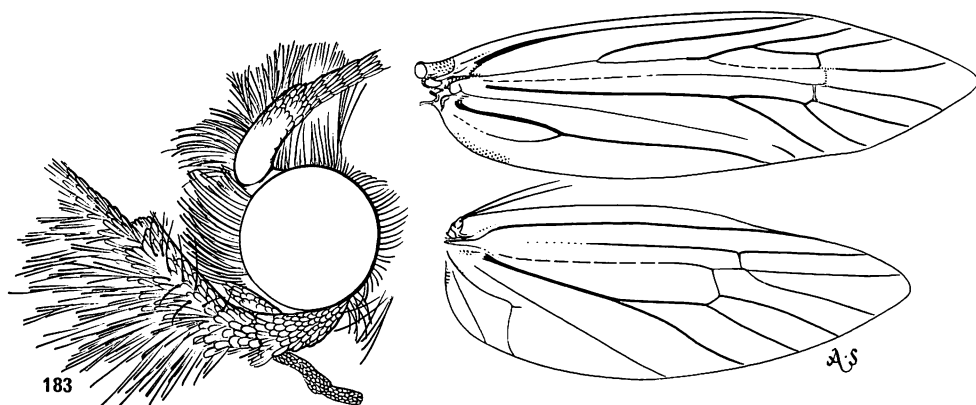


Figure 183—*Decadarchis simulans* (Butler), the type-species of *Decadarchis*. The head is from a female from Honolulu, and the wing venation is from the holotype, also from Honolulu (BM slide 9608). Note the areole in the cell of the forewing and the course of vein 1b in the hindwing in this tineid group.

conspicuously from those of *Neodecadarchis flavistriata* and *Lepidobregma minuscula*, and it is unfortunate that the female remains unknown and cannot now be described. In the forewing of the male it appears that vein 11 does not arise from the cell as it normally should. It has been displaced by the development of the squamose "sex patch" on the underside. Also, in the forewing, the posterior margin of the cell is sinuous and veins 4 + 5 and 6 distinctly diverge distad and thus are unlike the development in *flavistriata* and *minuscula*. The strongly sinuous costa and vein 8 in the hindwing are also points of obvious difference between the males of these species. The hindwings bear "pectens" of hair on the vannus.

Genus **DECADARCHIS** Meyrick

*Decadarchis* Meyrick, 1886b:290. Type-species: *Tinea simulans* Butler (= *Decadarchis melanastra* Meyrick).

As noted in the key to the genera, the species of this genus as defined here have the costal and posterior margins of the forewing convexly arcuate from base to apex, and there is an areole near the apex of the cell in the forewing. The two species assigned to *Decadarchis* in Hawaii have the basal antennal segments of the males strongly and conspicuously subapically "notched". The head is clothed entirely with erect "rough" hairs. The antennae are about three-fourths as long as the wings and the pecten on the first segment is either much reduced or absent. The proboscis is rudimentary, the maxillary palpi are long and folded, and the vestiture of the labial palpi is widely expanded below. The metanotum is bare. Further studies may reveal that *kerri* and *simulans* are not congeneric. The course of veins 2 and 3 in the forewing, the contour of the anterior margin of the hindwing, and the position of the crossvein between veins 6 and 7 in relation to the point of forking of veins 5 and 6 in the hindwing are some other features to consider (compare the illustrations).

The larvae feed in dead plant tissues, but animal matter comprises at least part of their food.

# KEY TO THE SPECIES OF DECADARCHIS IN HAWAII

Forewings basically white with large dark brown or black maculae, as in figure 188, the species thus strikingly and boldly maculate; apices of spread forewings abruptly upturned; abdominal tergites, especially behind middle, with masses of slanting-erect long hairs (male) or long scales (female), thus making the abdomen dorsally rough or shaggy... **simulans** (Butler).

Forewings variably colored from almost entirely pale straw-colored to basically straw-colored with a variable amount of dark brown scaling varying from scattered flecks and patches to mostly dark scaled, as in figure 187; apices of spread forewings turned somewhat downward; abdomen smooth-scaled, the scales not forming suberect tufts..... **kerri** (Swezey).

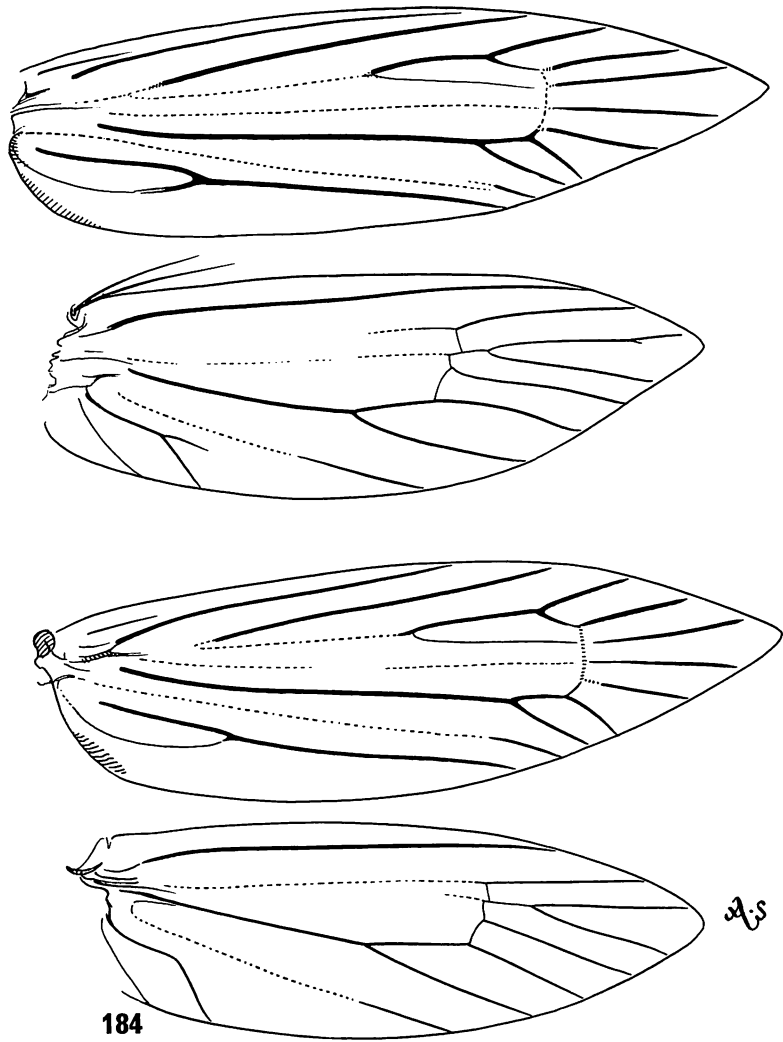


Figure 184—*Decadarchis kerri* (Swezey), wing venations of two females. Top, from a paratype of the synonymous *incerta* Swezey from Johnston Island (Busck slide 120). Bottom, from a paratype of *kerri* from French Frigate Shoals (Busck slide 21).

**Decadarchis kerri** (Swezey), **new combination** (figs. 171*d*, pupa; 184, venation; 185, pupa; 187, moth; 189, male genitalia; 190–191, female genitalia).

*Ereunetis kerri* Swezey, 1926*b*: 77.

*Ereunetis incerta* Swezey, 1926*b*: 77. **New synonym.**

French Frigate Shoals (type locality of *kerri*), Lisianski, Laysan, Pearl and Hermes Reef (type locality of *incerta*), Johnston Island.

Immigrant (or indigenous?); source unknown, possibly widely distributed in the middle Pacific.

Hostplants: "bunch grass", *Eragrostis*, *Nicotiana*.

There is much variation in the color pattern of the forewings in this moth, and this variation may easily confuse the taxonomist. I have synonymized Dr. Swezey's name *incerta*, because I believe it to be based only upon a pale color form. The genitalia of the specimens separated under the two names are similar, as my illustrations demonstrate. The forewings of the moths vary from nearly immaculate pale straw-colored through variable maculation with dark brown scales to individuals that have extensive dark scaling. Thus, some individuals appear to be very pale when their wings are closed, whereas others appear to be quite dark. The accompanying illustrations demonstrate some of the variations in color pattern.

The antennal pecten is absent on many individuals, but on others it is represented by one or two setae. It may be present on one antenna and not on the other.

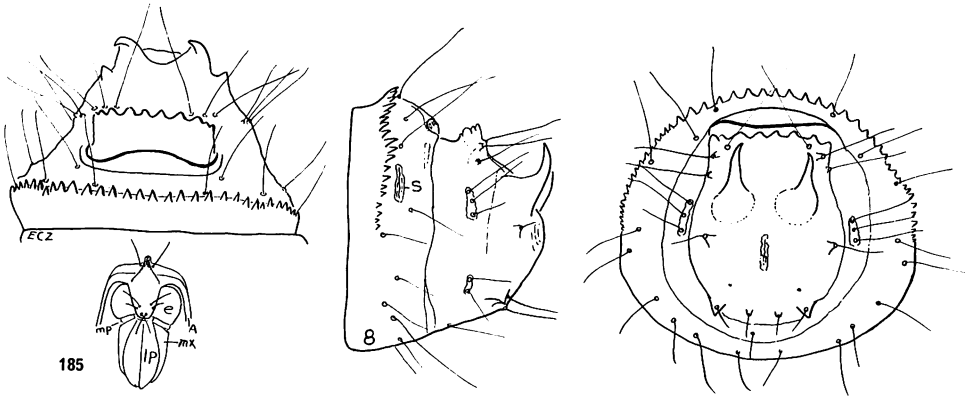


Figure 185—*Decadarchis kerri* (Swezey). Dorsal, lateral, and caudal aspects of the caudal end of the abdomen of a male pupa from Lisianski Island, with a sketch of the cast cuticle of the head in facial aspect. (Note: if the dorsal crest is viewed from a more ventral position so that the bases of the setae cannot be seen, the crest will appear much wider and will not resemble this sketch.) The wings extend near to the apex of the fourth abdominal segment, and the hindlegs extend to about the middle of the fifth abdominal segment. *A*, antenna; *e*, eye; *lp*, labial palpus; *mp*, groove into which the maxillary palpus fits; *mx*, galea of maxilla (proboscis); *S*, spiracle of eighth abdominal segment.

Unlike the wings of most of the species of this complex, the tips of the forewings in *kerri* are not upturned. If the wing tips are viewed when the wings are spread, the tips appear to be somewhat turned downward (if they were not artificially flattened when they were mounted). Actually, the apices of the wings are turned slightly mesad when they are closed so that they tend to enclose the end of the moth's body when it is at rest.

Dr. Swezey had specimens from Laysan and Johnston before him when he described the species, but the specimens were in such poor condition that he was not positive that they were all the same species. Through the courtesy of J. W. Beardsley, I have been able to examine a series of specimens from Laysan Island, collected by G. D. Butler in 1959, and I can confirm the Laysan Island distribution record.

Dr. Swezey said that the holotype of *kerri* was reared from a dead grass stem, and he considered that larvae taken from bunch grass on Johnston Island and a pupa from a *Nicotiana* stem on Laysan Island were of this species. The larvae may develop in a variety of dead plant tissues.

In September, 1964, Dr. Beardsley reared several specimens from the stems of *Eragrostis* grass growing on Laysan, Lisianski Island, and Pearl and Hermes Reef, and he sent me two cocoons from which pupal skins protrude. The cocoon is composed of white silk in which is incorporated closely packed white coral reef sand, plant fragments, dried insect feces, and other debris. One is covered almost entirely with sand grains. These cocoons give the appearance of being larval cases.

I have also studied some larvae that Dr. Beardsley took from the stems of *Eragrostis*, and in the gut of one of them I found the skeleton of an oribatid mite, numerous fragments of insect cuticle (including parts of the head capsule of a lepidopterous larva and parts of a lepidopterous pupa), and various unidentifiable material. Perhaps the larvae feed extensively upon the remains of arthropods.

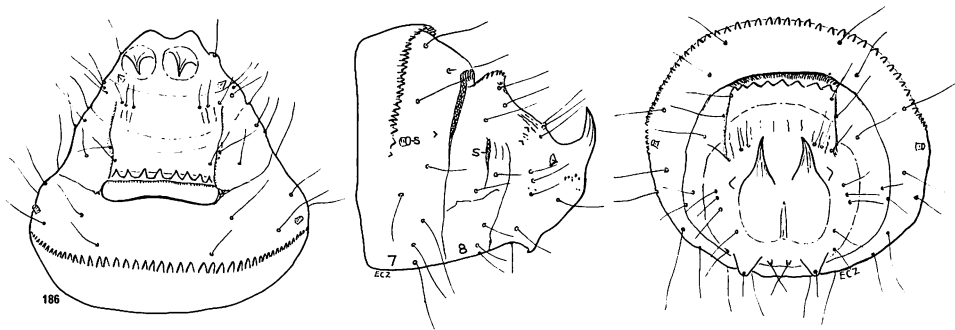


Figure 186—*Decadarchis simulans* (Butler). Dorsal, lateral, and caudal aspects of the caudal end of the abdomen of a female pupa. The wings reach to about the middle of the fourth abdominal segment, the hindlegs extend near to the apex of the fourth abdominal segment, and the antennae are shorter than the wings. The dorsal fossa of the male is between segments nine and ten instead of between seven and eight as on this female specimen.

**Decadarchis simulans** (Butler) (figs. 105*c*, antenna; 171*c*, pupa; 180, moth, larva, pupa; 183, head, venation; 186, pupa; 188, moth, male genitalia; 191, female genitalia).

*Tinea simulans* Butler, 1882:43.

*Decadarchis melanastra* Meyrick, 1886*b*:291; described from Fiji. Synonymy by Walsingham, 1907*b*:715.

*Ereunetis simulans* (Butler) Walsingham, 1907*b*:715, 737, pl. 25, fig. 15. Swezey, 1909*d*:13, pl. 2, figs. 10–12.

*Decadarchis simulans* (Butler) Meyrick, 1927*c*:111; 1928*a*:506.

*Comodica decaspila* Lower, 1905:114; described from Australia. Synonymy by Meyrick, 1928*a*:506.

Kauai, Oahu (type locality: Honolulu), Molokai?, Maui?, Lanai?, Hawaii. Immigrant: known also from Australia, the Solomons, Fiji, Samoa, Ellice, Society and Marquesas Islands and probably widely distributed in Polynesia. Meyrick (1928:506) recorded it from East Africa. Its habits make possible its dispersal by commerce.

Hostplants: the caterpillars are scavengers in dead wood, and they have been recorded from *Coffea* (coffee), *Hibiscus tiliaceus* ("hau"), *Samanea saman* (monkeypod), *Sapindus oahuensis*, and other trees. Is the true food, at least in part, animal?

Parasites: *Agathis hawaiiicola* (Ashmead), *Brachymeria obscurata* (Walker).

This is the largest species of the subfamily in Hawaii, and its wings expand from about 15 to about 20 mm. The conspicuously maculate black (or dark brown) and white forewings make it the most distinctive and easily recognized species in the complex, and the unusual color pattern makes it appear out of place in its group in Hawaii. The dark maculae are larger on the females than on the males. The base of the male antenna is strongly "notched", and I have seen no antennal pectens on the specimens I have examined. There is a well-developed tuft of long, rather stiff hairs near the base of the upper side of the hindwing in the male; this tuft is represented in the female by only a few finer hairs. The posterior half of the abdomen has conspicuous tufts of slanting-erect, long hairs in the male and scales in the female. The forewing tips are strongly upturned. It is a common species.

The larvae of this species feed in dead wood, particularly the bark and outer parts of stems and trunks. The "hau" tree is a great favorite with them, but many other species are attacked as well. Their presence may be known by the numerous black pellets of excrement, which are to be seen on the outside of the bark and in crevices, where they cling by the web which the caterpillars produce in abundance.

The eggs are white, about .5 mm. long by about as much in diameter, cylindrical rounded at the ends, a little larger at one end on which is a circle of elongate spines bifid at tip, placed close together; surface slightly corrugated. They are deposited by the female in crevices and beneath loose pieces of bark, quite a number in a batch. In some batches twenty-seven, forty-seven and fifty respectively were counted. They were quite regularly placed, flattened somewhat by being crowded beneath the bark.

The full-grown larva (Plate II, Fig. 11) is 25–30 mm. long, of a dirty whitish color; the head dark reddish-brown; cervical shield with a wide transverse blackish-brown band; segment three mostly pale brownish, the tubercles of other segments of the same color; spiracles circular, pale brownish.

Pupation takes place in a tough cocoon in a tunnel in which the caterpillar has lived, it being either near the outside, or else has one end near the outside so that the moth may readily emerge. The empty pupa cases may be seen projecting from these after moths have emerged. The pupa (Plate II, Fig. 12) is about 10 mm. long; quite similar to that of *minuscula* except that it is larger and has two conical teeth wide apart ventrally on cremaster instead of four close together as in *minuscula* [*minuscula*]; and the frontal protuberance is more prominent, in lateral view the ventral point is about a right angle, and there is but one carina extending dorsally. (Swezey, 1909:14–15, pl. 2, figs. 10–12.)

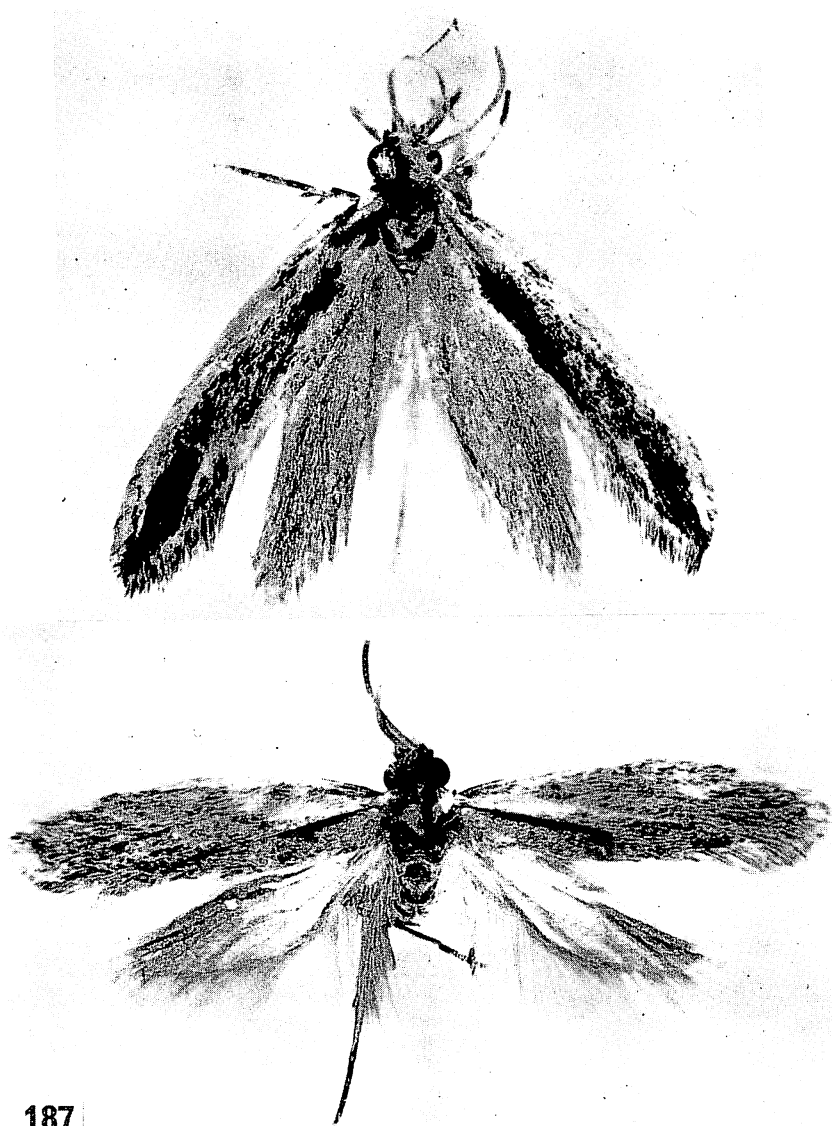
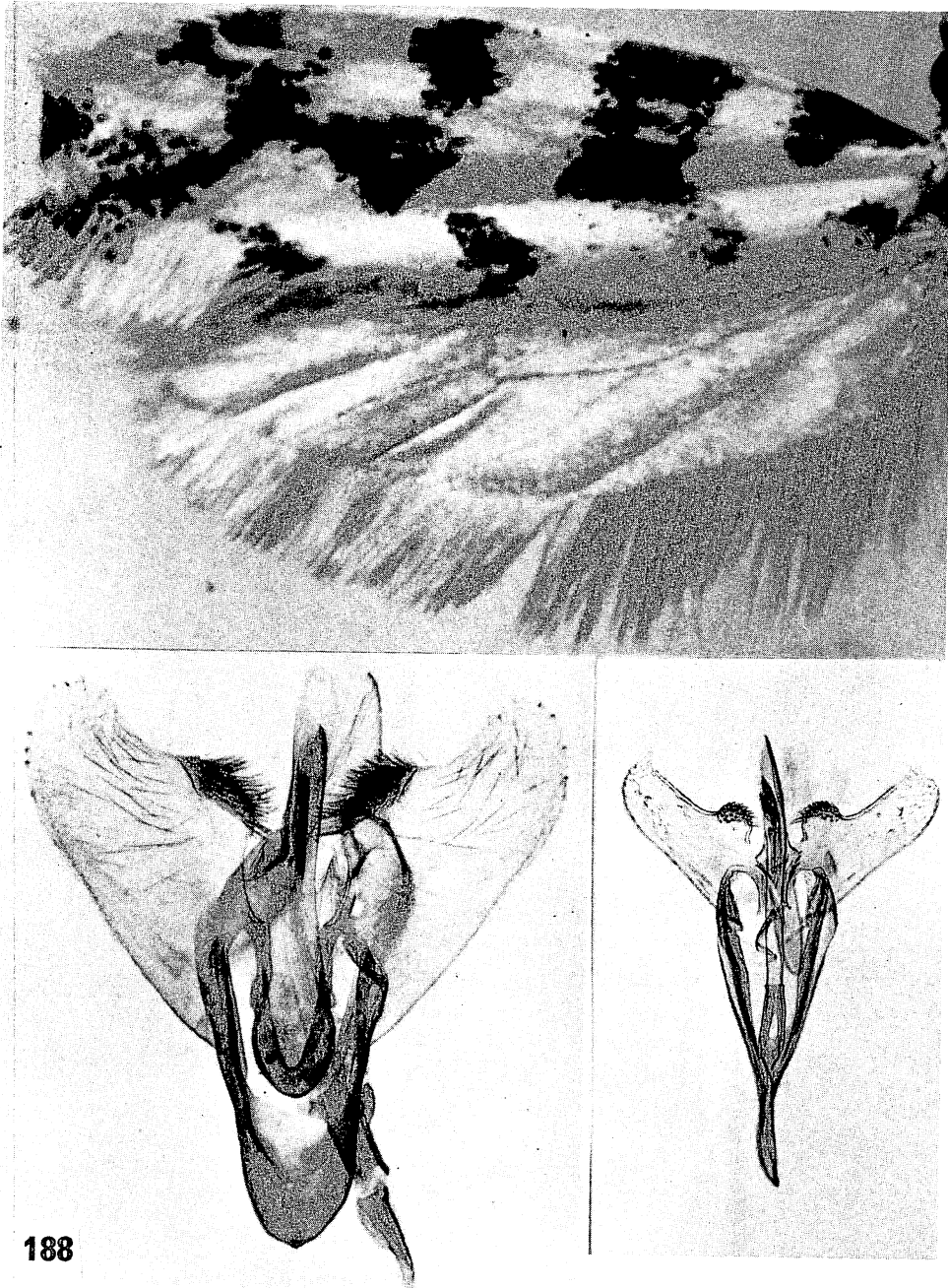


Figure 187—*Decadarchis kerri* (Swezey). Top, the holotype of the synonymous *Ereunetis incerta* Swezey, Pearl and Hermes Reef, forewing = 7 mm. Bottom, the holotype of *kerri* from French Frigate Shoals, forewing = 5.75 mm.; the dark oblique lines on the forewings are shadows of folds and are not colored lines. There is much variation in the coloration of individuals of this species—some specimens may be nearly all pale while others are even more darkly colored than the one in the top figure.



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Figure 188—*Decadarchis simulans* (Butler). Top, left wings of the holotype female with the Blackburn labels "Hawaiian Islds. 82.9/(159)"; forewing = 8.5 mm.; note the upturned forewing tip (BM slide 9608 Clarke). Bottom left, male genitalia from a Marquesan specimen, aedeagus in situ (BM slide 3824). Bottom right, male genitalia of *Ereunetis iuloptera* Meyrick, the type-species of *Ereunetis*, aedeagus in situ (BM slide 3823). From the appearance of the genitalia as here displayed, these species would appear to belong to the same genus. However there are other characters which appear to indicate that they represent two genera. See the text for discussion.



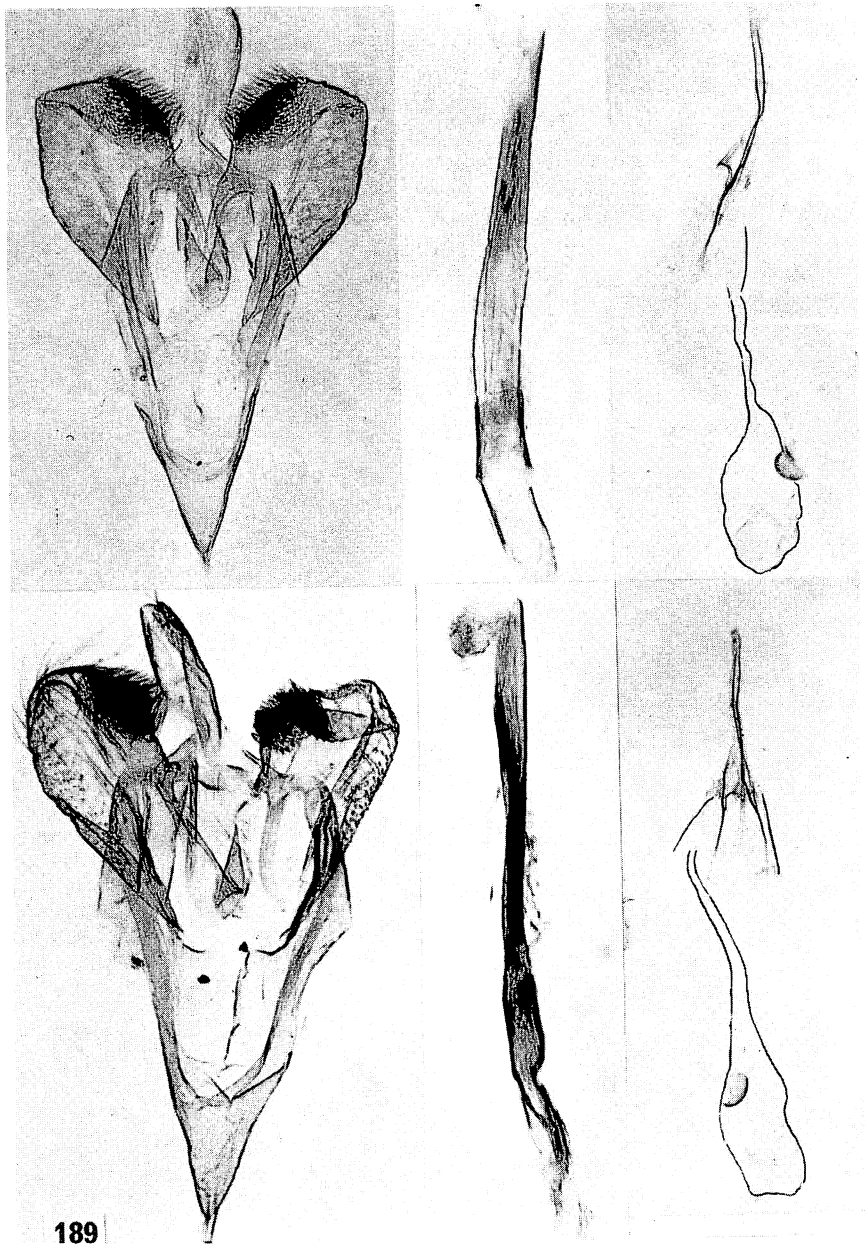


Figure 189—*Decadarchis kerri* (Swezey), male and female genitalia. Top, left and middle, from a male from Laysan Island (slide Z-IV-1-60-4). Top right, from a female paratype of the synonymous *incerta* Swezey, Johnson Island (Busck slide 120); see figure 191 for an enlarged photograph of the ostium. Bottom, left and middle, from a male from French Frigate Shoals (slide Z-IV-1-60-5). Bottom right, from a female from the same locality (Busck slide 121).

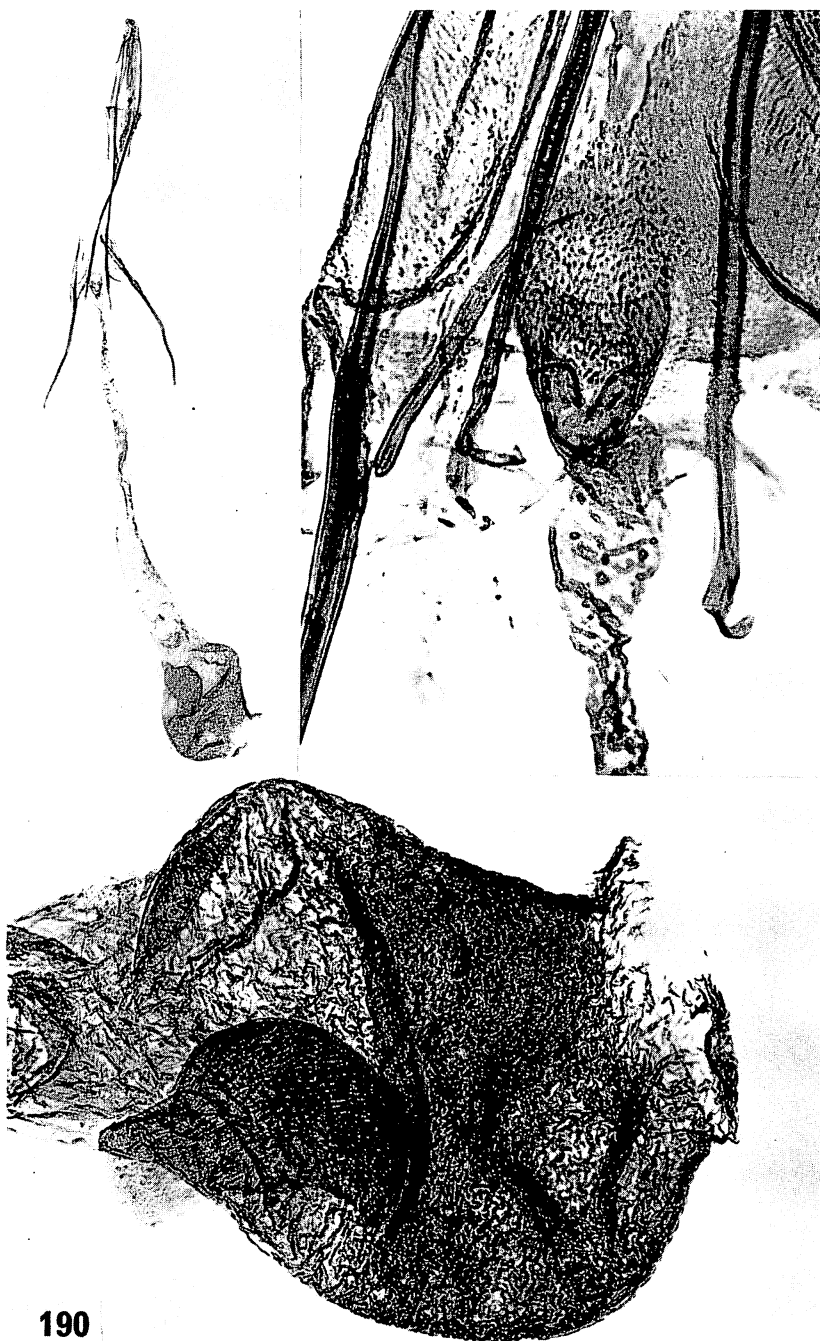
**190**

Figure 190—*Decadarchis kerri* (Swezey), female genitalia, Laysan Island (slide Z-III-10-65-B).



Figure 191—Female genitalia of *Decadarchis*. Top, *simulans* (Butler), Honolulu (Busck slide 114) with an enlargement of the signum at bottom right. Bottom left, ostium of *kerri* (Swezey), in lateral aspect, from the paratype of the synonymous *incerta* from Johnston Island shown on figure 189 (Busck slide 120).

Genus **ERECHTHIAS** Meyrick

*Erechthias* Meyrick, 1880*b*:261; 1915*c*:233, delimited. Type-species: *Erechthias charadrota* Meyrick, 1880*b*:268.

There have been more than 30 species assigned to *Erechthias*, but the group no doubt contains representatives of several genera. Most of the species have been described from Australia and New Zealand. Pending detailed studies of this and allied genera, I am unable to render an opinion regarding the correct generic assignment of the one species in the Hawaiian fauna assigned to *Erechthias*. I have figured the male genitalia and the wing venation of the type-species (see figures 193–194).

***Erechthias zebrina*** (Butler) (figs. 192, head, venation, aedeagus; 194, moth, male genitalia; 195, female genitalia).

*Argyresthia zebrina* Butler, 1881:403.

*Ereunetis zebrina* (Butler) Walsingham, 1907*b*:715, pl. 25, fig. 16.

*Erechthias zebrina* (Butler) Meyrick, 1915*c*:253; 1927*c*:111; 1928*a*:505. T. B. Fletcher, 1921 (1920):178.

*Ereunetis lanceolata* Walsingham, 1897*b*:158. Synonymy by Meyrick, 1915*c*:253.

*Ereunetis xenica* Meyrick, (1910*d*:230, *nomen nudum*); 1911*b*:301. Synonymy by Meyrick, 1915*c*:253.

Oahu (type locality: Honolulu), Hawaii.

Immigrant. Although it was first described from Hawaii, it is a widespread

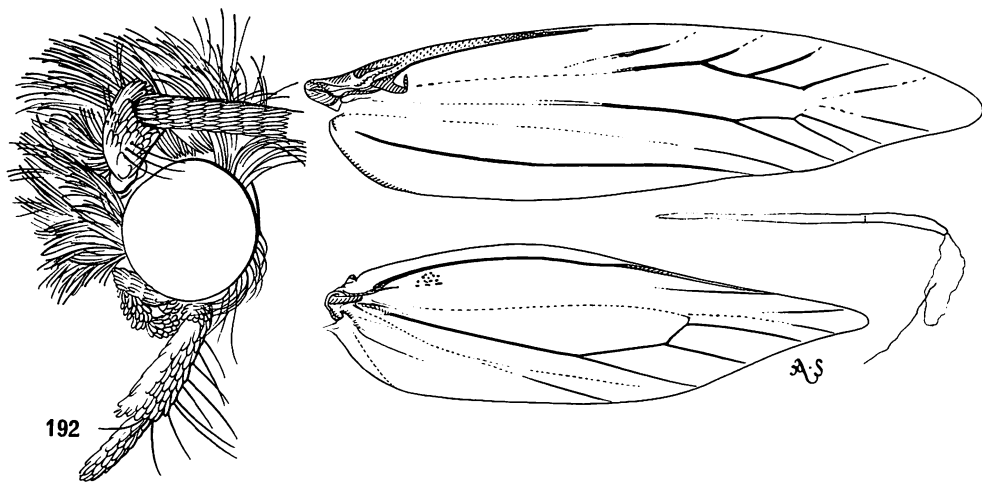


Figure 192—*Erechthias zebrina* (Butler). Head of a specimen from Nandarivatu, Viti Levu, Fiji. The wings are from an Hawaiian example (BM slide 4238). The hindwing has a stiff subcostal hairbrush from the position indicated by the cluster of dots. I have inserted a sketch of the aedeagus of another specimen (slide Z-VIII-11-65) from Honolulu. The venation is evidently subject to considerable variation.

species reported from Africa, the Seychelles (type locality of *xenica*), Ceylon, India, China, Java, Borneo, Fiji, Samoa, Society Islands, South America (Brazil is the type locality of *lanceolata*), and the West Indies.

The habits of the species are not known. Specimens have been collected amongst old books, in a mud-dauber's abandoned nest, in houses, on the trunk of *Aleurites moluccana*, and in light traps in Hawaii. It may feed upon the remains of arthropods. Meyrick (1915c:253) considered it to be "doubtless a refuse-feeder and artificially spread."

The head is clothed entirely with erect "rough" hair. The metanotum is bare except for a patch of vestiture on the metascutellum.

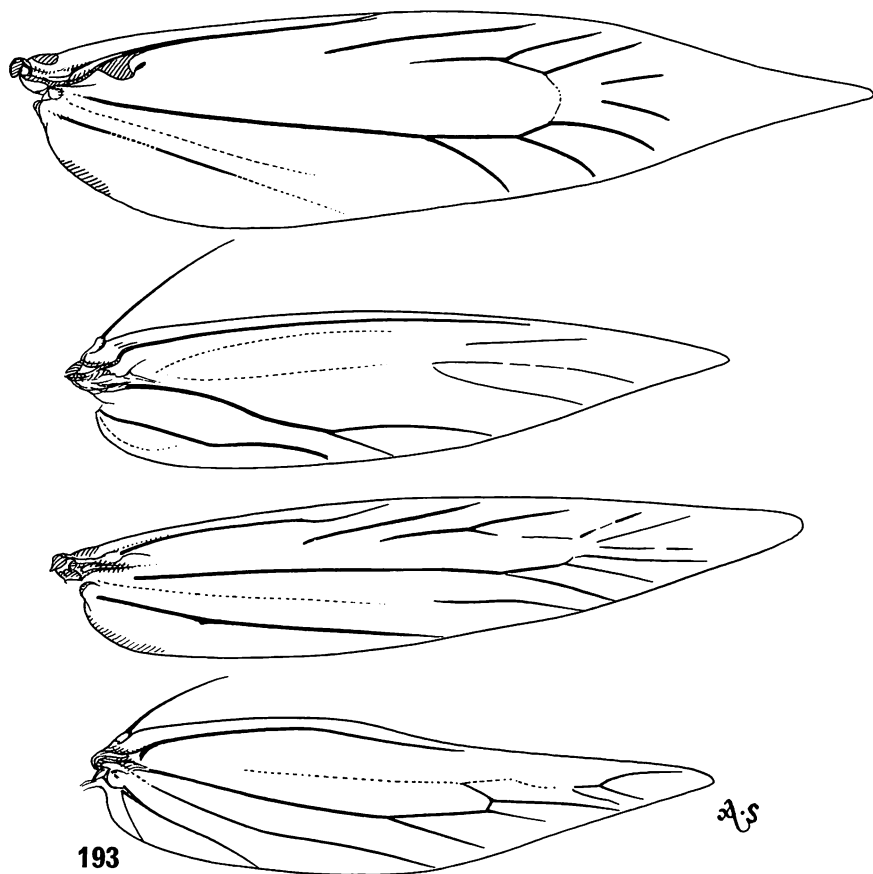


Figure 193—Wing venations of the type-species of *Ereunetis* and *Erechthias*. Top, *Ereunetis iuloptera* Meyrick, New South Wales (BM slide 3823). Bottom, *Erechthias charadrola* Meyrick, New Zealand (BM slide 3828). See figure 188 for male genitalia of *Ereunetis* and figure 194 for male genitalia of *Erechthias*.

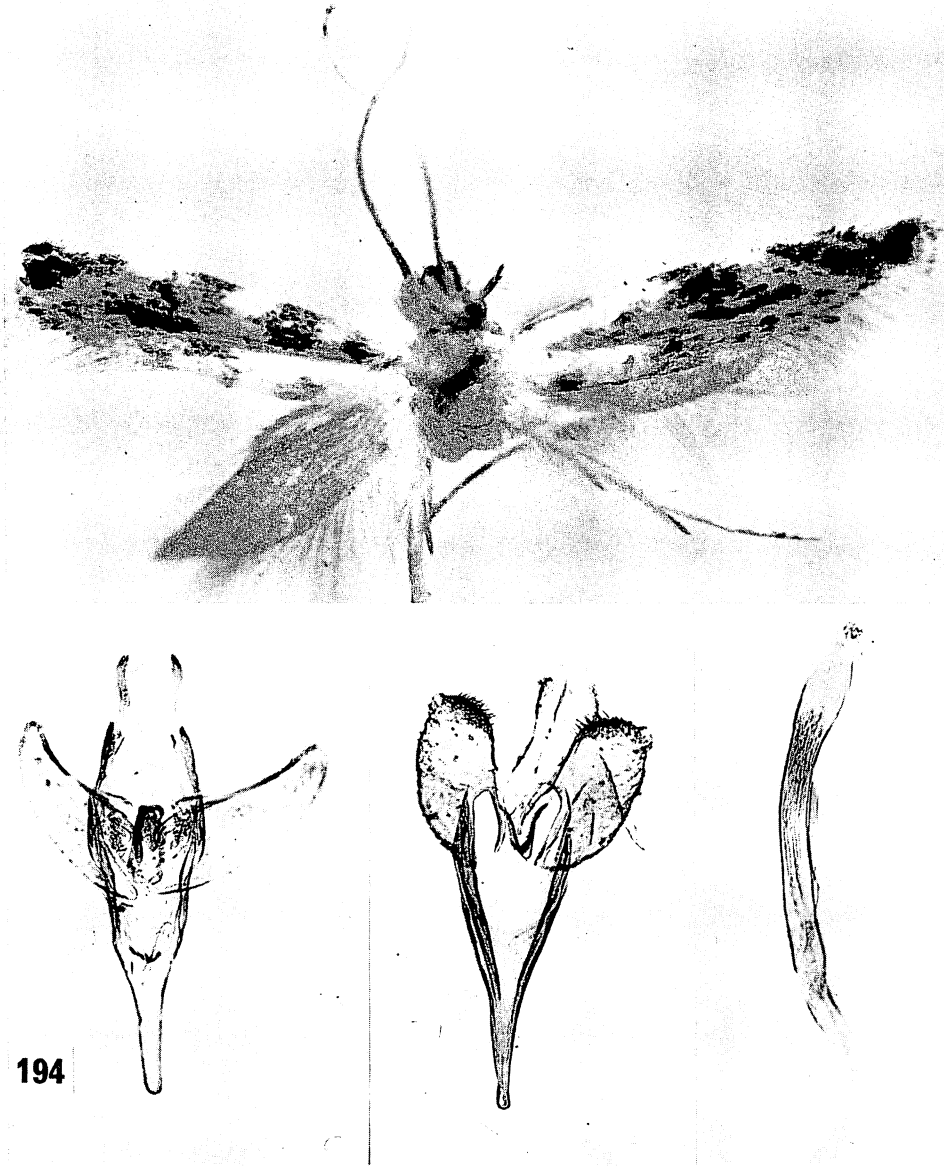


Figure 194—Top, *Erechthias zebrina* (Butler); the holotype from Honolulu (abdomen lost); expanse 8 mm. Bottom left, male genitalia of the same species, Waianae Mountains, Oahu (BM slide 4238); the aedeagus is not shown here, but a sketch is in figure 192. Bottom middle and right, male genitalia of *Erechthias charadrota* Meyrick, the type-species, New Zealand (BM slide 3828).

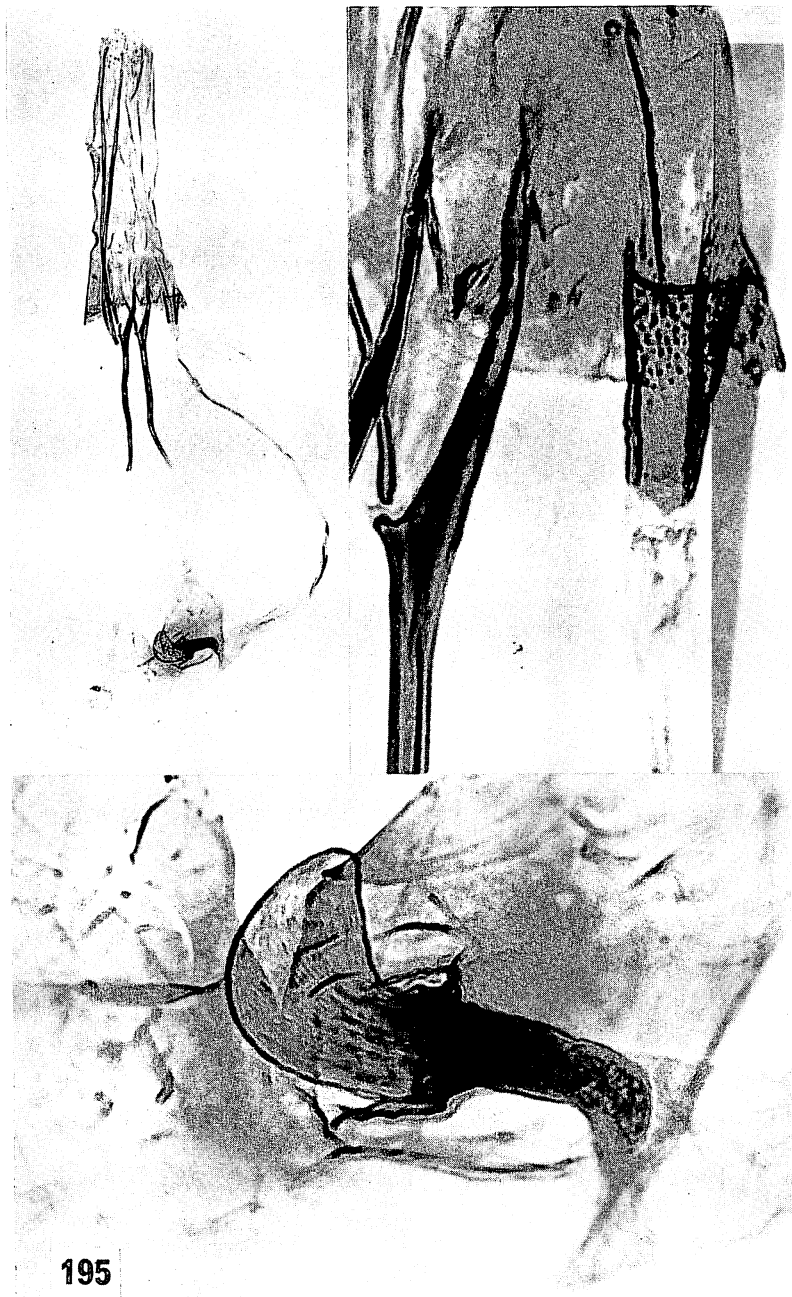


Figure 195—*Erechthias zebrina* (Butler), female genitalia; Honolulu (slide Z-IX-28-65).

Genus **MECOMODICA** Zimmerman, **new genus**

Head as illustrated (see figures 105*b*, 196), entirely rough-haired; ocelli absent; proboscis reduced; maxillary palpi long and folded; labial palpi with second segment rather narrow, subequal in length to third, bristles on outer side numerous and strong, third segment flattened, concave internally, and somewhat paddle-shaped. Antenna of male with a strong "notch" involving several basal segments, as illustrated; pecten absent. Forewing with apex produced, with 11 veins; cell very long, its apex at about distal four fifths of length of wing (excluding terminal prolongation) in type-species, as figured. Hindwing with eight veins, costa nearly straight to beyond middle, vein 5 out of 6, the others free, 1*b* gently arcuate, as illustrated. Genitalia as illustrated.

Type-species: *Comodica fullawayi* Swezey.

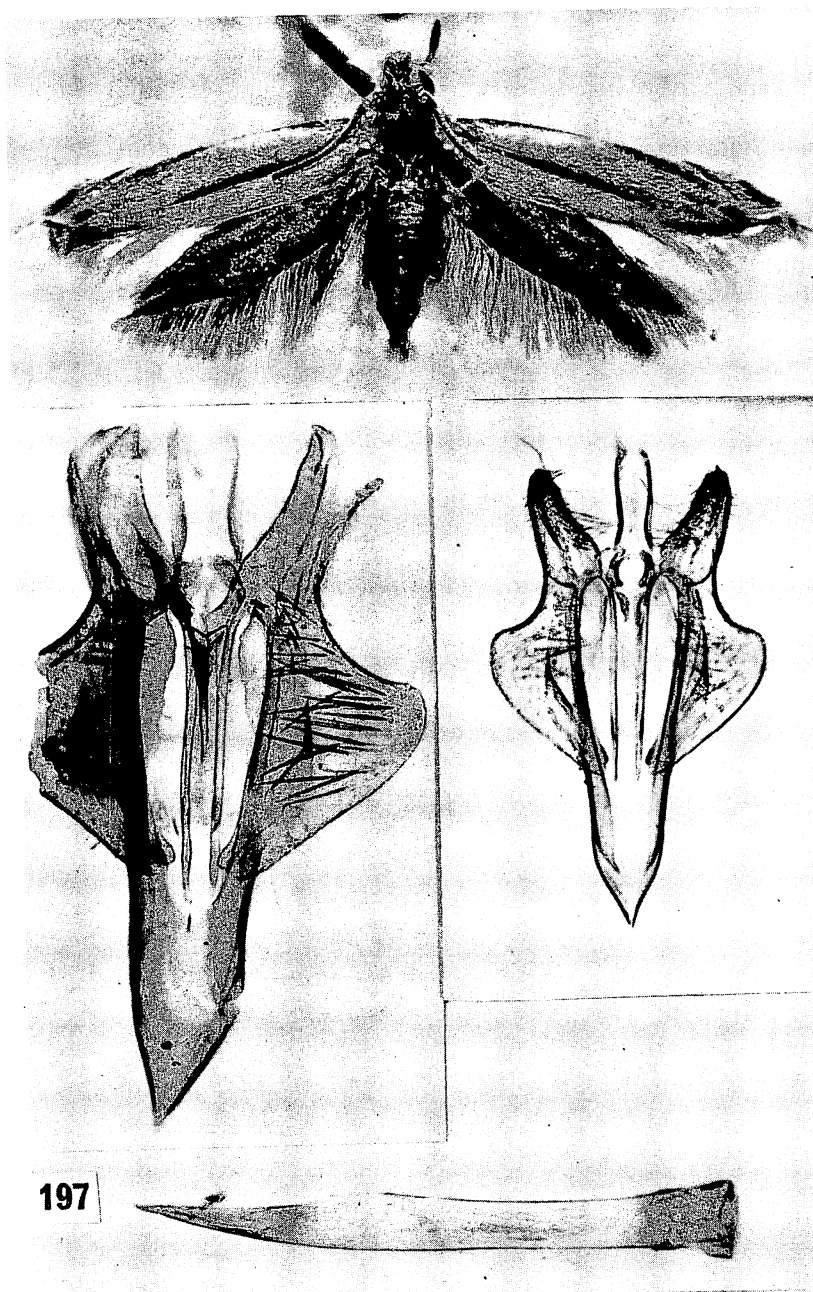
The name *Mecomodica* is formed from the Greek *me*, "not," and *Comodica* (feminine gender).

The species for which this generic name is proposed can hardly remain in *Comodica*, where it was placed originally, because of structural differences between it and the type-species; but, because of the confusion that exists in the taxonomy of the Erechthiinae, it cannot be placed accurately among its relatives at this time. *Comodica* Meyrick [1880*b*: 254; 1893 (1892): 563, emended description] was erected for *tetracercella* Meyrick, its type-species by monotypy, but it is now a compound and confused assemblage. There are about 15 or more species now assigned to *Comodica*, but I do not know how many are congeneric. Most of the species have been described from Australia and New Zealand, and others have been recorded from Norfolk Island, Fiji, and Samoa. It is improbable that the Mexican species placed in the genus by Walsingham belong to *Comodica*. The apex of the male abdomen in *Comodica tetracercella* (figure 199) is extraordinarily modified with accessory spines, sclerotized



Figure 196—*Mecomodica fullawayi* (Swezey), the type-species of *Mecomodica*; paratype male, Kure (BM slide 5215). There is no antennal pecten. For an enlarged view of the inner aspects of the basal antennal segments, see figure 105. The tip of the forewing has been lost.





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Figure 197—*Mecomodica fullawayi* (Swezey). Top, the holotype, Kure (Ocean) Island; forewing = 4.5 mm., mostly butter-yellow (the seemingly dark vitta is a shadow along the fold and not dark coloring). Middle left and aedeagus at bottom, from a paratype from Kure (BM slide 3991); the valvae have been damaged. Compare the middle right figure of an unbroken paratype.

processes, and hair tufts, making it very different from *Mecomodica fullawayi*. The costal margin of each hindwing of *Comodica tetracercella* is conspicuously arcuate; in *fullawayi*, it is straight to beyond the middle.

The forewing of *Mecomodica fullawayi* has 11 veins, but, on the two examples studied, vein 3 is weak and easily overlooked. It may be very shortly stalked with vein 4 at the base, and its apex does not reach the wing margin.

***Mecomodica fullawayi* (Swezey), new combination** (figs. 105*b*, antenna; 196, head, venation; 197, moth, male genitalia; 198, female genitalia). *Comodica fullawayi* Swezey, 1926*b*:77.

Kure (Ocean) Island (type locality).

Immigrant? Distribution unknown.

This small, mostly yellow moth was described from a series of 14 specimens, and I have no further records of the species. The hindwing of the male lacks a subcostal brush.

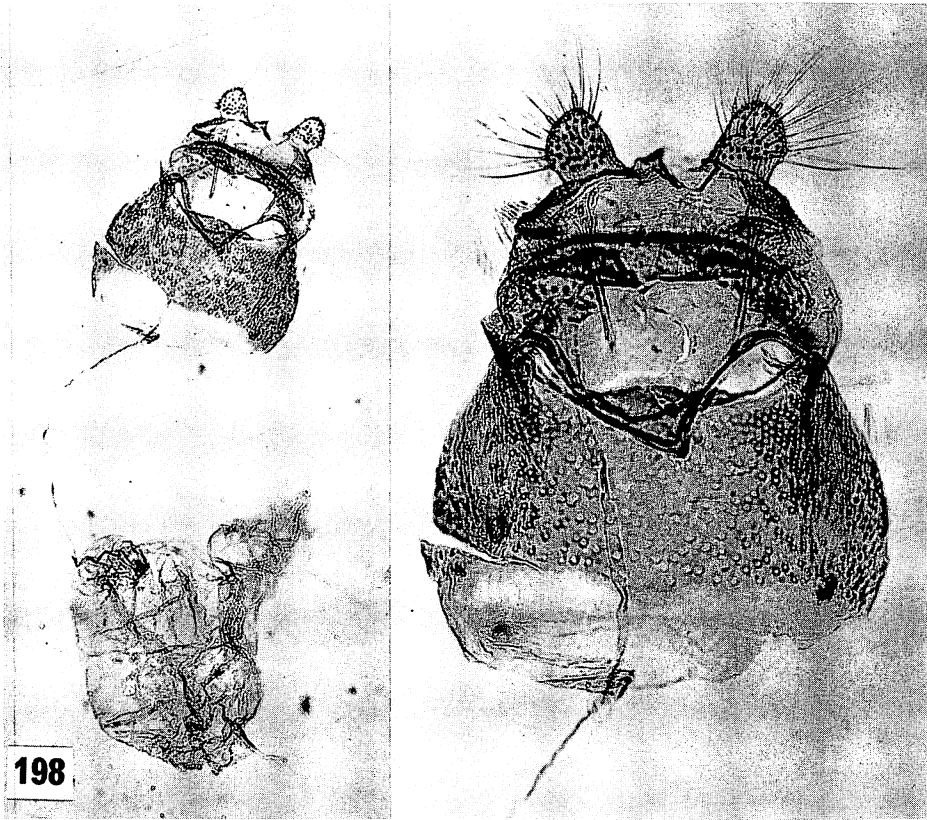


Figure 198—*Mecomodica fullawayi* (Swezey), female genitalia. (Photographs kindly supplied by J. F. G. Clarke, U.S. National Museum.) Compare figure 200 of the type-species of *Comodica* and note the major differences.

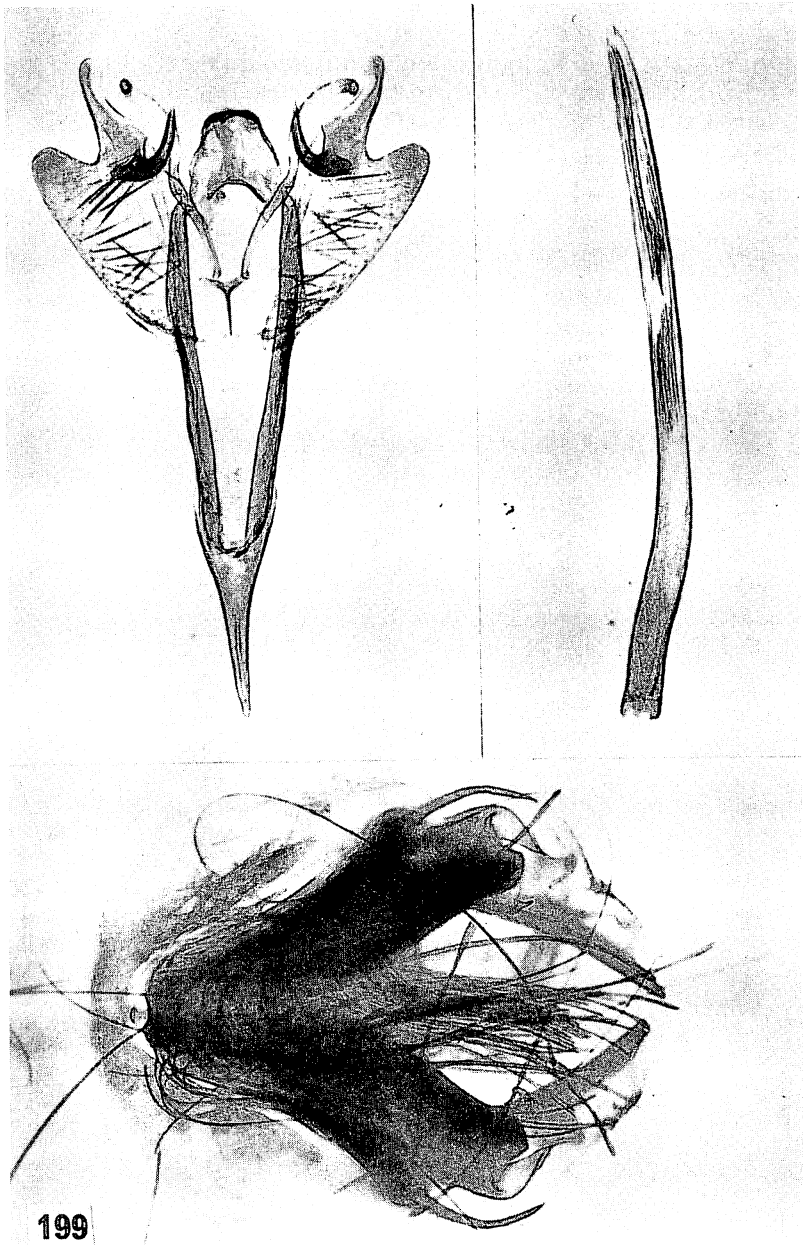


Figure 199—*Comodica tetracercella* Meyrick, the type-species of *Comodica*. Male genitalia and apex of the abdomen of a specimen from New South Wales, Australia (BM slide 3825). Compare figure 197 of *Mecomodica*.

Subfamily **SETOMORPHINAE** Walsingham

*Setomorphinae* Walsingham, 1891:81.

*Setomorphidae*: Busck, 1914a, pl. 2.

It is strange that this subfamily name has not been used more often, and it is generally overlooked. The included species are distinctive moths. In his larval studies, Hinton placed them in his concept of the *Nemapogoninae*, but, as shown in my larval key, the larvae are not typical of the *Nemapogon* group. Moreover, the external morphology and the genitalia of the adults are not similar to *Nemapogon*. The smooth, prostrate vestiture of the heads of *Setomorphinae* contrast strongly with the bristling erect vestiture of the heads of typical *Nemapogoninae*.

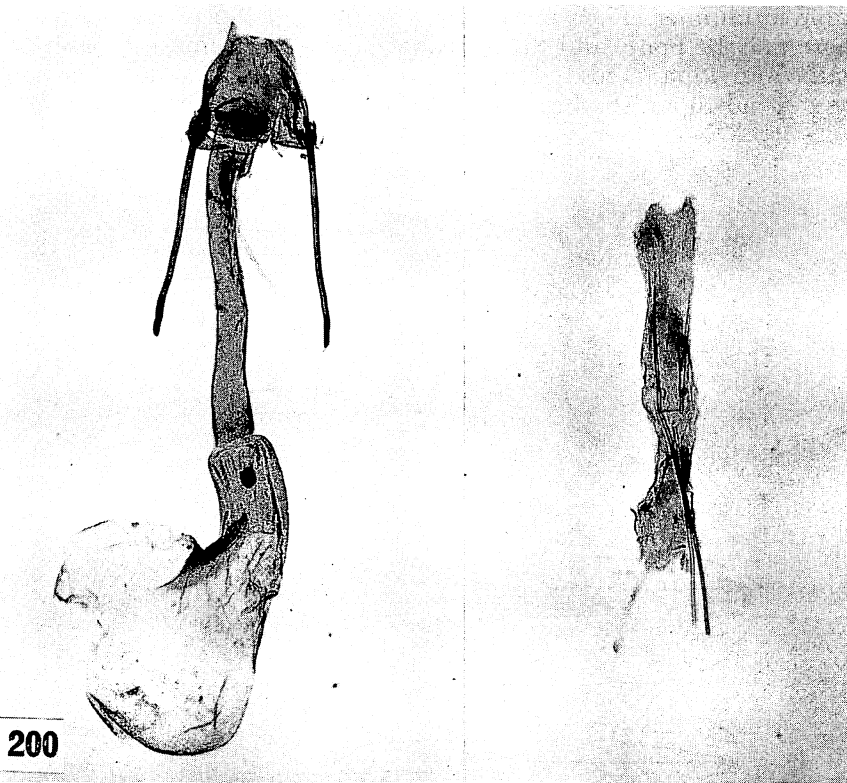


Figure 200—*Comodica tetracercella* Meyrick, the type-species of *Comodica*. Female genitalia from a specimen from New South Wales, Australia (BM slide 3749). Compare figure 198 of *Mecomodica*.

Genus **SETOMORPHA** Zeller

*Setomorpha* Zeller, 1852a:93. Type-species: *Setomorpha rutella* Zeller.

Diakonoff, 1938:404, redescription and discussion.

Corbet and Tams, 1943d:111, figs. 200, 235, 262.

See Fletcher, 1929:203, and Diakonoff, 1938:405, for synonymy.

In *Setomorpha*, the wing venation is sexually dimorphic: veins 3 and 4 are fused in both fore- and hindwings in the male, but they are separate in the female. Thus, in the male there are only 11 veins in the forewings and seven in the hindwings, but the veins number 12 and eight in the female.

There is a strong brush of hair on vein 1*b* on each hindwing. The head is "smooth-scaled" and all of the squamae of the face are directed ventrad. The stiff, erect, specialized bristles on the second palpal segments (so characteristic of the Tineidae) are here in the process of reduction or loss, and they are variable in number. There may be one to three or more setae on the palpus, or there may be none, and the number may be different on opposite sides of the same individual. This reduction and variability may cause some confusion if one depends upon the bristles alone for family identification.

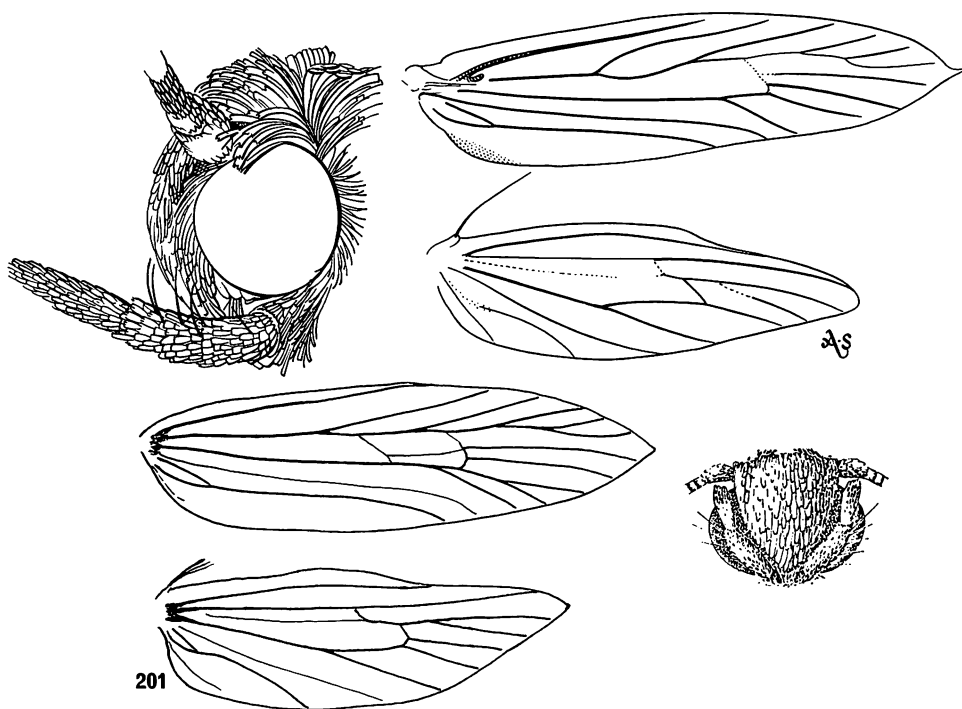
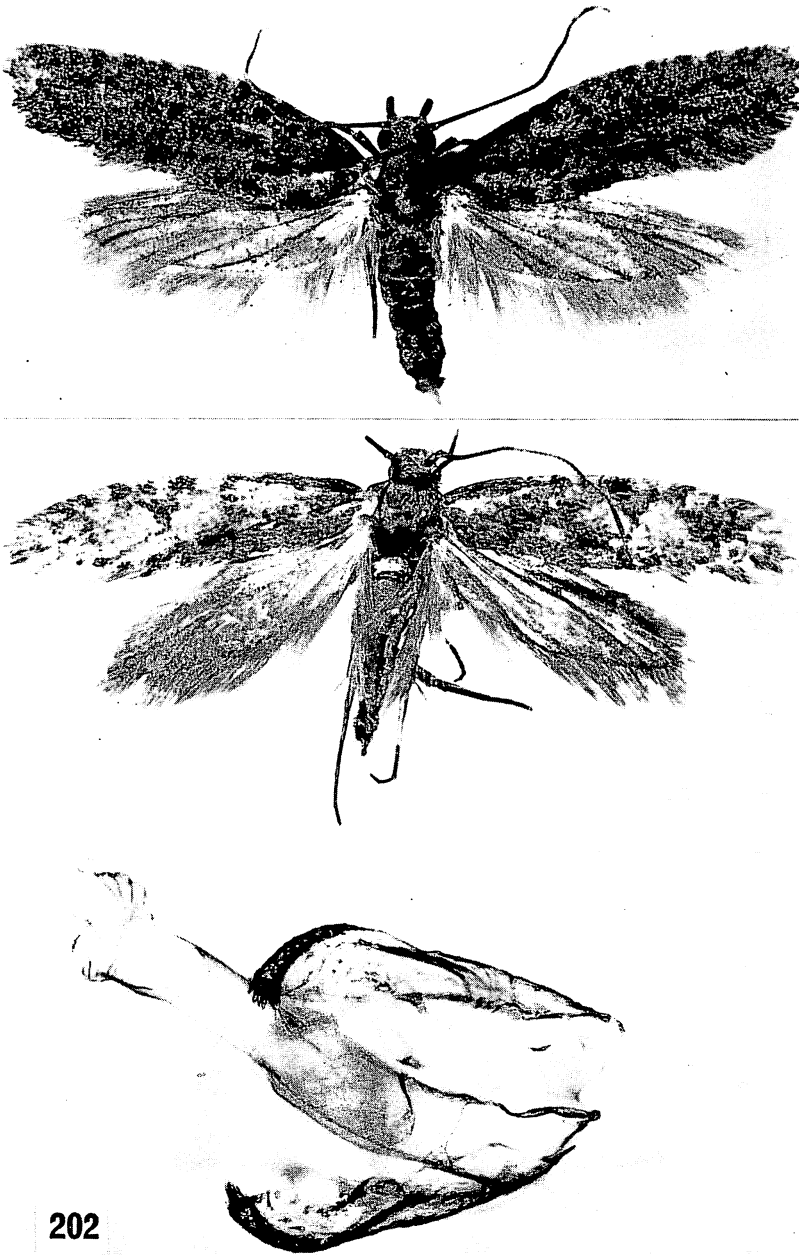


Figure 201—*Setomorpha rutella* Zeller. Lateral and frontal aspects of the head and male (BM slide 5187, Hawaiian example) and female wing venation. Note that the male has 11 veins in the forewing whereas the female has 12 veins. The sketches of the female wing venation and the frontal view of the head are after Diakonoff, 1938; the other figures are originals by Arthur Smith.



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Figure 202—*Setomorpha* and *Lindera*. Top, *Setomorpha rutella* Zeller, Hamakua-poko; forewing = 9 mm., pattern variable. Middle, *Lindera tessellatella* Blanchard, Kula, Maui; forewing = 10 mm. Bottom, male genitalia of *tessellatella*, from a European specimen from the Zeller collection, aedeagus in situ and much of genitalia out of focus (BM slide 4178); compare figure 206.

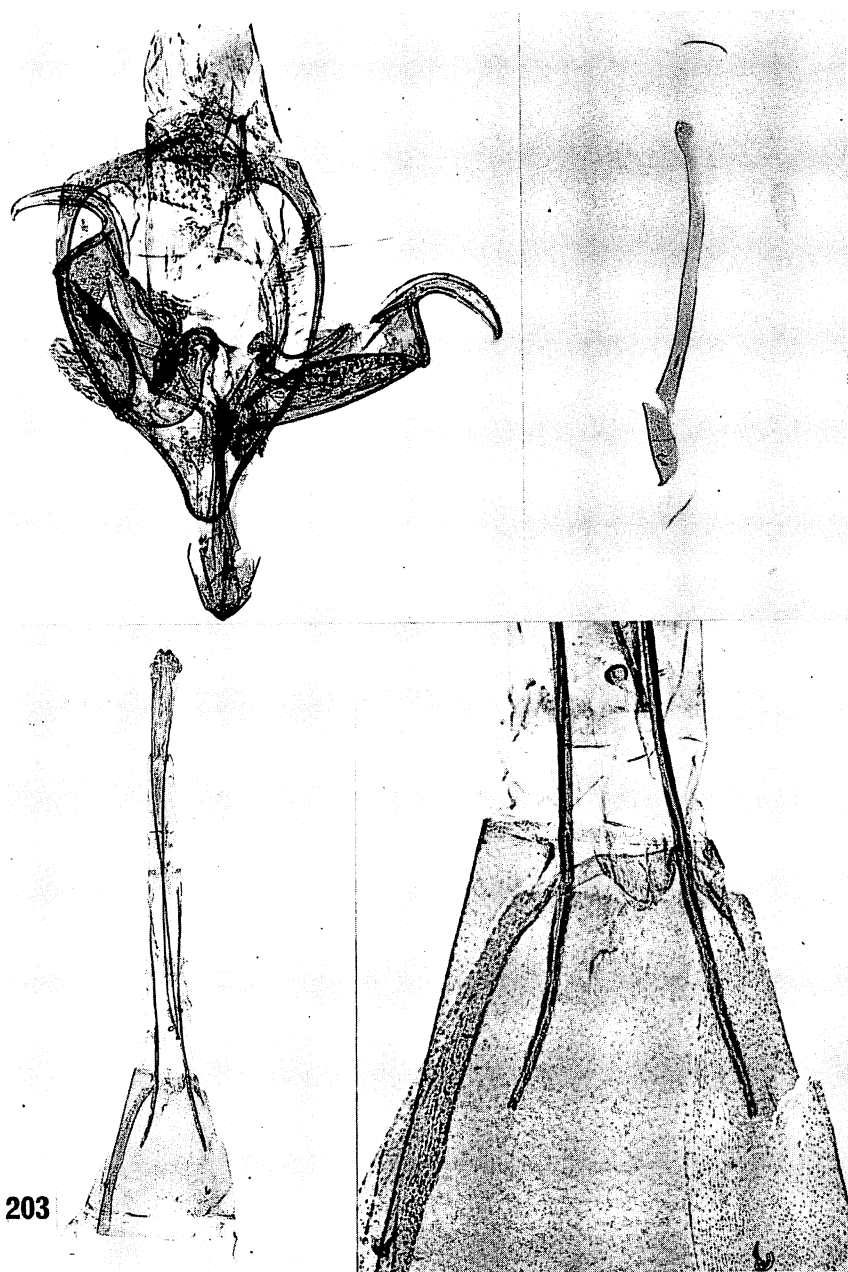


Figure 203—*Setomorpha rutella* Zeller, male (BM slide 8419) and female (BM slide 8097) genitalia from specimens from the Canary Islands.

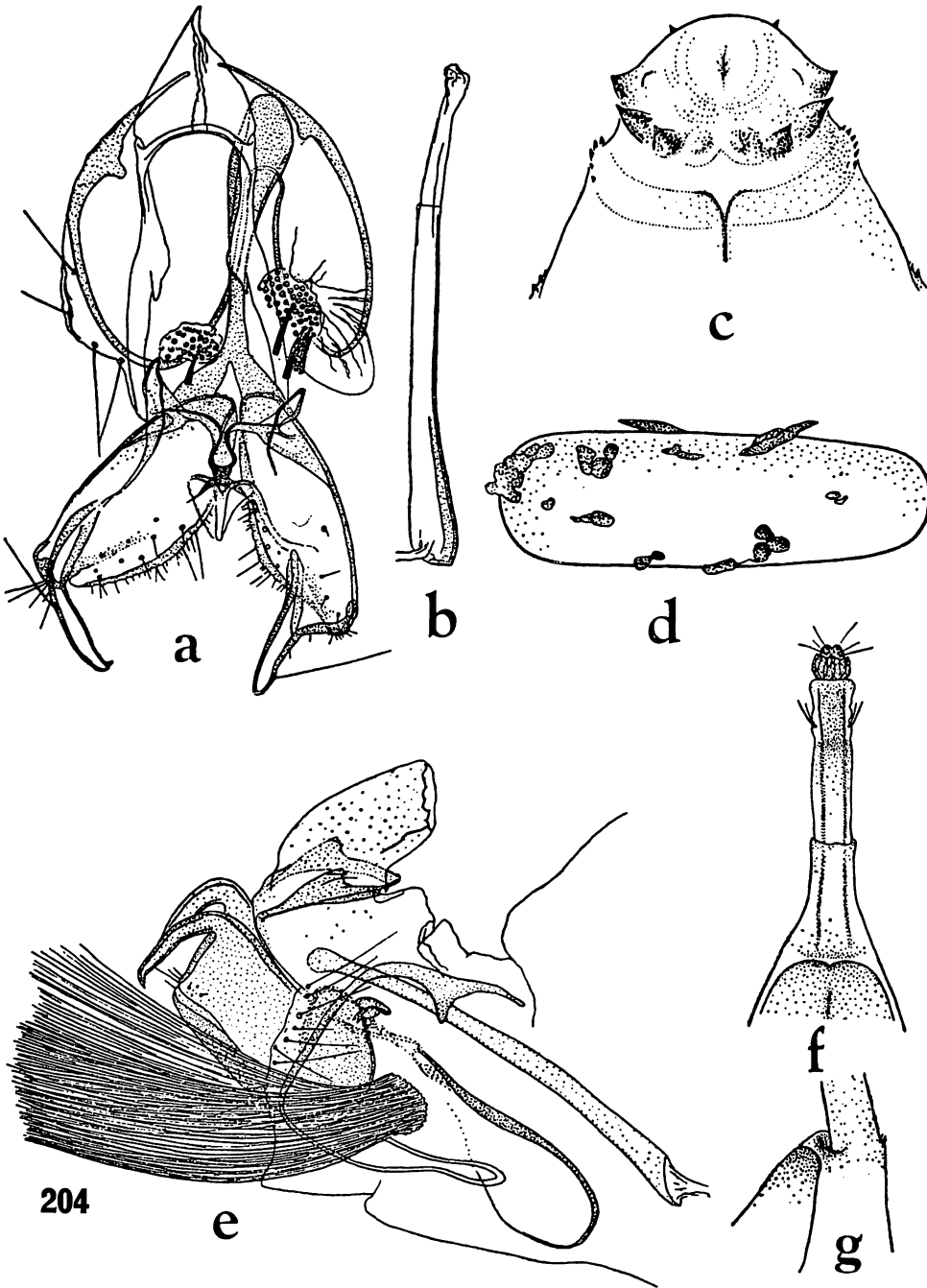


Figure 204—Details of *Setomorpha rutella* Zeller. *a*, male genitalia partly in caudal aspect with the valvae bent downward; *b*, aedeagus; *c*, caudal end of pupa; *d*, cocoon; *e*, male genitalia in lateral aspect; *f*, ventral aspect of ostial area and partly extruded ovipositor; *g*, lateral aspect of ostium. (Rearranged from Diakonoff, 1938.)



Hinton (1956:271) said that he had examined larvae supposedly of *Setomorpha rutella* and could not find any character to separate *Setomorpha* from *Lindera*. He stated that "I am therefore forced to conclude that *Setomorpha* and *Lindera* are synonymous." Because the specimens he was given under the name of *Setomorpha* may not have been correctly identified, reared material should be studied to confirm or to disclaim his opinion. Gozmány (1967:29) listed *Lindera* as a synonym, but I do not know whether or not he was influenced by Hinton's conclusion. The adults appear to represent distinct, although evidently allied, genera. Walsingham (1891:81) proposed the subfamily Setomorphinae to include this genus. One of the characters upon which he based the subfamily name, "forewings with veins 7 and 8 arising from a common stem out of vein 9. . . .", would, however, exclude the allied *Lindera*.

*Setomorpha* is a small cluster of mostly Old World species.

**Setomorpha rutella** Zeller (figs. 201 head, venation; 202 moth; 203–204, male, female genitalia, larval case, pupa).

*Setomorpha rutella* Zeller, 1852a:94. Corbet and Tams, 1943d:111, figs. 200, 235, 262.

*Chrestotes dryas* Butler, 1881:401. Synonymy by Walsingham, 1907b:754.

*Setomorpha dryas* (Butler) Walsingham, 1907b:726. (Walsingham listed this as a new species, but he really meant that he was making a new combination.)

*Setomorpha insectella*, as a misidentification, T. B. Fletcher, 1921(1920):188, notes on biology.

For detailed synonymy, see Diakonoff, 1938:405, and Corbet and Tams, 1943:111. For detailed discussion and redescription, see Diakonoff, 1938:399–414, figs. 1–10.

The tropical tobacco moth.

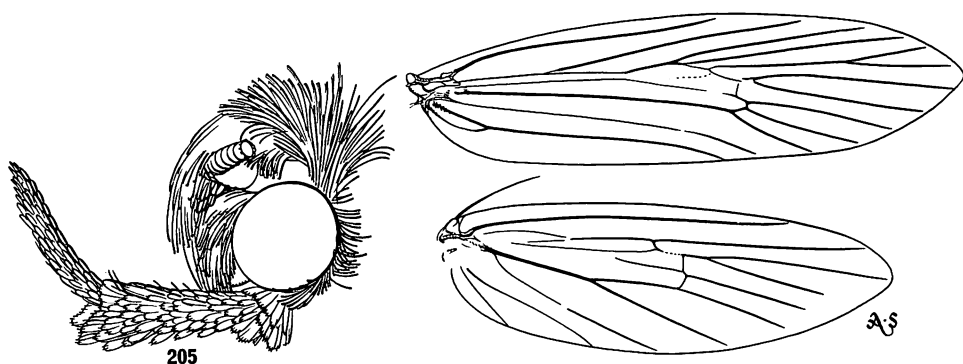


Figure 205—Head and wing venation of *Lindera tessellatella* Blanchard from a specimen from the Zeller collection (slide BM 4178).

Oahu, Maui, Hawaii, and probably more widely distributed in the state of Hawaii.

Immigrant. A widely spread species that has been distributed by commerce over much of the warmer parts of Africa (type locality), Eurasia, Malaysia, Australia, many Pacific islands, and America. It was first found in Hawaii at Honolulu by Blackburn and described from his material as *Chrestotes dryas* by Butler in 1881.

In some Hawaiian (and other) literature, it has appeared under the incorrect name of *Setomorpha insectella* (Fabricius) (now known as *Haplotinea insectella*). In the main body of his text of *Fauna Hawaiiensis* (1907b:726), Walsingham used *Setomorpha dryas* (Butler) as the name of this species, but in his tabular summary in the same work (p. 754) he submerged *dryas* as a synonym of *rutella* Zeller.

Not many records of this species are available in Hawaii, but the larvae have been found in the ears of corn, abundantly in alfalfa meal and in partly decayed alfalfa hay. Don R. Davis recently found the larvae associated with pigeon guano on Hawaii. It is a pest of dried tobacco leaves in some regions. It is also recorded elsewhere from a large variety of stored cereals, grains, other vegetable products, and dry animal matter. It has been reported on occasion as a pest of dried insect specimens. A summary of the known habits, with references, is given by Hinton (1956:264). Meyrick (1927c:116) reported that in Samoa it had been "reared from larvae feeding in fowl's excrement and from rotten breadfruit, which had been riddled by fly-larvae and had begun to dry up. . . ." The 1938 paper by Diakonoff, cited above, contains a useful account of the species.

T. B. Fletcher [1921(1920):188-189] said that "the eggs are laid singly. Before depositing an egg the female extrudes her ovipositor for about 2 mm. and moves it from side to side, then raises it upwards between the wings and then with a jerk deposits an egg at the utmost reach of the ovipositor, and then moves to another place to lay another egg. . . . The full-grown larva is about 17 mm. long, cylindrical, dirty-white, skin transparent, head red-brown, prothoracic shield greyish-brown; spiracles black. . . ."

Hinton (1956:264) said that "the eggs are deposited singly or in groups, and they are glued to the substrate. As many as 143 eggs may be laid by a single female. . . . The larva pupates in a closely woven and smooth cocoon within a loosely spun outer framework or outer cocoon, to which particles of food and excrement adhere. The inner cocoon is similar to that of *Lindera tessellatella* Blanchard."

### Genus **LINDERA** Blanchard

*Lindera* Blanchard, 1852:105. Type-species: *Lindera tessellatella* Blanchard.

*Safra* Walker, 1864a (not 1863):785.

*Chrestotes* Butler, 1881:401 (a new name for *Safra* Walker, 1864), not Scudder, 1868.

*Paraneura* Dietz, 1905:12.

*Cervitinea* Amsel, 1956(1954):307 pl.3, fig. 12. Synonymy by Gozmány, 1967:29.

Stringer, 1943:177, redescription.

*Lindera* is a small cluster of mostly American species. See the comments above under *Setomorpha* regarding Hinton's opinion that *Lindera* and *Setomorpha* may be the same.

***Lindera tessellatella*** Blanchard (figs. 202, moth, male genitalia; 205, head, venation; 206, male genitalia; 207, female genitalia; 208–210, larva).

*Lindera tessellatella* Blanchard, 1852:106.

*Safra bogotatella* Walker, 1864a:785; described from Colombia, South America.

*Paraneura simulella* Dietz, 1905:13; described from California.

*Paraneura cruciferella* Dietz, 1905:14; described from California.

*Setomorpha calcaris* Meyrick, 1906a:66; described from Australia.

Philpott, 1925:32, figs. 1–9, description of the unusual genitalia (his notes are repeated by Stringer, 1943).

Stringer, 1943:177, figs. 1–12, redescription, synonymy and discussion.

Maui.

Immigrant. A widely distributed species described from South America and known from parts of Africa, Europe (first found in England in 1943; see Stringer, 1943), North America, Australia, New Zealand, Fiji, and elsewhere.



Figure 206—Male genitalia of *Lindera tessellatella* Blanchard; Chosica, Peru (BM slide 8051).

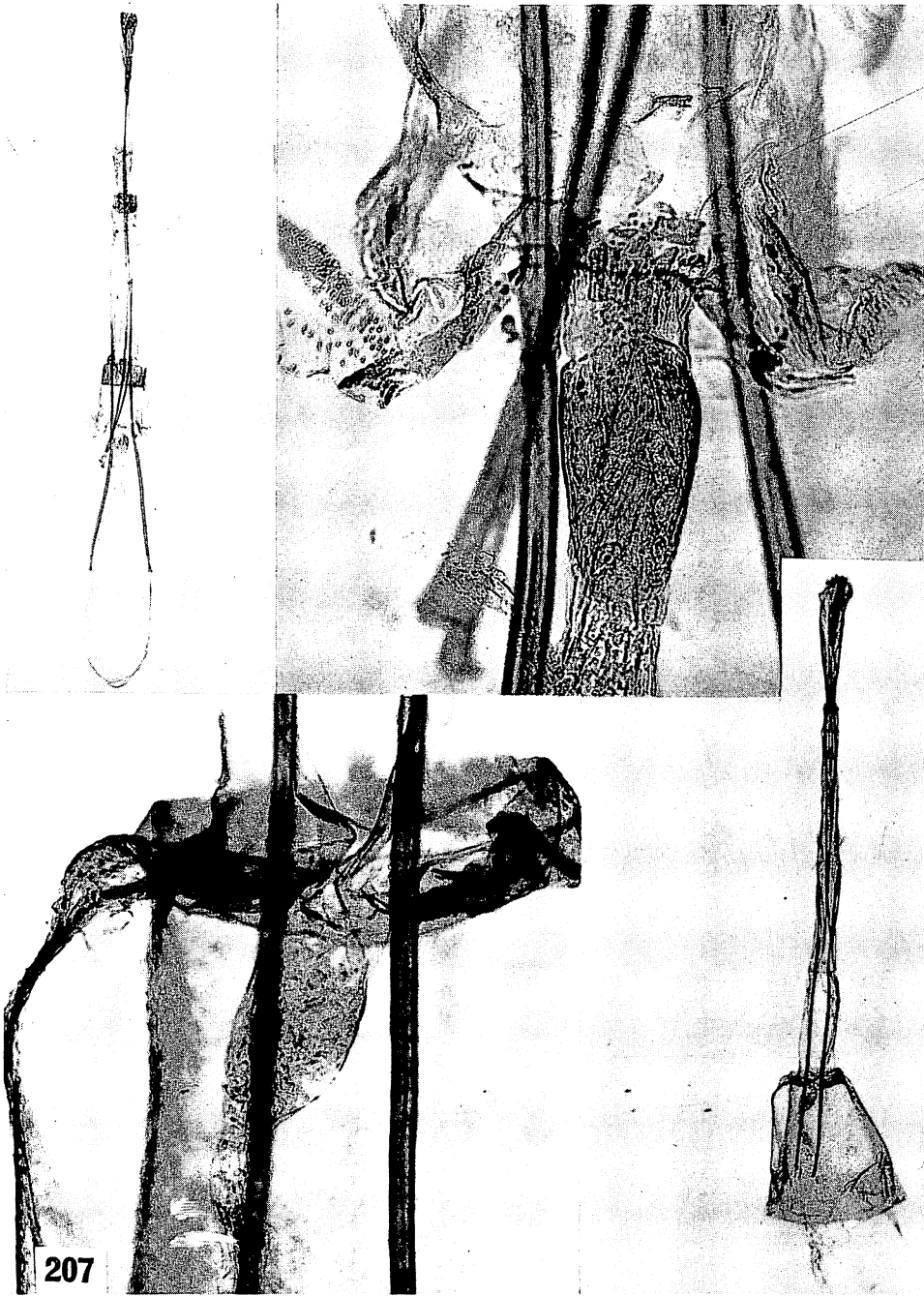


Figure 207—Female genitalia of *Lindera tessellatella* Blanchard. Top, from a specimen from the Juan Fernandez Islands (USNM slide, Clarke 11274; photographs supplied by J. F. G. Clarke). Bottom, from the type of the synonymous *Saфра bogatella* Walker (BM slide 8093).

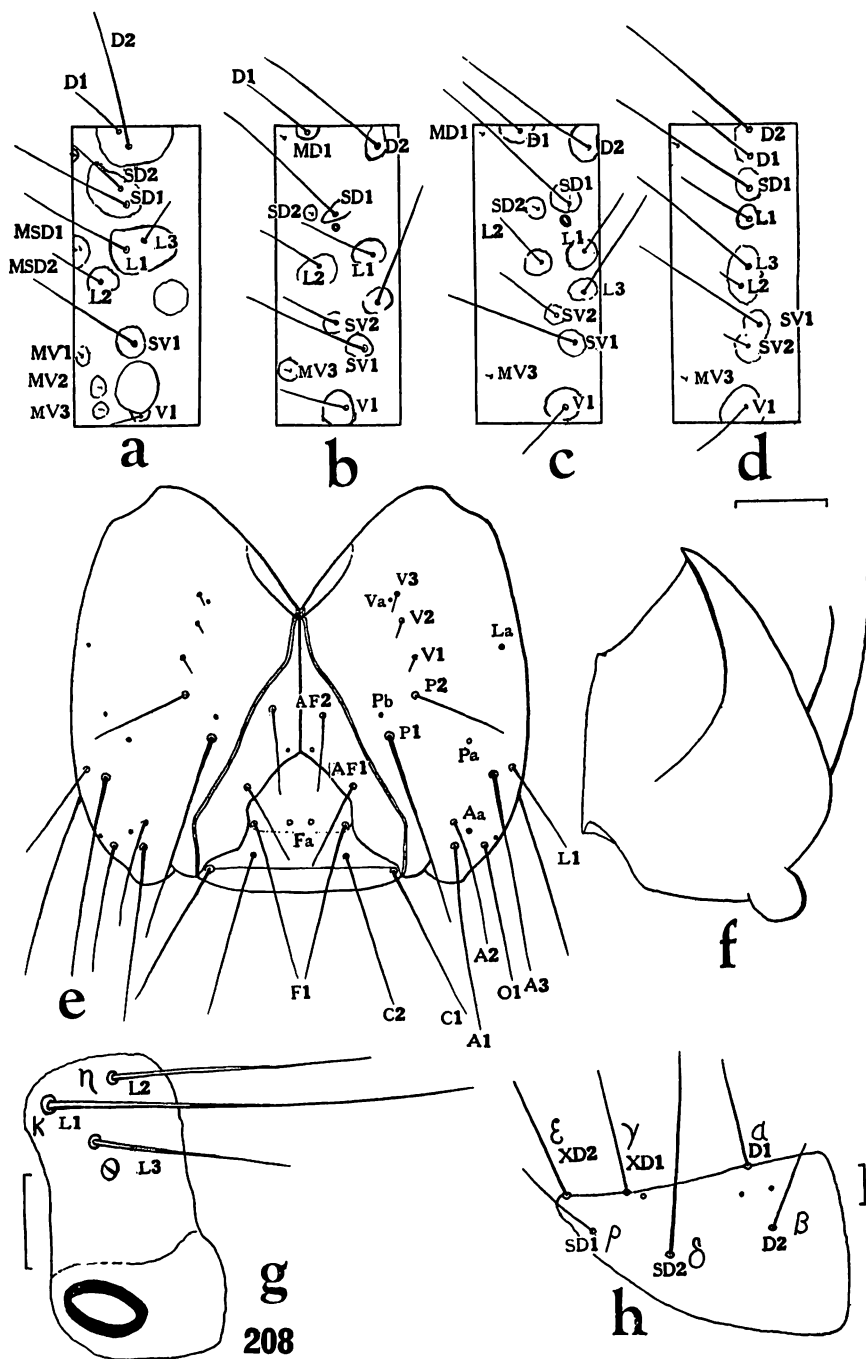


Figure 208—Details of the mature larva of *Lindera tessellatella* Blanchard. *a*, left lateral aspect of mesothorax; *b*, *c*, *d*, left lateral aspects of abdominal segments seven, eight, and nine; *e*, frontal view of head capsule; *f*, ventral aspect of left mandible; *g*, spiracle and L group of setae of prothorax; *h*, dorsal aspect of the left side of prothorax. (After Hinton, 1956.)

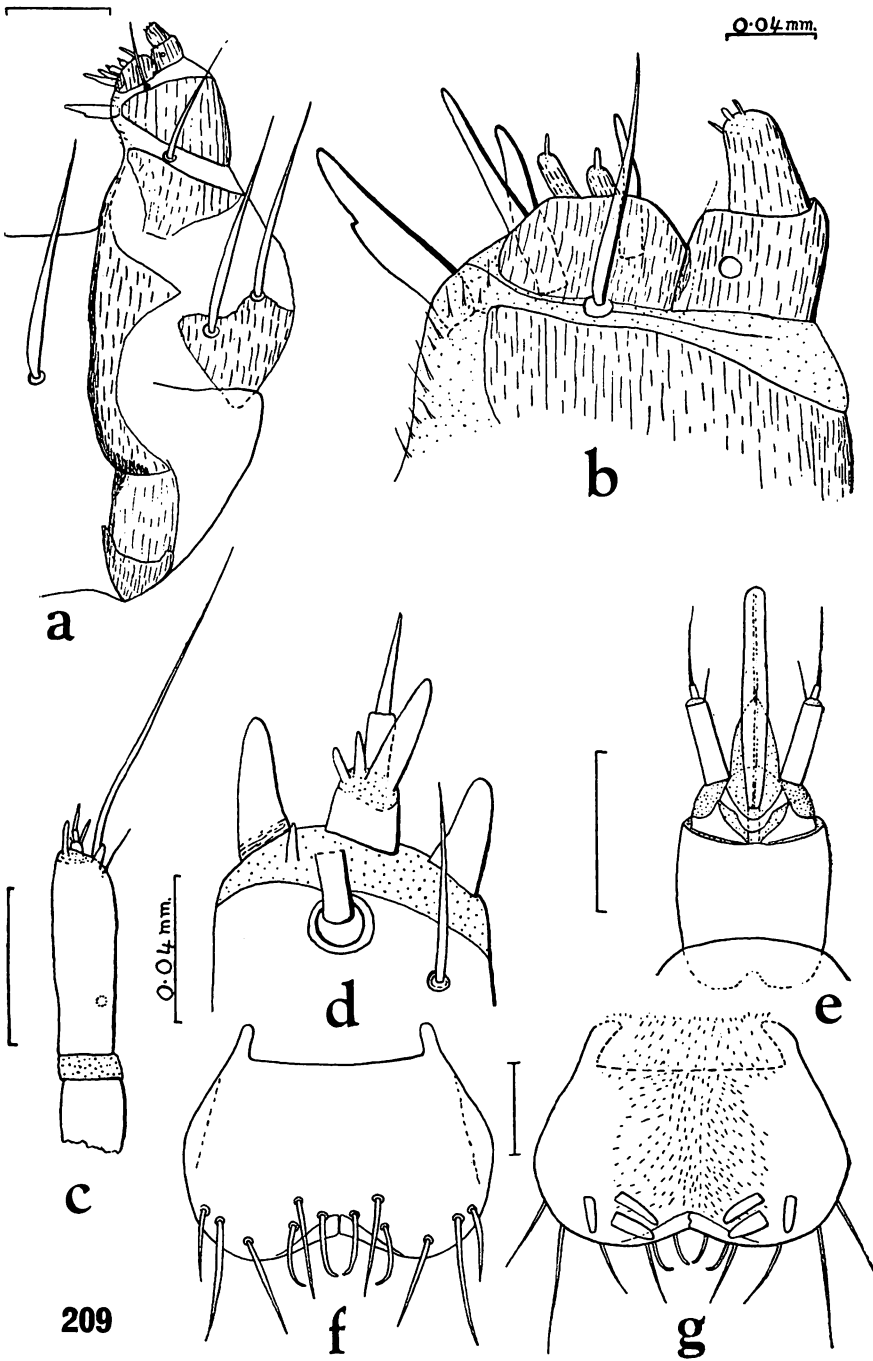


Figure 209—Details of the mature larva of *Lindera tessellatella* Blanchard. *a*, ventral aspect of left maxilla; *b*, ventral aspect of the apex of the left maxilla; *c*, dorsal aspect of right antenna; *d*, ventral aspect of the apex of right antenna; *e*, ventral aspect of prementum; *f*, *g*, dorsal and ventral views of labrum. (After Hinton, 1956.)

First recorded from Hawaii by Swezey (*Proc. Hawaiian Ent. Soc.* 12(2):214, 1945) from examples found by him at Kula, Maui in 1911.

This species resembles *Setomorpha rutella* Zeller, and it frequents stored food products and refuse where it evidently feeds upon arthropod remains. Hinton (1956:261, figs. 15–31) has given a modern, well-illustrated account of the larva. He said that “in the gut of a mature larva dissected there were numerous Tyroglyphid mites and the remains of lepidopterous larvae, including the mandibles of smaller *Lindera* larvae.” Hinton also said that “this (and *Setomorpha*?) is the only species of Nemapogoninae known to occur in stored products that is without convex ocellar lenses and the only species with minute recurved spines above the ventral prolegs. The black or nearly black peritreme of the spiracles and the large size of the mature larvae [24–28 mm.] are additional distinguishing features.” As noted above, I do not agree with Hinton that these moths belong to the Nemapogoninae.

The record by Swezey (who probably found the specimens in stored maize in 1911) is the only one I have of the occurrence of this species in Hawaii. It is strange that it has not been found commonly in the islands. It is highly variable in size. Large individuals may have an expanse of 28 mm., and it would, therefore, include the largest of the tineids found in Hawaii.

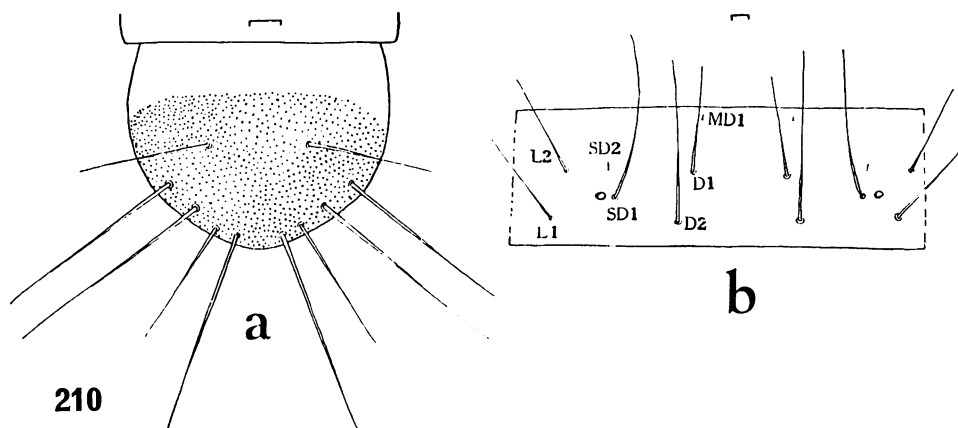


Figure 210—Further details of the mature larva of *Lindera tessellatella* Blanchard. *a*, dorsal aspect of tenth abdominal segment; *b*, dorsal aspect of ninth abdominal segment. (After Hinton, 1956.)

Subfamily **HIEROXESTINAE** (Meyrick), **new status**

*Hieroxestides* Meyrick, 1893(1892): 478.

*Hieroxestidae*, *auctorum*.

*Opogonidae*, *auctorum*?

The members of this group are easily distinguished by their flat, smooth-scaled faces (whose vestiture is directed ventrad), by their conspicuous "brow ridges" (figure 211), long folded maxillary palpi and narrow wings (which have reduced venation, figures 211–212), and by their lack of heavy antennal pectens.

The suprageneric placement of *Opogona* and allied genera has long been confused (only *Opogona* of this group occurs in Hawaii). Some authors, including some of my contemporaries, place the moths incorrectly in the Lyonetiidae. Spuler [1910 (1901–1910): 421] erected the family Oinophilidae (incorrectly proposed as Oenophilidae) to include *Oinophila* (incorrectly cited as *Oenophila*) and *Opogona*. Forbes also placed *Opogona* in the Oinophilidae in his 1923:160 monograph. When Meyrick erected *Hieroxestis* (now considered a synonym of *Opogona*), he proposed the family-group name Hieroxestides [1893 (1892):478]. Hence, unless there is an earlier name which has been overlooked, the family-group name for *Opogona* and its allies must be based upon Hieroxestides of Meyrick. Opogonidae, as has been suggested by some workers, cannot be used.

I have long considered *Opogona* to be closely associated to the Tineidae and have been unable to understand why it has been placed in the Lyonetiidae by many workers. The long, stiff, erect bristles on the labial palpi, so characteristic of the typical tineids, are here represented by only one or two bristles, and these remnants may easily be overlooked. This fact appears to have escaped notice by some workers who have been led to consider *Opogona* to be rather widely removed from the Tineidae. The smooth heads, of course, contrast strongly with the rough-headed, typical tineids, but other tineids have smooth heads.

The larvae are tineidlike, and the *Opogona* of Hawaii have larvae which agree with Hinton's concept of the tineid subfamily Nemapogoninae as he defined the group preliminarily in his key in 1956. However, the larvae and the adults of *Opogona* have distinctive characters which enable them easily to be distinguished from the true allies of *Nemapogon*, and I consider them

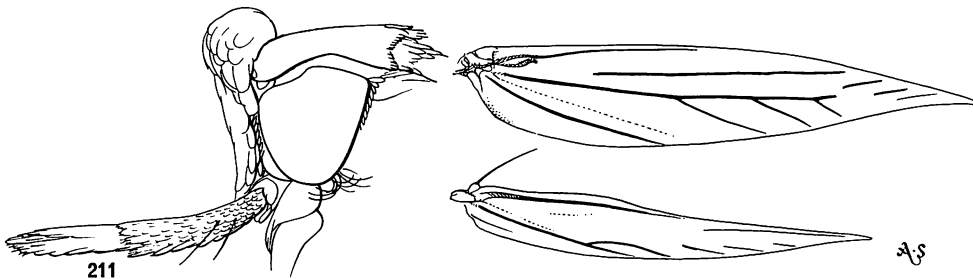


Figure 211—Head and wing venation of *Opogona aurisquamosa* (Butler), Oahu specimens (BM slide 2041).



different groups. Hinton did not treat *Opogona* in his work probably because he was not aware of the true relationship of the group. The external facies of adult *Opogona* are certainly distinct from those of the rough-headed typical Tineidae and the Nemapogoninae; the genitalia are also distinctive.

Some members of this group are of economic importance. One such species is *Opogona sacchari* (Bojer) (= ? *subcervinella* Walker). Its larvae damage bananas in the Canary Islands, and it is reported also to damage sugarcane. A well-illustrated, detailed account of the larva and its damage was published by Oldham (1928:147). Other species might become destructive to crops if they become transported to foreign areas or if they enter new agricultural developments in tropical and subtropical lands within their range. The larvae are generally considered to be "scavengers" in dead plant material in Hawaii, but, on occasion, they damage the buds of sugarcane (see below under *aurisquamosa* and *omoscopa*).

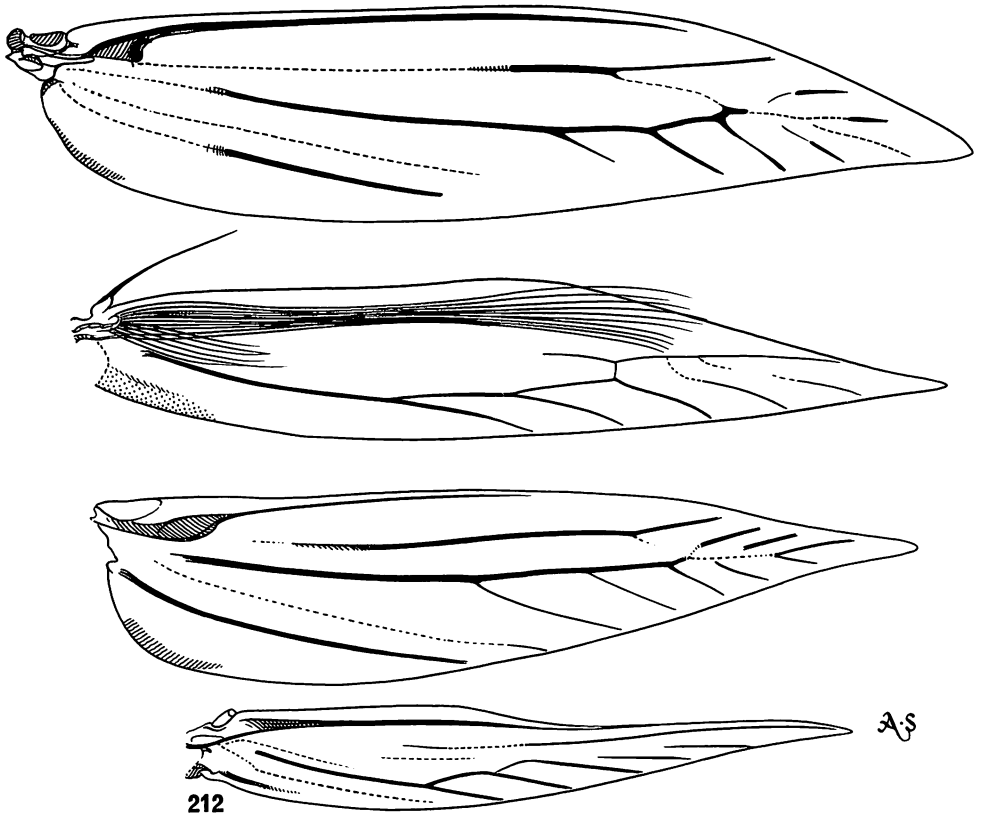


Figure 212—*Opogona* wing venations. Top, *omoscopa* (Meyrick), Sydney, Australia (BM slide 1868). Bottom *purpuriella* Swezey, male from Honolulu (BM slide 8610).

Genus **OPOGONA** Zeller

*Opogona* Zeller, 1853:504 (p. 3 in reprint). Type-species: *Opogona dimidiatella* Zeller, 1853:507, from Java, by monotypy. Meyrick, 1915:232; 1928b:398.

*Hieroxestis* Meyrick, 1893(1892):567; 1915c:232; type-species: *Hieroxestis omoscopa* Meyrick, 1893(1892):567. Synonymy by Meyrick, 1927d:315. (Meyrick described *Hieroxestis* as having "ocelli small", but the ocelli are absent.)

Fletcher, 1929:155, listed *Lozostoma* Stainton, 1859; *Conchyliospila* Wallengren, 1861; *Cachura* Walker, 1864; and *Dendroneura* Walsingham, 1892(1891); as synonyms, but, not having examined the type-species of those generic names, I cannot comment upon the synonymy.

*Opogona* means "angle-faced," and Zeller chose a most appropriate name for the genus.

Supposedly a large and widespread Old World genus, *Opogona* is most extensively developed in the Indo-Pacific. As it is now constituted in the literature, however, it appears to contain species of more than one genus. Our species *omoscopa* and *purpuriella* have genitalia closely similar to those of the type of the genus, but they are, of course, specifically distinct. Our *aurisquamosa* has a greatly prolonged saccus which gives the male genitalia a divergent appearance.

The habits of some of the species make easy their widespread dispersal by man. Perkins (1913:clxix) commented that "one or two other species, that have reached the islands on imported plants, have been intercepted and destroyed [by plant quarantine inspectors at Honolulu]. The imported larvae of a pretty species, infesting the drupes of coconuts in Samoa, have more than once been bred to maturity."

See color plate 1, figures 3, 4.

## KEY TO THE SPECIES OF OPOGONA IN HAWAII

1. Forewings iridescent purple with two yellow costal maculae and a yellowish vitta from base to about middle of posterior margin.....**purpuriella** Swezey.  
Not so colored.....2
2. Crown of head with feeble hair tufts between antennae; tips of forewings bent down; expanse 12 to 15 mm. ....  
.....**aurisquamosa** (Butler).  
Crown of head with very strong tufts of erect hair between antennae; tips of forewings bent up; expanse about 18 to 20 mm. or larger.....**omoscopa** (Meyrick).

**Opogona aurisquamosa** (Butler)

*Argyresthia?* *aurisquamosa* Butler, 1881:403.

*Opogona aurisquamosa* (Butler) Walsingham, 1907b:713, 737, pl. 25, fig. 14. Meyrick, 1915c:232; 1928a:505. Swezey, 1909d:16, pl. 3, figs. 1-3.

Kauai, Oahu (type locality: Honolulu; Blackburn's code "77.43"), Molokai, Maui, Lanai, Hawaii.

Immigrant. It was described from material collected by Blackburn, and it

is now known from various other parts of the Pacific including Easter Island, the Marquesas, Society, Fiji and Kermadec Islands. It may have been dispersed by the Polynesians as well as by Europeans.

**Hostplants:** The larvae are scavengers, and they have been reared from dead or decayed materials such as from *Alectryon macrococcum*, bamboo (*Bambusa*), banana (*Musa*), castor bean (*Ricinus communis*), *Clermontia*, decayed fruits, dry cow dung, palm fronds, *Pipturus*, rotten wood, *Sicana odorifera*, sugarcane (*Saccharum officinarum*), and *Thespesia populnea*.

**Parasites:** *Apanteles trifasciatus* Muesebeck, *Orgilus swezeyi* Fullaway.

F. X. Williams (1931:156) said that it "is a little larger than the budworm moth [*Neodecadarchis flavistriata*] and the forewings, instead of being upturned at their tip, are somewhat down-curved. The antennae, except for their dark tips, are nearly white; the general color of the body is a sort of bronzy yellowish with a good deal of violet or purplish, particularly in the forewings."

The larvae of this moth are often associated with bud-worms, and feeding in a similar manner; hence, they are also responsible for some destruction of the eyes of the cane. They occur more abundantly, however, feeding inside of diseased, dead, or rotten cane, especially in those shoots which have been choked or smothered and have died off at the top, and in cane sticks which have been attacked by borers. In the latter, many may often be found in old borer tunnels, feeding on the chewed-up cane left by the borer, or on the disintegrating substance of the cane itself. They also feed on decaying fruits and other decaying substances, on the dead leaves of bananas and palms, and in rotten wood. I have found them quite numerous in fruit clusters and dead stems of the castor oil plant, and in decaying bamboo stems, also in *Pipturus*, *Clermontia*, and other native trees in the mountains. I once reared quite a number of the moths from dried cow dung. They occur generally throughout the islands and are always found in cane fields, though not particularly injurious on account of their general feeding habits as given above. The species is also known in the Marquesas and Society Islands.

The moths may often be seen at rest on the cane leaves. They are of a bronzy-yellowish color with metallic reflections. They are about  $\frac{1}{4}$  inch in length with the wings folded over the back. The wings are somewhat bent down at the tips. The antennae [are] extended forward.

The full-grown larva (Plate III, Fig. 3) is about 15 to 18 mm. long, dull dirty white; finely pubescent, except head and segment two [prothorax]; head and cervical shield blackish-brown; tubercles slightly infuscated, especially those of segments two to four; tubercles i [D1] and ii [D2] in a straight longitudinal line, iii [SD] separated into two above the spiracle, iv [L1] and v [L2] below spiracle and about as far apart as iiia [SD2] and iiib [SD1] above; spiracles pale with black margins. Like *Ereunetis* larvae, they are of slow growth; the length of larval period has not been definitely determined.

The pupa (Plate III, Fig. 2) is 6–6.5 mm. in length; nearly uniform light brown, paler below, darker at extreme anterior end; fine hairs are situated where they were on the caterpillar; head bluntly, triangularly produced in front near ventral side; all of the abdominal segments movable, except first and second; near basal dorsal margin of segments four to eight is a slight transverse ridge armed with a row of numerous short spines, which assist in emerging from the cocoon at the time the moth emerges; cremaster has two short,

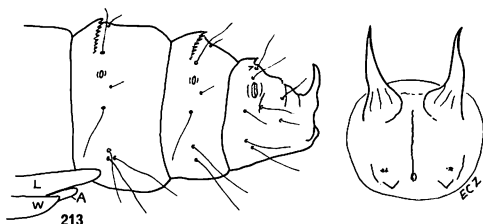


Figure 213—Details of a cast pupal skin of *Opogona omoscopa* (Meyrick) from Hawaii. At left are the five caudal abdominal segments in left lateral aspect: A, antenna; L, leg; W, wing. At right is the caudal segment in direct caudal aspect and drawn to a larger scale. Note the resemblance between *Opogona* and the members of the Erechthiinae (figures 172–174, 185, 186).

stout spines on dorsum and slightly curved forward, two slight conical protuberances on ventral side; antenna- wing- and leg-cases extend to near middle of eighth abdominal segment, free beyond third segment.

The pupa is formed in a compact cocoon made in the place where the larva has fed. The cocoon is about 8 mm. long by 2.5 mm. in diameter, rounded at the ends and covered with frass and other debris, few fibers of the cane or leaves, etc.; at each end, a strip of white silk extends out about 5 mm. onto the surface of whatever the cocoon is attached to. About ten days are passed in the pupal stage. (Swezey, 1909*d*: 16-17, pl. 3, figs. 1-3.)

**Opogona omoscopa** (Meyrick) (figs. 212, venation; 213, pupa; 214, moth; 215, male genitalia; 218, female genitalia; 219, moth, larva; col. pl. 1:3).

*Hieroxestis omoscopa* Meyrick, 1893 (1892):567; 1915*c*:232.

*Hieroxestis praematura* Meyrick, 1909*a*:26, pl. 8, fig. 5; synonymy by Meyrick, 1930*b*:321.

*Opogona omoscopa* (Meyrick) Meyrick, 1928*b*:398; 1937:88 (remarks on scale tufts on forewings).

*Opogona apicalis* Swezey, 1909*d*:17, pl. 3, figs. 4-5.

Philpott, 1927*c*:331, figs. 12-13, genitalia. K. M. Moore, 1959:346, pls. 41 (larva; figure inaccurate?), 42 (pupa; error in determination?), 43 (adult), biology, including details of the larva.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. India, Australia (described from Newcastle and Sydney, New South Wales), New Zealand, Fiji, Society Islands, Marquesas, St. Helena, Rodriguez, Mauritius, South Africa. It was first discovered in Hawaii on the windward side of the island of Hawaii in 1905 by Dr. Swezey, and he found it to be abundant at that time. Soon thereafter it became a common and widespread moth in Hawaii.

Hostplants: The larvae are scavengers and are common in rotten wood, bark, and dead leaves. They have been reared from *Acacia koa*, *Clermontia*, dead fern fronds, *Hibiscadelphus giffardianus*, *Rubus hawaiiensis*, *Saccharum officinarum* (sugarcane), and *Wikstroemia*.

The moths are most common in the damper regions of the islands. On occasion, when there is an abundance of damp trash at the base of sugarcane, the larvae may eat the buds of the sugarcane and thus cause minor damage. Meyrick, in the original description, stated that "it has been bred from larvae feeding on sheets of cork."

Parasite: probably *Sierola opogonae* Fullaway.

In the original description, Meyrick said that the head has a "dense erect tuft on crown", but there are two specialized erect tufts on the crown.

I do not know of a formal statement synonymizing Swezey's name *apicalis*, but he had begun to use *omoscopa* for this species as early as 1926.

This is the largest *Opogona* in Hawaii, and it may expand to more than 20 mm. It is darker in color than *aurisquamosa*. Upon emergence, the pupal skin protrudes from the fine silken cocoon. In Australia, K. M. Moore (1959:346) found the life cycle to be 10 to 12 weeks long during the summer. Dr. Swezey's observations (1909*d*: 18) on the species in Hawaii are as follows.

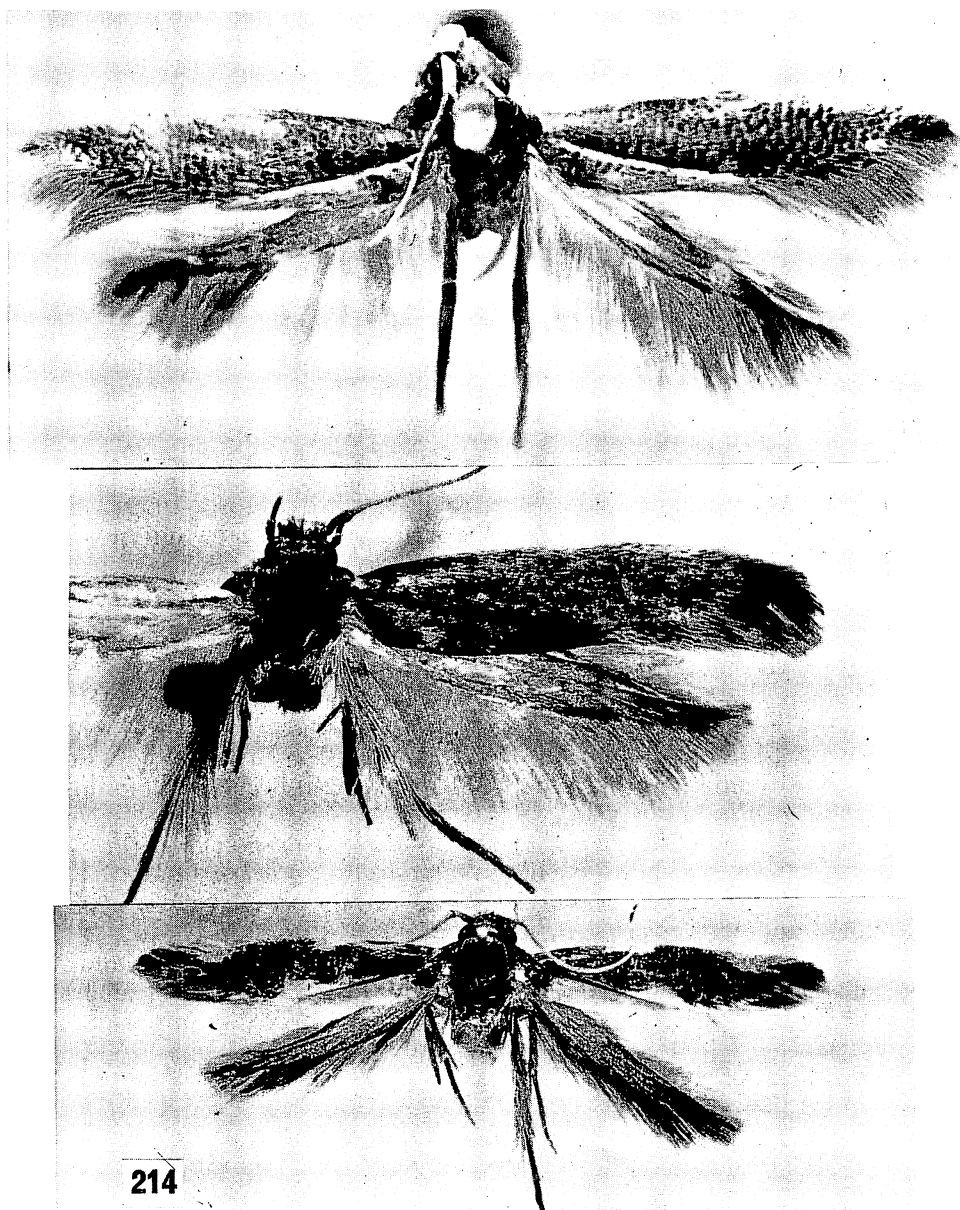


Figure 214—*Opogona*. Top, *aurisquamosa* (Butler), holotype (BM slide 1867); Honolulu; right forewing = 5.5 mm. Middle, *omoscopa* (Meyrick) from the holotype of the synonym *apicalis* Swezey; Hamakua, Hawaii; forewing = 8 mm. Bottom, *purpuriella* Swezey, lectotype; Kona, Hawaii, forewing = 5.25 mm.

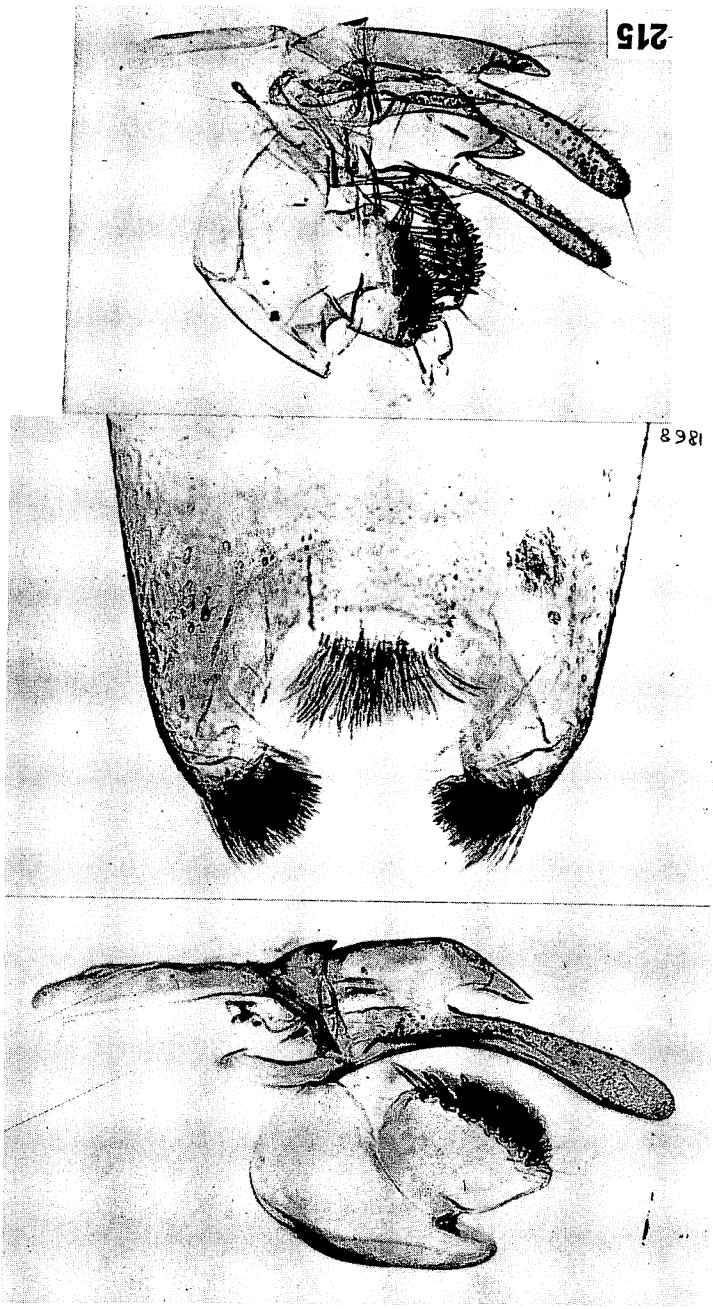


Figure 215—*Opogona omoscopia* (Meyrick), male genitalia. Top, a specimen from Sydney, Australia, with the seventh abdominal segment shown at middle (BM slide 1868). Bottom, the same species from a Kauai example (Busck slide 115); this specimen is less well mounted and has some parts folded—this accounts for the differences in appearance.

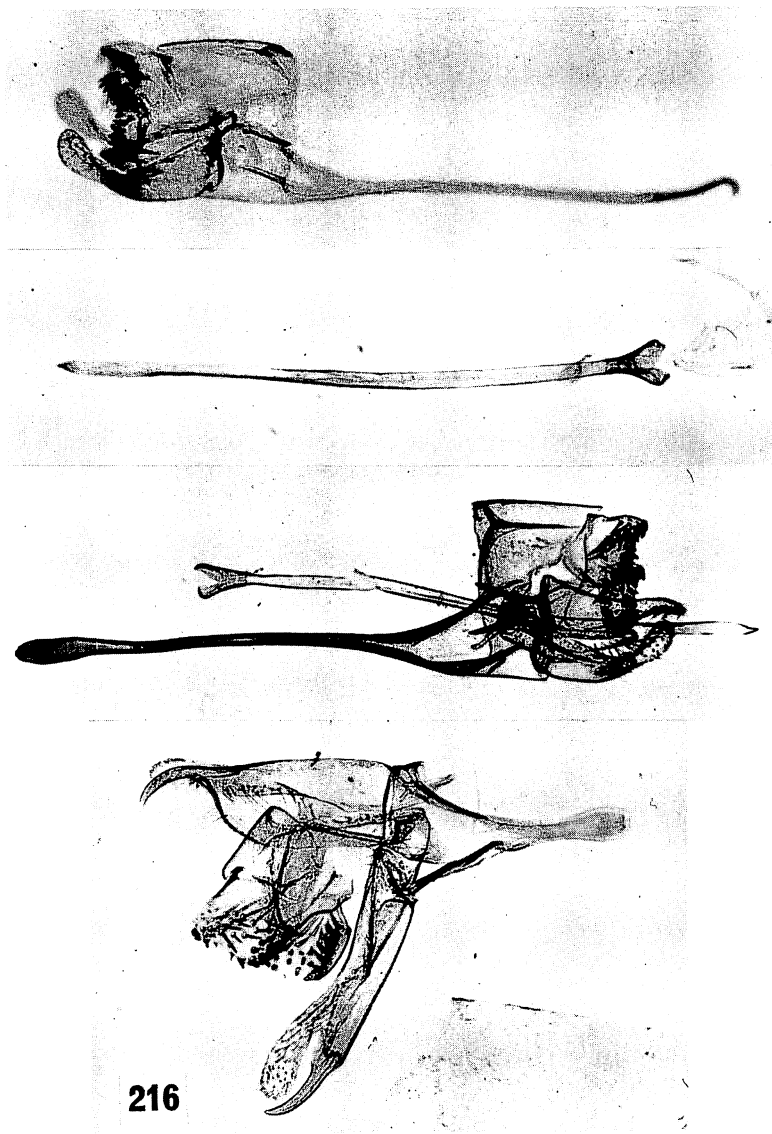


Figure 216—Male genitalia of *Opogona*. The top two figures are of the holotype of *aurisquamosa* (Butler) from Honolulu (slide BM 1867). The third figure is of another specimen of *aurisquamosa* with aedeagus in situ (BM slide 2041), from Oahu. Bottom, *purpuriella* Swezey, Manoa, Honolulu (Busck slide 160). Note the great difference in the lengths of the saccus in these two species.

This moth is very abundant on the windward side of Hawaii. It is not included in the Fauna Hawaiiensis, which would indicate that it was very rare when Dr. Perkins was collecting and has since become numerous, or else that it is a recent introduction which has now become very numerous. . . .

The larvae are often numerous in dead cane, especially those which are rotting on account of having been badly bored by the cane borer [*Rhabdoscelus obscurus*]; and [in] shoots which have been killed by "iliau," or have died from being smothered or any other cause. . . . their appearance comes after the beginning of decomposition. They may sometimes eat the lower eyes of cane where there is a lot of wet trash at base of cane. They prefer wet situations, and for this reason they have not been observed in the sugar plantations of Oahu. They occur on this island, however, as I have collected the moths at Wahiawa, and found the larvae in rotten logs. On Hawaii, I have found the larvae in the stipes of dead fronds of tree ferns; and the moths came numerously to lights. . . . at Waimea.

The full-grown larva (Plate III, Fig. 5) is about 20 mm. long; of a dirty whitish color; head and cervical shield blackish-brown, [with] large blackish-brown chitinized plates enclosing tubercles of segments 3 and 4 [meso- and metathorax]; tubercles of other segments fuscous with black center at base of hair except those of iiib [SD] series; tubercle ii [D2] directly behind i [D1] so that they form two straight longitudinal lines down the back; iiia [SD2] and iiib [SD1] wide apart, iiib [SD1] just over spiracle, iiia [SD2] farther forward; iv [L1] just behind spiracle and contiguous to it; v [L2] below iiia [SD2]; hairs dark brown; spiracles black; surface of body covered with minute black pubescence.

The cocoon is like *O. aurisquamosa*. The pupa is quite similar, but a little larger and does not have the two conical projections ventrally on the cremaster.

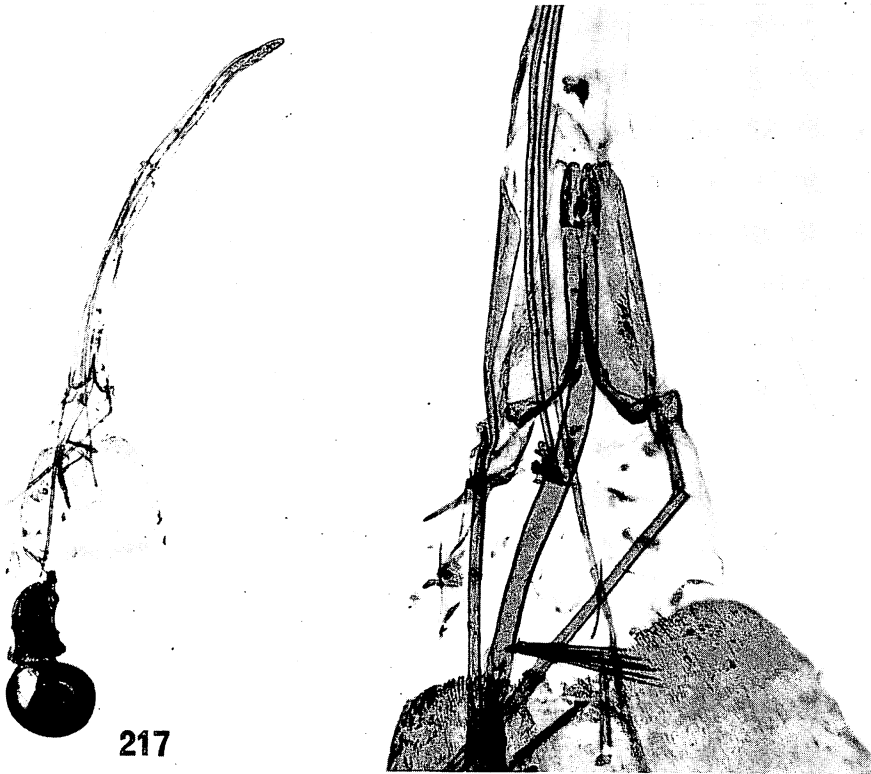


Figure 217—*Opogona aurisquamosa* (Butler), female genitalia; Honolulu (BM slide 8091). The bursa copulatrix was not emptied of its contents, and the contents appear as a black mass in the photograph.



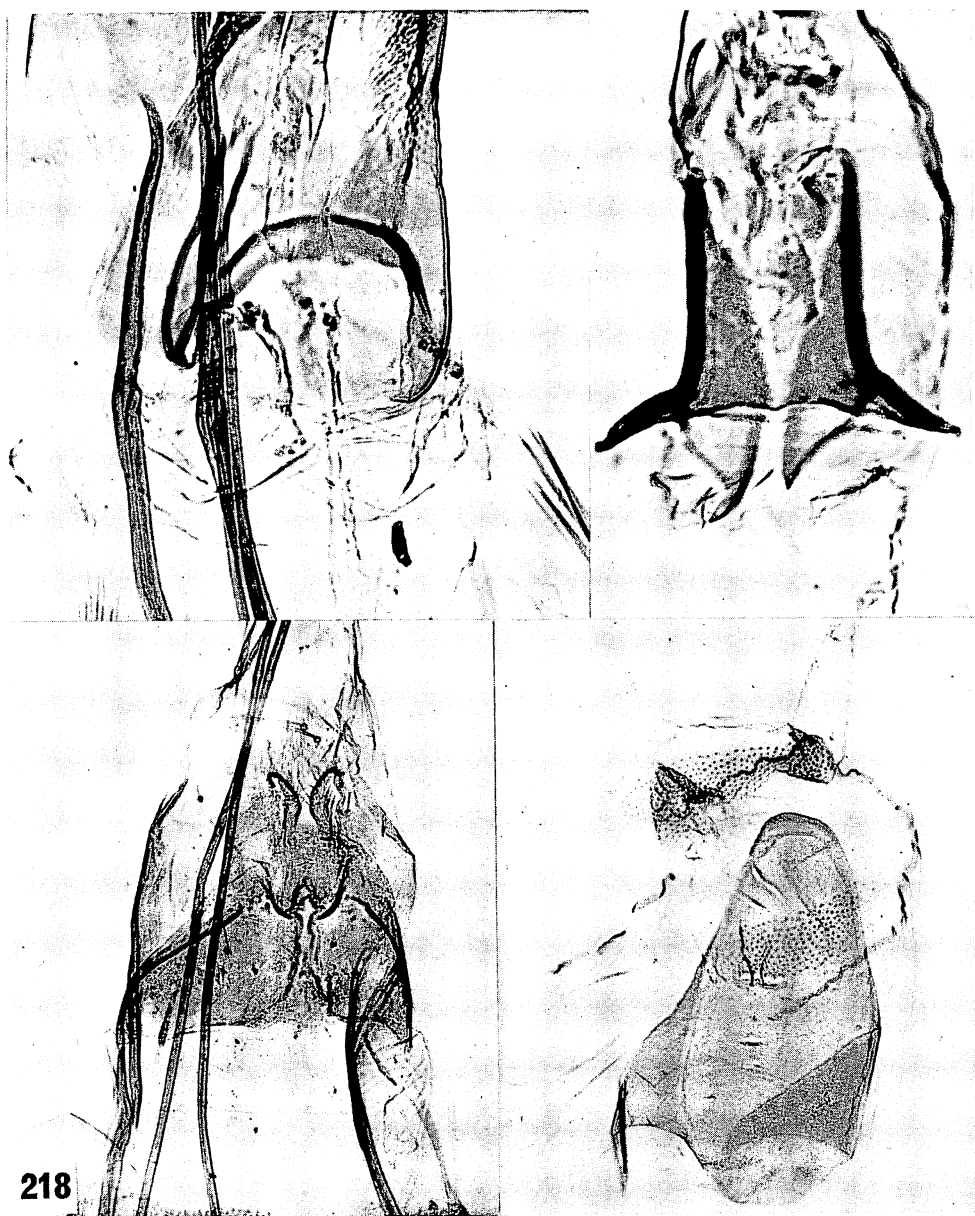


Figure 218—Female genitalia of *Omoscopa*. Top, *purpuriella* Swezey, ostium at left (position reversed) and sclerotized section of ductus bursae at right; Manoa, Honolulu (Busck slide 161, in the Bishop Museum). Bottom, *omoscopa* (Meyrick), ostium at left and signum at right; Kauai (Busck slide 116, in the Bishop Museum).

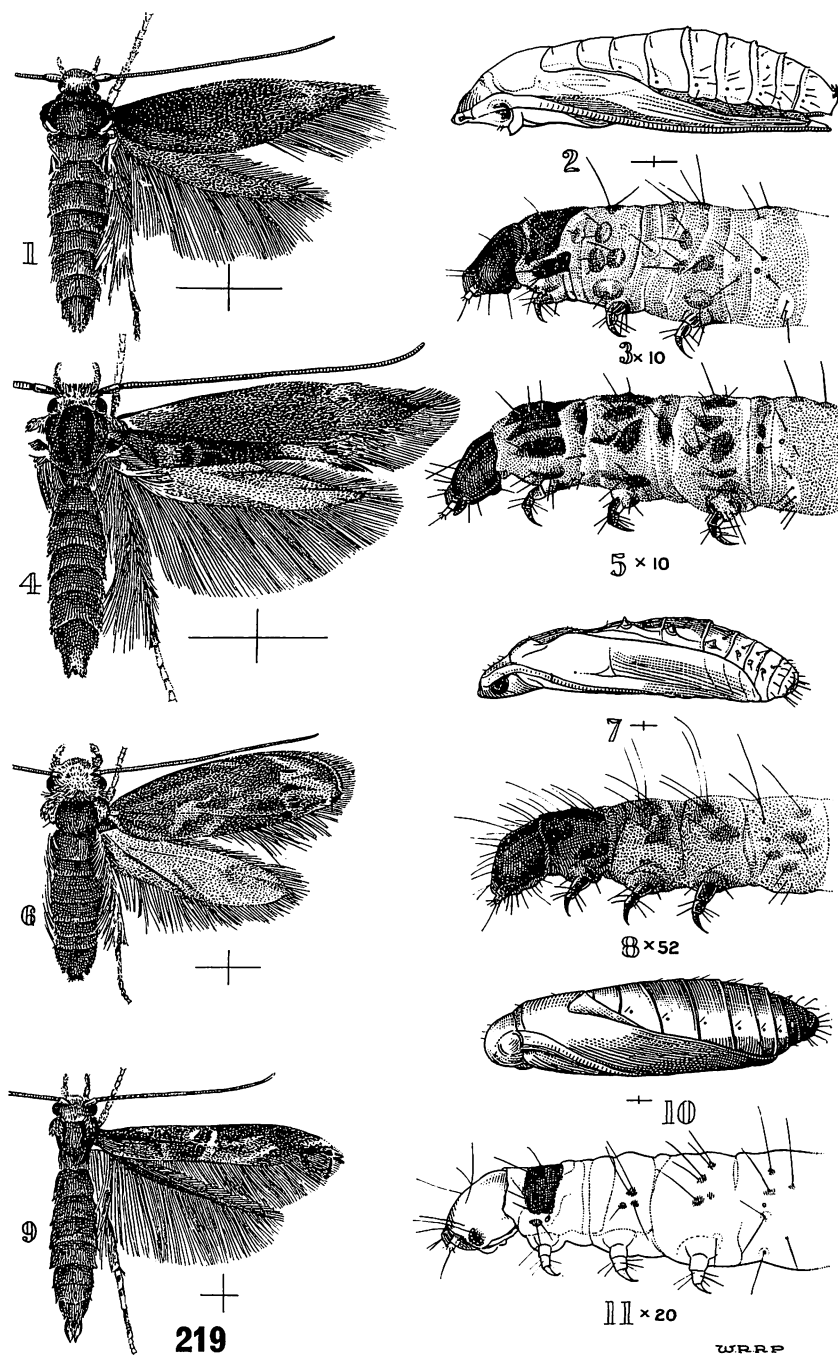


Figure 219—1, *Opogona aurisquamosa* (Butler); 2, pupa of same; 3, anterior part of larva of same. 4, *Opogona omoscopia* (Meyrick); 5, anterior part of larva of same. 6, *Choropleca terpsichorella* (Busck); 7, pupa of same; 8, anterior part of larvae of same. 9, *Anatrachyntis rileyi* (Walsingham); 10, pupa of same; 11, anterior part of larva of same. (After Swezey, 1909.) The larval chaetotaxy may not be accurately illustrated.

I have seen one pupa of *omoscopa*, and it has a subbasal row of thornlike spines on abdominal tergites 4 to 8, but the spines are much reduced on tergite 8. The caudal abdominal segment has a pair of large dorsal horns. The antennae reach the apices of the wings and the wings reach to the apex of the 5th abdominal segment with the hind tarsi very little longer.

K. M. Moore (1959: 346–349, pls. 41–42) has given an account of the species in Australia together with a description of the larva, but there may be some confusion in his material. His illustrations are especially suspect. Moore discusses the species as follows:

oviposition occurs soon after the adults have emerged, and probably extends over some weeks, as larvae of all instars, and pupae, have been collected at the one time from the one feeding-site. The egg, approximately 0.3 mm. in length, is smooth, shiny, and ovoid. It remains translucent and almost white in colour from oviposition to eclosion. Embryonic development is evident about the fifth day, and eclosion occurs from 10 to 12 days after oviposition. The chorion is not consumed by the young larvae, which, before feeding, are transparent and almost colourless. . . .

Pupation occurs in silken cocoons composed of fine webbing and excreta, either in the workings in timber, in stems of weeds, grass, etc., or externally on the surface. Pupation occupies approximately 25 days during June at Lisarow. The cocoons are usually covered with particles chewed from the host plant. The pupal shell is protruded for approximately two-thirds of its length from the cocoon when the adult is emerging.

During the warmer months of the year at Lisarow, the approximate time taken for the life-cycle from oviposition to the emergence of the adult is 10 to 12 weeks but during the colder months the period occupies approximately four months.

**Opogona purpuriella** Swezey (figs. 212, venation; 214, moth; 216, male genitalia; 218, female genitalia; col. pl. 1:4).

*Opogona purpuriella* Swezey, 1913f: 280.

Oahu, Molokai, Hawaii (type locality: Kona).

Immigrant, but source not determined. It may be a synonym of a species described from some other part of the Pacific. It was first found on the island of Hawaii in 1912 and on Oahu in 1921 by Dr. Swezey. It is probably established on most of the high islands. [Klaus Sattler has recently informed me that G. S. Robinson has identified specimens reared by his father from *Cajanus cajan*, *Artocarpus* and *Inocarpus fagiferus* on Tongatapu, Tonga. This appears to be the first record for the species outside of Hawaii.]

Hostplants: The larvae are scavengers and have been reared from dead sugarcane, dead bark of breadfruit (*Artocarpus*) and other decaying vegetable matter, *Plumeria*, *Reynoldsia* and *Sicana odorifera*.

This species "expands to about 10 mm. Its forewings are largely metallic purple and violet with three pale yellowish patches, of which the largest one is on the inner or hind margin [of the forewing] so that when the insect is at rest with the wings closed, this patch is brought alongside the one on the opposing wing and together they form a conspicuous mark in the middle of the back" (F. X. Williams, 1931: 157).

There are two specimens on the mount labeled "type" by Swezey. I hereby designate the specimen illustrated in my figure 214 as lectotype and the second specimen as paralectotype.

## Superfamily **TORTRICOIDEA** (Latreille)

*Tortricoidea*: Mosher, 1916:28, 31, 51. Forbes, 1923:38, 375.

### Family **TORTRICIDAE** (Latreille)

*Tortrices* Linnaeus, 1758:530, as a division of *Phalaena*.

*Tortrices* Latreille, 1802:415 Guenée, 1845*a*:135. (Emended: International Commission on Zoological Nomenclature, Opinion 450, 1957).

*Tortricida*: Leach, 1815:133.

*Tortricides*: Billberg, 1820:90. Herrich-Schäffer, 1843(1843–1856):14.

*Tortricidae*: Stephens, 1829:168.

*Tortricites*: Newman, 1835:179.

*Tortricina*: Gravenhorst, 1843:167.

*Tortricidi*: Guenée, 1845*a*:136; 1846:2.

*Platyomidae* Duponchel, 1834:5.

*Sciaphilidi* Guenée, 1845:29.

*Apheidi* Guenée, 1845:67.

*Exapatidae* Stainton, 1845:10, 11.

*Plicatae* Stainton, 1858:188.

*Tortricodidae*: Stainton, 1859*c*:277.

*Tortriocoidae*: Spuler, 1898*a*:30.

Bentinck and Diakonoff, 1968. Bradley, 1959. Busck, 1907. Common, 1958*a*, 1965. Diakonoff, 1939, 1950, 1952*b*, 1953, 1954*a*, 1961. Dugdale, 1966. Fernald, 1882, 1908. Freeman, 1958. Hannemann, 1961. Heinrich, 1917, 1923, 1926. Kennel, 1908–1916. Meyrick, many titles. Obraztsov, many titles. Powell, 1964. Razowski, 1967. Stephens, 1852.

The taxonomy of the Hawaiian tortricids has been in a state of almost complete confusion, and a similar situation applies to many of the faunas of the world. The classification of the Tortricoidea has been one of mostly “inflated” categories which is out of step with the taxonomy of other orders. The task of revising even the small Hawaiian fauna has been most difficult, and the presentation advanced here is a tentative one. An extraordinary divergence of opinion exists among workers concerning even such fundamental questions as the number of families, subfamilies or tribes included in the Tortricoidea. I have found much of the literature to be confusing, contradictory, or useless for the purposes of this text. Fortunately, however, there has been an increase in interest in the tortricoids in recent years, some workers have made enlightened contributions, and there is now good reason to hope that much of the chaos existing in the classification of the group will be eliminated. Obraztsov, Diakonoff, Common, Dugdale, and Freeman have been the leaders in the new classification, and readers are referred to the writings of those authors for additional information. Powell has made an excellent beginning of the study of western North American species. Margaret MacKay has made worthy contributions to a general knowledge of the family in her well-illustrated studies of the larvae of many American species. Swatschek has published on the European larvae.

The separation of the Tortricidae into suprageneric categories is a difficult task when one must attempt to fit a particular fauna such as that of Hawaii into published schemes of classification based upon the faunas of other regions. Surely, the taxonomy in most texts is untenable. Some characters which may appear to be of value in separating possible subfamilies in one limited faunal region prove worthless elsewhere. Some authors use the family names Eucosmidae, Olethreutidae, Cnephasidae, Sparganothidae, Schoenotenidae, and others, without being able adequately to define them as families in the sense that families are used in other orders of insects. Until more detailed and comprehensive studies of the Tortricidae of the world have been made, the subdivision of the family will remain unsatisfactory.

Heinrich was a strong advocate of maintaining the Olethreutinae as a family distinct from the Tortricidae, and he had the following to say (1923:8-9):

The family Olethreutidae is sharply distinguished from the Tortricidae on genitalia, which alone enable clear and exclusive definition of the two families, and on genitalia the Olethreutidae are distinctly in advance of the Tortricidae. The genitalia of the Olethreutidae with the peculiar fusing of the upper margin of sacculus [sic] to the costal edge of the harpe [valva] leaving a restricted opening toward the base of the harpe, the narrowed articulating base of the harpe, articulating against the juxta of the anellus and connecting with the tegumen only by the costal hook, or (as in *Rhyacionia*) by a thin membrane from the place usually occupied by the hook, rather than the primitive articulation along the lateral margin of vinculum, as well as the loss of transtilla and the progressive reduction and elimination of many fundamental structures all indicate a specialized and advanced type. From this no generalized type could have developed, and in every way the Tortricid genitalia are distinctly the more generalized type. The genitalia of the Olethreutidae are unique and like those of no other group in the Lepidoptera. Indeed it is hard to see just where the connection is made between the two families, so complete is the break. At any rate, it is far back, and one thing is certain, the Tortricidae could have developed from no group with the genitalic development of the present Olethreutidae. Exactly reversing Meyrick's order I would derive the Olethreutidae from the Tortricid stem, interpreting the Laspeyresiinae as their most advanced development. The Olethreutidae as a whole are a newer more plastic group, with structural characters unsettled, generic limits poorly defined, and many species in process of change. From it no other family has yet developed.

Clarke, a fellow worker and disciple of Heinrich, and a firm believer in maintaining the olethreutids as a family distinct from the Tortricidae, said in his introductory volume to his series on Meyrick's Microlepidoptera (1955:25-26) that

the family TORTRICIDAE characteristically possesses vein 1C of the forewing, no cubital pecten on the hindwing, symmetrical male genitalia with broadly attached harpe [valva] and moderate to slender aedeagus and a subtriangular, somewhat folded, anellus. The signum, when present, consists of a single stellate plate, a sclerotised band or a single thorn with a large bulbous base. . . .

Among the five Tortricoid families the OLETHREUTIDAE are the most closely related to the TORTRICIDAE. The genitalia of this family, however, serve to distinguish any member from any species of Tortricid. In fact, there are no genitalia in the Lepidoptera that can be easily confused with those of the OLETHREUTIDAE. The peculiar anellus with the aedeagus strongly fused to it is unique and is diagnostic of the family. The female of any Olethreutid may be distinguished from any Tortricid, or from species of other families of this complex, by the signum, which consists of a single or double thorn *without* large bulbous base, or a pair of small dentate cones. Exceptions to this [there] are . . . , but other characters leave no doubt as to their family position.

Although the features mentioned may serve to distinguish *most* species, they do not characterize *families*, and there is no reason to use them to inflate the tortricoid taxonomy.

Heinrich, in his revision of the North American Laspeyresiinae and Olethreutinae (1926:79), demonstrated some of the exceptions and noted the confusion when he said: "On several characters . . . *Episimus* would go as well

in the Eucosminae as in the Olethreutinae." And he also said (1923:12) of the American *Pseudogalleria*, a relative of *Cryptophlebia*, "On genitalic [genital] structure this genus would go into the Laspeyresiinae. Its hind wing venation, however, is typically Eucosmid and it will have to go here as the highest development of the Eucosminae, linking that subfamily and the Laspeyresiinae." In writing about the separation of the olethreutids into "subfamilies", Heinrich (1926:5) said that "in female genitalia there are no definitive subfamily characters. . . . There is a certain habitus that tells one experienced with the genitalia of the group whether a specimen belongs to one subfamily or another; but it does not seem possible to express this in any satisfactory description." Does something which cannot adequately be described exist as a family?

Margaret MacKay, in her detailed study of the larvae of the North American "Olethreutidae" (1959:5), said: "One hundred species or more in the other families of the Tortricoidea were cursorily examined, but no characters were found that would define the Olethreutidae." Edna Mosher, in her monograph on lepidopterous pupae (1916:51) said: "It was impossible to group the pupae of this superfamily according to any of the schemes of classification now in use. The four groups into which the Tortricoidea discussed in the following pages have been divided are designated as Epiblemidae, Olethreutidae, Tortricidae, and Sparganothidae. These names, however, are without any significance whatever as far as previous classifications are concerned, and are merely used as a matter of convenience."

What is the unfortunate student to do when confronted by such conflicting opinions and confusing problems? One can hardly escape the conclusion that the groups in question cannot be considered to be separate families. Moreover, to separate them as families results in deemphasizing their close interrelationship and evolutionary history. No useful purpose is gained by continuing to maintain the olethreutids as a family distinct from the tortricids.

The cell of the forewing of some tortricids contains an accessory cell at the costal-distal corner of the main cell which is formed by the development of the vein called the *chorda* (Turner, 1918:155; 1947:310) which extends from the radial sector to the apex of the cell (see figure 18). An examination of only a select few species might lead to the incorrect conclusion that considerable reliance may be placed on this character to separate genera. The character, however, is variable. In the Hawaiian Tortricinae, the chorda is absent on *Croesia*, *Spheterista*, *Epiphyas*, *Bradleyella*, and *Amorbia*; it varies from being very faintly indicated in *Paraphasis* to feebly developed in *Panaphelix* and *Mantua*; and it may be feeble or absent in *Pararrhaptica*. In none of the Hawaiian Tortricinae which I have examined is it very strongly developed. In contrast, most Hawaiian Olethreutinae have it strongly formed, although it is absent from *Eccoctocera*, *Epinotia*, and *Episimus*. The remaining genera, *Bactra*, *Cryptophlebia*, *Macraesthetica*, *Cydia*, *Strepsicrates*, and *Crociosema*, have it fully developed.

A number of years ago I discovered a character—one that apparently has been overlooked heretofore—which has proven to be of value in the identification of the Tortricidae. The squamae on the lower part of the face on the

Tortricidae are directed dorsad, whereas they are directed ventrad (toward the base of the proboscis) on most other Microlepidoptera. It is particularly significant that many of the Cossidae, as well as some genera of Tineidae, have a similar arrangement. This lends support to the placement of the Tortricidae near those families. I have used this character to advantage when sorting some rather confusing specimens, and other workers may find it of value.

The separation of the genera of the tortricids is difficult if genital characters are not used. The long-used features of palpi, wing venation, legs, and tufts of hair are often confusing and unreliable. Great variation in wing venation is often found between species of the same genus. "Odd" individuals may have atypical venation; for example, the venation of the left and right wings of the same individual often may differ. Specimens of some species vary in characters which one might reasonably expect to be constant for the genera to which they belong.

A new system of classification is needed for the tortricids, and characters of the body sclerites, in addition to wing venation, genitalia, and hair tufts, eventually may come into general use. Why should lepidopterists overlook the fact that beneath the obscuring scales of the head and thorax are many features of taxonomic importance?

Although Hawaii has a rich tortricid fauna, the species are not usually found in abundance in the forest. The scarcity of individuals is not a recent phenomenon, and Perkins remarked upon this (1896:192) as follows: "*Tortrices* were very scarce [on Haleakala, Maui, in May, 1896], as they are throughout the whole group [of islands]; probably they are kept down by the large number of endemic *Odyneri*, which seem to prefer their larvae to those of other moths for provisioning their cells. A species of *Proteopteryx* [not this genus; probably *Eccoptocera*], well known to me on other Islands, was amongst the Ohia trees, one or two other species of probably undescribed genera turning up singly. A few specimens of *Bactra* sp.? flew gently around at sunset."

### VARIABILITY AMONG THE HAWAIIAN TORTRICIDAE

Many of our tortricids display a bewildering variability in color and pattern. It is possible that several of the names listed below represent color forms and are, therefore, synonyms. It is probable that the type series of some are mixtures of species; it is also probable that the sexes of various species are not correctly associated. Swezey (1908c:16) called attention to "the great variability among the Tortricids of the Hawaiian Islands. . . ." He demonstrated the correctness of his conclusions regarding the variability of some species by rearing the moths. He noted that "this variability has led to some confusion by Lord Walsingham in his recently published 'Microlepidoptera' (Fauna Hawaiiensis, I, Pt. V). He has apparently often made varieties of some of these variations. Each species and variety is figured; hence, it should be easy to identify any Hawaiian 'Micro'; but on account of such great variation in so many species, one may often not have a specimen of any certain species, which agrees with the particular specimen figured by Lord Walsingham. This makes it very difficult to identify specimens with any certainty, altho from a first glance at the excellent colored plates, it would appear an easy matter."

My text suffers greatly, because, with few exceptions, series of specimens have not been reared for study. It is, therefore, impossible to comment upon range of variation, or, in many species, to be sure that the sexes before us are correctly associated. Several years' work in the Hawaiian forests will be necessary before even a moderately comprehensive text on the Tortricidae can be written. I have been denied the opportunity for such work.

## HABITS OF THE LARVAE OF THE TORTRICIDAE IN HAWAII

Tortricids are commonly called "leaf-rollers", but the larvae of many species do not roll leaves. Some are stem-, twig-, or shoot-borers, others are seed-eaters; some are flower-head eaters; others eat berries or fruits; and many tie leaves together or form extensive webbing on their hosts, especially during their later instars. I have used the broad term "leaf-tier" instead of "leaf-roller", because it more accurately describes the habit of many species and includes those which do roll leaves.

In the total Hawaiian tortricid fauna (that is, both endemic and introduced species), there are species whose larvae bore in the stems of sedges, some which web the leaves of a native lily, some which web the leaves of orchids, some which bore in stems, twigs, or shoots of various dicotyledons, some which feed on the seeds of various dicotyledons, other which feed on buds or flower heads and many which are leaf-tiers on a wide range of many genera in many families of dicotyledons. None are known to attack any grass or fern. With the exception of the endemic *Panaphelix* which is a leaf-tier on an endemic lily, all of the endemic Hawaiian Tortricidae are confined exclusively to dicotyledons. Many genera of native plants are attacked by them.

The following are the genera of Tortricidae found in Hawaii together with their larval habit and hostplant genera:

### TORTRICINAE

*Amorbia*: leaf-tiers on many genera of plants, including orchids.

*Bradleyella*: leaf-tiers on *Lysimachia*, *Perrottetia*, *Phyllanthus*, *Xylosma*.

*Croesia*: leaf-tier on *Rubus*.

*Epiphyas*: leaf-tier on many genera of plants.

*Panaphelix*: leaf-tier on *Astelia*.

*Paraphasis*: unknown.

*Pararrhaptica*: shoot-borer, leaf-tier on *Myrsine*.

*Spheterista*: leaf-tiers, twig tip-borers, bud-eaters on *Cassia*, *Cheirodendron*,

*Pipturus*, *Pterotropia*, *Reynoldsia*, *Santalum*, *Tetraplasandra*, *Urera*.

*Mantua*: leaf-tier on *Xylosma*.

### OLETHREUTINAE

*Bactra*: sedge stem-borers.

*Crociosema*: flower buds, fruits, and seeds of various Malvaceae.

*Cryptophlebia*: seed-eaters on many hosts.

*Eccoptocera*: leaf-tiers on *Cheirodendron*, *Metrosideros*, *Osteomeles*, *Psidium* (guava), *Syzygium*.



*Epinotia*: stem-borers and twig-borers, and are found in the pods and flower heads of *Bignonia*, *Lantana*, *Litchi*, *Tecoma*.

*Episimus*: leaf-tier on *Schinus*.

*Cydia*: twig-borers, and stem-borers, and seed-eaters on *Acacia*, *Canavalia*, *Sophora*, *Strongylodon*.

*Macraesthetica*: unknown.

*Strepsicrates*: leaf-tier on *Myrica*.

In the Hawaiian fauna, only the Carposinidae and Tortricidae of the old, untenable concept of the "Tortricodea" are represented, and they can easily be separated as follows:

1. Hindwings with only four veins from cell, thus the hindwings have only six veins; forewing with vein 2 leaving cell close to apex, distad of three-fourths the length of the posterior margin of cell, as in figure 537; ocelli absent; chaetosemata absent; forewings characteristically with patches or strong clusters of raised or erected scales; squamae on the lower part of the face directed *ventrad* . . . . . **Carposinidae.**
2. Hindwings with five or six veins from cell, thus with a total of seven or eight veins; forewings with vein 2 leaving cell far before apex and much more basad than the apical three-fourths of the length of the posterior margin of the cell, as in figure 221; ocelli present in all genera in Hawaii except *Amorbia*; chaetosemata present; squamae on the lower part of the face directed *dorsad* . . . . . **Tortricidae.**

The genitalia of the carposinids differ greatly from the genitalia of the tortricids, as the illustrations will demonstrate. As discussed elsewhere, the two groups belong to different superfamilies. They cannot be associated as they were for many years and as some workers continue to associate them.

#### KEY TO THE SUBFAMILIES OF TORTRICIDAE IN HAWAII

1. Ocelli absent (in Hawaiian species); abdomen with a conspicuous, single, median, dorsal pit near base . . . . . *Amorbia* in the **Tortricinae.**
- Ocelli present; abdomen either without such a single pit or with a pair of pits on tergites 2 and 3 . . . . . 2
2. Dorsal surface of hindwing with a line of very long, specialized hairs, or a dense row, or a large, conspicuous, elongate mass of such hairs ("cubital pecten") definitely along the basal part (cubitus) of the posterior margin of cell (be very careful not to confuse hairs elsewhere than actually on the cell margin); or, if such a pecten is absent, then there are many long, conspicuous

hairs over most of the area between vein 1a and the inner (basal) margin of the wing, and there may be a line of such hairs along the basal parts of vein 1a, but there is not a consolidated, isolated tuft of hair only at the origin of vein 1 (do not confuse the often rather similar tuft of hair usually evident in the axil between the wing base and thorax), and/or metanotum (metascutum) on either side of metascutellum mostly clothed with scales or rather broad, scalelike, flattened hairs, but not fine hairs only . . . . . **Olethreutinae.**

Hindwing without such vestiture along posterior margin of cell basad and without long hairs over most of the area between vein 1a and inner (basal) wing margin, but usually with a well-developed, consolidated hair tuft at the origin of vein 1 (in addition to the rather similar tuft of hair which is usually conspicuous in the axil between wing base and thorax), and this hair tuft is definitely not on the posterior margin of the cell (cubitus) but is near the origin of vein 1; metanotum (metascutum) on each side of metascutellum with a patch of long, fine hairs or long and very narrow hair scales (but not squamose) in all Hawaiian genera except the anomalous *Paraphasis* . . . . . **Tortricinae.**

### NOTES ON THE KEY

For convenience, I have separated first the common, introduced pest *Amorbia*, because it is the only member of the Tortricidae in Hawaii which lacks ocelli, and, being one of the commonest tortricids encountered in Hawaii, it must often be identified.

The character of the cubital pecten, or hair tuft, and the hairs on the hindwing of some species may be confusing to the student, especially if the specimen being examined is abraded or in poor condition. The character of the vestiture of the caudal parts of the metanotum adjacent to each side of the metascutellum is usually quite distinctive and easily recognized once the differences are appreciated. Unfortunately, one anomalous genus (*Paraphasis*), which otherwise appears to belong in the Tortricinae, has this character developed more as in our Olethreutinae. The undersides of the hindwings provide another character which may usually easily be seen; they are either conspicuously and extensively dark-maculate, or they are immaculate or nearly immaculate. The undersides of the hindwings of most Hawaiian Olethreutinae are plain and not spotted, but, unfortunately, the wings of *Cryptophlebia* are strongly spotted and the undersides of the hindwings of *Crociosema* have some spots along the anterior parts (these genera belong to the Olethreutinae). Moreover, *Paraphasis*, a confusing genus of uncertain status, and *Bradleyella*, obviously a member of the Tortricinae, lack the spotting which is so character-

istic of other Hawaiian Tortricinae. These unfortunate exceptions add to the confusion and compound the work of determination.

Briefly restated, using characters which are often more easy to distinguish than the pectens or hairy vestiture of the hindwing, we may note that all species which have the vestiture of the metanotum at each side of the metascutellum consisting mostly of scales or flat or rather broad hair scales and not fine hairs (except laterad on some species) belong to the Olethreutinae with the exception of the anomalous *Paraphasis* (whose wing venation is unusual and the antennae of the male are strongly bipectinate). Also, the undersides of the hindwings of all of the Hawaiian Olethreutinae are immaculate or nearly so, with the exception of *Crocidosema* (which has some spots along the anterior part of the wing), *Cryptophlebia* (which has strongly maculate wings—as conspicuously maculate as some of the more pronounced maculation found in our Tortricinae), and *Cydia* which has some feeble marginal maculation. In Hawaiian Tortricinae, the vestiture on the metanotum on each side of the metascutellum of all genera consists of long fine hairs, or very fine hair scales which contrast sharply with the squamae of the metascutellum; the only exception to this is the anomalous *Paraphasis* which has broad and elongate-scale-like hairs. Also, Hawaiian Tortricinae all have the undersides of the hindwings strongly maculate on the discs and overall, with the exception of *Paraphasis* and *Amorbia*, which have immaculate hindwings, and *Bradleyella*, which has immaculate or mostly immaculate hindwings. Once these characters are learned by experience, the entomologist will find that they assist materially in identifying many Hawaiian specimens.

The males of many, but not all of the species of *Cydia* (Olethreutinae) have a peculiar elongate “pocket” behind vein 2 or along vein 1c in the hindwing which extends beneath the wing as a flaplike structure. No other moths in Hawaii have such a feature. The males of *Cryptophlebia* have a strongly developed “sex patch” of modified squamae beneath veins 1a and 1b of the hindwing, but it is very different from the structure in *Cydia*. The males of *Eccoptocera*, *Strepsicrates*, and *Epinotia* of the Olethreutinae have strong costal folds or flaps on the forewings. Similar strong costal folds are found in the Tortricinae in the males of *Epiphyas* and some, but not all, species of *Spheterista*. The antennae of the males of *Eccoptocera* and *Strepsicrates* (both Olethreutinae) have a so-called “notch” on the dorsal surface near the base. The males of *Panaphelix* and *Paraphasis* (Tortricinae) have strongly bipectinate antennae, and the males of *Mantua* have long hairs beneath.

### Subfamily **TORTRICINAE** (Latreille) Fernald

*Tortricidi*: Guenée, 1845a:136.

*Tortricidae*: Meyrick, 1881b:413.

*Tortricinae*: Fernald, 1882:1. Walsingham, 1895:496; 1897a:59; 1897b:131. Spuler, 1898a:30.

Diakonoff, 1953–6, key to New Guinea genera.

Most of the Hawaiian species of Tortricinae are variable or highly variable; some are sexually dimorphic, some are dichromatic, and some have many

color forms. This often leads to confusion and compounds the task of description and identification. It is possible that the sexes under several of the names are not correctly associated. This text reflects the confusion, and I regret that circumstances beyond my control prevent me from elucidating the problems.

## KEY TO THE GENERA OF TORTRICINAE IN HAWAII

1. Ocelli absent ..... **Amorbia.**  
     Ocelli present ..... 2
- 2(1). Forewing with vein 7 running to costa, not to termen,  
         thus six veins end on costa, figure 221; forewings  
         with small patches of raised scales (one introduced  
         species whose larvae feed on blackberry) . . . . **Croesia.**  
     Forewing with vein 7 running to termen and not to  
     costa, thus with only five veins ending on costa;  
     forewings without raised scale patches ..... 3
- 3(2). Forewing with veins 7 and 8 fused for a distance  
         beyond cell, then forked, as in figures 225–231 . . . .  
         . . . . . **Spheterista.**  
     Forewing with veins 7 and 8 free from origins or  
     connate, not stalked ..... 4
- 4(3). Venation of forewings and hindwings unusual, as in  
         figure 300; forewing with vein 2 ending on posterior  
         margin (“dorsum”) of wing instead of on termen  
         as is normal; hindwing with vein 5 widely separated  
         from 4 at origin and 6 widely separated from 7 at  
         origin; antennae of male strongly bipectinate, as in  
         figure 220 . . . . . **Paraphasis.**  
     Venation very different ..... 5
- 5(4). Second (subterminal) segment of labial palpus  
         moderately to strongly and rather evenly expanded  
         distad above and below to produce a characteristic  
         shape, as in figure 310; undersides of hindwings not  
         spotted or, at most, weakly maculate . . . **Bradleyella.**  
     Second segment of labial palpus not expanded  
     beneath in such a design, most of the expansion  
     is on the dorsal side; undersides of hindwings  
     strongly maculate ..... 6
- 6(5). Labial palpus with terminal segment distinctly and  
         fully separated from the subterminal segment, as  
         in figures 302, 307, or even more isolated, and  
         ventral margin of penultimate segment with scales  
         mostly closely appressed; large species, 28 to 37 mm  
         in expanse ..... 7

- Terminal segment of labial palpus more definitely enclosed or basally concealed by the rougher scaling of the subterminal segment, and scaling more expanded or suberect dorsad and ventrad, as in figures 268, 273 . . . . . 10
- 7(6). Males . . . . . 8  
Females . . . . . 9
- 8(7). Antennae strongly bipectinate, figure 220 . . **Panaphelix.**  
Antennae long-hairy, but not bipectinae . . . . **Mantua.**
- 9(7). Scales on mesonotum and tegulae mostly multi-dentate at apices; inner terminal spur on hind tibia only slightly longer than outer spur . . . **Panaphelix.**  
Scales on mesonotum and tegulae mostly rounded at apices and not dentate; inner terminal spur on hind tibia about one-third longer than outer spur . . . . . **Mantua.**
- 10(6). Forewing with vein 10 much nearer to 9 than to 11, as in figure 273 . . . . . **Pararrhaptica.**  
Forewing with the origin of vein 10 about halfway between 9 and 11, as in figure 268 . . . . . **Epiphyas.**

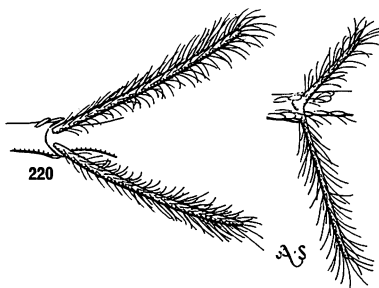


Figure 220—Ventral aspects of bipectinate male antennal segments of two species of Tortricidae. Left, a segment just basad of the middle of the right antenna of the holotype of *Panaphelix marmorata* Walsingham. Right, the third segment beyond the scape of the left antenna of the type of *Paraphasis perkinsi* Walsingham. The fine hairs on the shafts of the segments are not shown.

### Genus **CROESIA** Hübner

*Croesia* Hübner, 1825 (1816–1826):392. Type-species: *Phalaena Tortrix Bergmanniana* Linnaeus, 1758:531.

This is a rather poorly known assemblage of a few species recorded from Eurasia and America. A Mexican species has been introduced purposely to Hawaii for use as a biological control agent against pest blackberry. Because of misidentification, it was recorded erroneously as a species of *Aptotoforma* (wrongly also as “*Aptotorma*”) in Hawaiian literature. When I finally saw

specimens of the moth, I examined the wing venation and genitalia and realized immediately that an error in generic assignment had been made. I then called for assistance from J. D. Bradley who placed the moth in *Croesia*. Because the species appears to be undescribed, I have asked my friend J. F. Gates Clarke (who has had long experience with the American fauna) to supply a description, and this he has kindly done. I have taken the liberty of altering parts of his text to make it conform more closely to the style of this book, and the material contributed by him is enclosed in quotation marks.

***Croesia zimmermani* Clarke, new species** (figs. 221, wing venation; 222, moth; 223, male, female genitalia; 224, pupa).

“Alar expanse 11–14 mm. Labial palpus cinnamon buff; second segment anteriorly and third segment slightly infuscated. Antenna fuscous; scape cinnamon buff with a sayal brown spot dorsally. Head cinnamon buff. Thorax sayal brown with sparse fuscous irroration. Forewing ground color sayal brown with variable leaden markings; from basal third of costa an outwardly curved transverse leaden fascia; on inner edge of fascia, at fold, a small group of raised blackish scales; from middle of costa a leaden, transverse fascia splits into two narrow fasciae which terminate at tornus; origins of fascia, on costa, sometimes strongly overlaid with buff scales; terminal area spotted with leaden scales; at middle of wing a transverse series of three small groups of

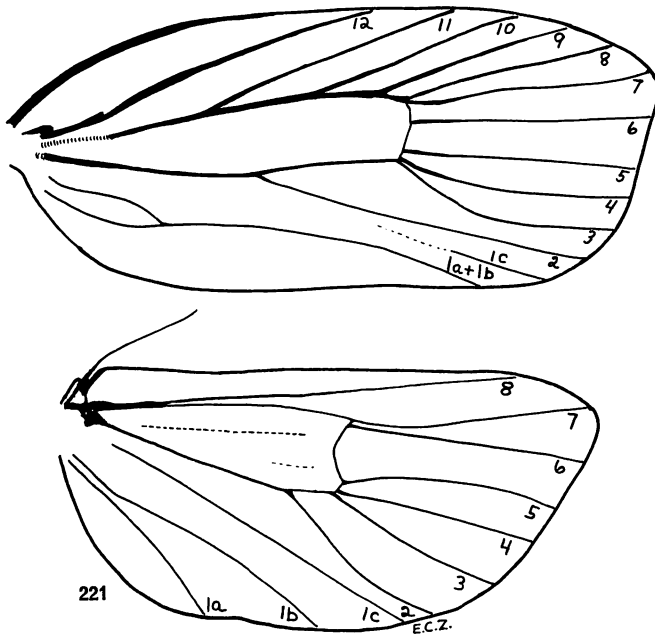


Figure 221—*Croesia zimmermani* Clarke. Wing venation of a specimen reared in Honolulu.

raised blackish scales edged with buff. Cilia cinamon buff with leaden basal line from apex to about vein 3, then leaden colored around termen to tornus. Hindwing greyish fuscous; cilia grey, somewhat paler at extremities. Legs cinnamon buff to buff shaded with fuscous on outer sides. Abdomen fuscous dorsally, buff ventrally.

"Male genitalia (slides JFGC 11899, 11923, 11925, in the U.S. National Museum) with the valva broad basally; ventral edge deeply excavated, bluntly terminated in a setose area; cucullus small, broadly digitate. Gnathus basally a rectangular plate, giving rise to a long, sharply pointed median process. Uncus obsolete. Vinculum a narrow band. Tegumen broad, arched. Anellus a small sclerotized plate. Aedeagus curved, moderately slender, narrowed before apex, terminating in a curved point.

"Female genitalia (slides JFGC 11900, 11924, in the U.S. National Museum) with ostium very broad, ventral edge convex. Antrum broad, sclerotized. Inception of ductus seminalis at junction of ductus bursae and bursa copulatrix. Ductus bursae membranous anterior to antrum. Bursa copulatrix membranous. Signum absent. Lamella postvaginalis a setose band.

"Holotype male (U.S. National Museum 70108), one male and two female paratypes reared in Honolulu (September 1968), and three male and five female paratypes from Volcano House, island of Hawaii (August 1968; E. Yoshioka, collector).

"This species appears to resemble most closely *bergmanniana*, but it is easily distinguished by its darker color. It pleases me to name it for Elwood C. Zimmerman, my friend and colleague, who has contributed so much to the



Figure 222—*Croesia zimmermani* Clarke, from an Hawaiian reared specimen. The wing expanse of this species is about 11 to 14 mm. Do not confuse the several abraded areas on the wings for pale maculae. USNM photograph.)

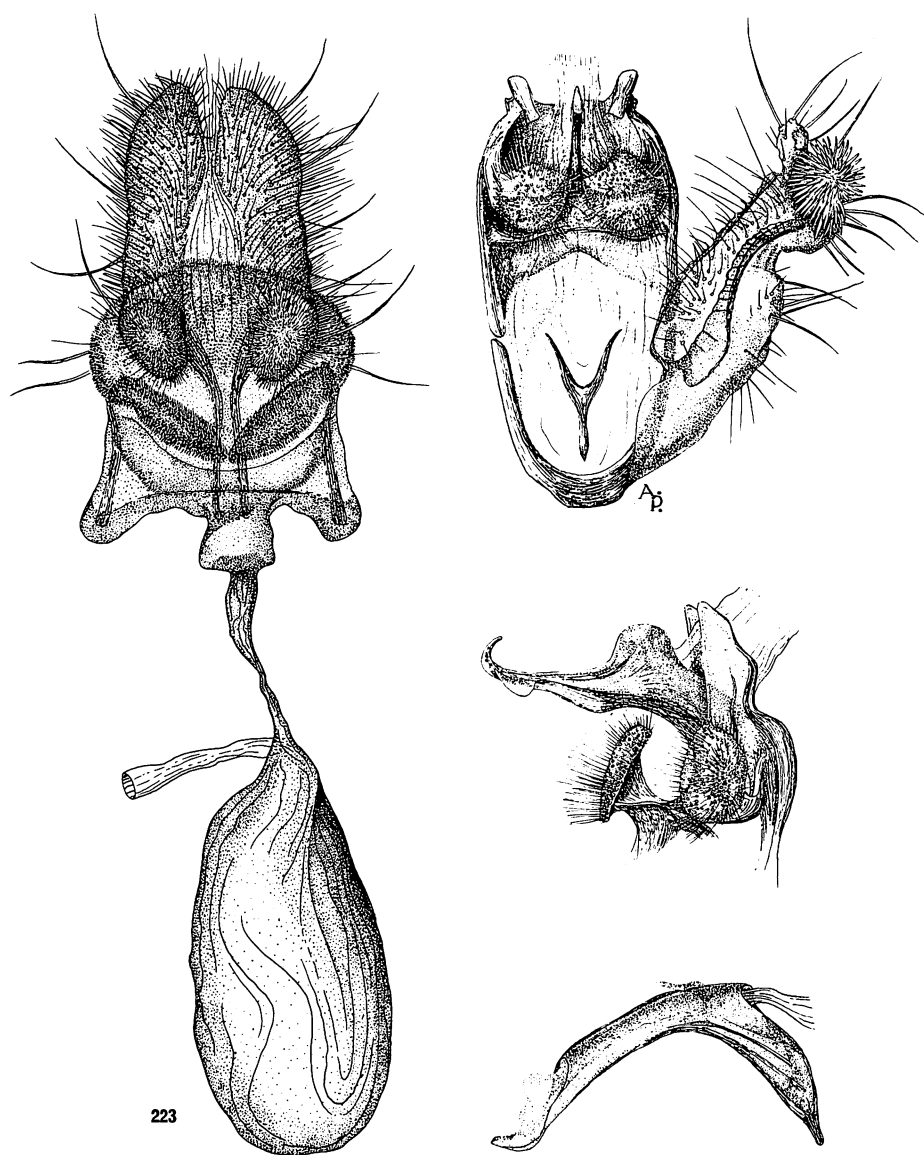


Figure 223—Male and female genitalia of *Croesia zimmermani* Clarke. Middle right, lateral aspect of the dorsal part of the tegumen with the socii and gnathus. Aedeagus at bottom right.



knowledge of Hawaiian entomology.

"The drawings of the genitalia were made by André del Campo Pizzini, and the photograph [figure 222] is by Victor Krantz."

Kauai, Maui, Hawaii.

Introduced purposely from Jalapa, Veracruz, Mexico by the Hawaiian Department of Agriculture for the control of blackberry (collected by N. L. H. Krauss).

Hostplant: *Rubus* (introduced blackberry).

The moth was first released in Hawaii at Olinda, Maui, in August 1964; at Kokee, Kauai, in July 1965; and at Kahuku Ranch on the island of Hawaii in August 1966. It became established quickly and dispersed rapidly.

### Genus **SPHETERISTA** Meyrick

*Spheterista* Meyrick, 1912 (1912–1916):2; 1913b:15. Type-species: *Capua variabilis* Walsingham, by original designation.

This supposedly endemic genus resembles such genera as *Dichelopa* Lower, 1901, *Clepsis* Guenée, 1845a, and *Adoxophyes* Meyrick, 1881c, but it appears to me, at this writing, that it is very close to the Old World *Epagoge* Hübner,

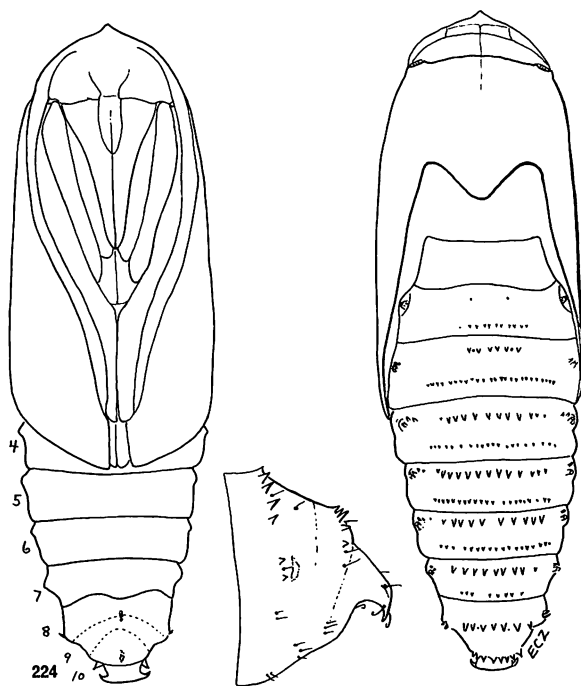


Figure 224—*Croesia zimmermani* Clarke. Ventral and dorsal aspects of a female pupa with a left lateral view of the cauda. Waiakamoi, Maui; length 6.5 mm. The setae are short and inconspicuous.

1825 (1816–1826). Vein 4 is absent from the hindwing of true *Dichelopa* from Australia (monotype: *dichroa* Lower), and, further, vein 7 of the forewing runs to costa or apex instead of to termen as it does on *Spheterista*. In *Clepsis*, veins 7 and 8 in the forewing are separate instead of being stalked as in *Spheterista*. In the forewing of *Adoxophyes*, vein 3 leaves the cell at a point about midway between veins 2 and 4, obviously far removed from the end of the cell or from vein 4; but on *Spheterista*, vein 3 originates near or at the end of the cell at a point not far removed from vein 4. The wing venation of both the forewings and hindwings of *Spheterista* is identical with that of *Epagoge*. Furthermore, the genitalia of *Spheterista* and *Epagoge* are similar. (Note that the wing venations of *Clepsis*, *Adoxophyes*, and *Epagoge* have been illustrated by Obratzsov, 1954, in the first part of his monograph *Die Gattungen der palaearktischen Tortricidae*.) I am tempted to merge *Spheterista* and *Epagoge*, but, because of my lack of experience with this group outside of Hawaii, I feel it best to leave the decision regarding possible synonymy to those who have had more experience with the family.

The stalking of veins 7 and 8 in the forewing will separate *Spheterista* from all other tortricids in Hawaii with the exception of the female of *Amorbia*, which lacks ocelli, and of *Eccoptyocera*, which belongs to the Olethreutinae and has only 11 veins in the forewing and only seven in the hindwing instead of 12 and eight.

The forewing of the male has a costal fold or flap on most of the species, but there is no costal fold on *infaustana*, *oheoheana*, or *urerana*. Males of *argentinotata*, *glaucoviridana*, *pernitida*, and *xanthogona* are unknown. The remaining males I

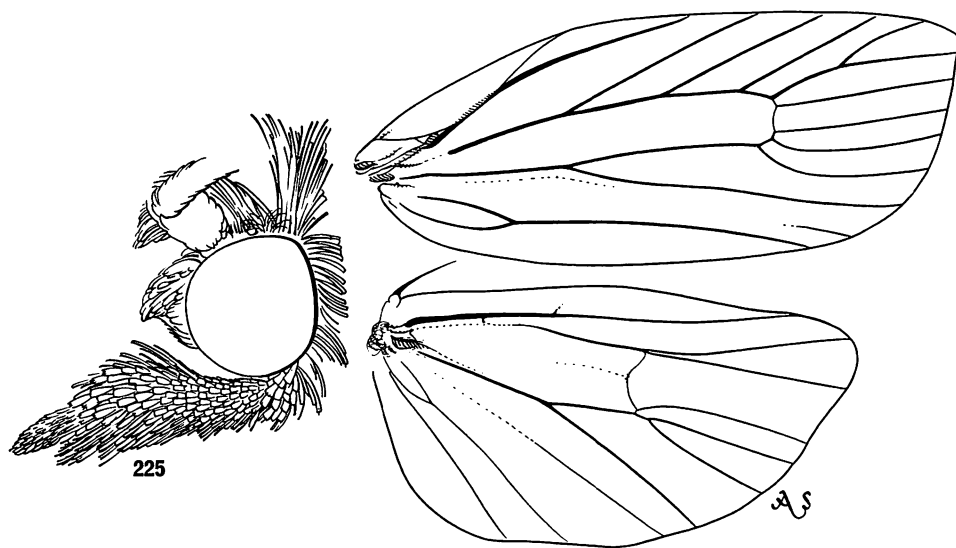


Figure 225—Head and wing venation of *Spheterista variabilis* (Walsingham), holotype (BM slide 9536); Kahanui, Molokai. Note the strong costal fold on the forewing.

have examined, and they all have the costal fold. They are: *cassia*, *flavocincta*, *flavopicta*, *fulva*, *ochreocuprea*, *pleonectes*, *pterotropiana*, *reynoldsiana*, *tetraplasandra*, and *variabilis*.

As my illustrations demonstrate, there is much variation in the wing shape and some variation in the venation. In the hindwing the discocellulars may be distinct, faint, or evidently obsolescent; veins 6 and 7 may be separate, connate, short- or long-stalked; veins 3 and 4 may also be separate, connate, or stalked.

The uncus displays great specific differences; it may be solid and single, split and bipartite, broad or narrow. The socii vary from small to large.

The female genitalia display various differences that must reflect differences in habit. The ovipositor lobes differ considerably in shape and sculpture. It is regrettable that I have been unable to illustrate each form as it should be illustrated. The bursa copulatrix is thinly membranous, and there is no signum. Many abdomens of the females examined appeared to have decomposed before drying, and it has been impossible to make satisfactory dissections of some of them.

See color plates 1, figures 5–8; 2, figures 1–4.

### DISTRIBUTION OF THE SPECIES OF *SPHETERISTA*

Listed by type locality only, the species have the following distributions: Kauai; seven; Oahu, five; Molokai, one; Maui, none; Lanai, none; Hawaii, four. There probably are many new species remaining to be collected, and only a few areas of the Islands have been searched for *Spheterista*. As now recorded, the distributions of the species are as follows (the type locality of each species is on the island whose name heads each list, unless the word "type" follows some other island name after the species name):

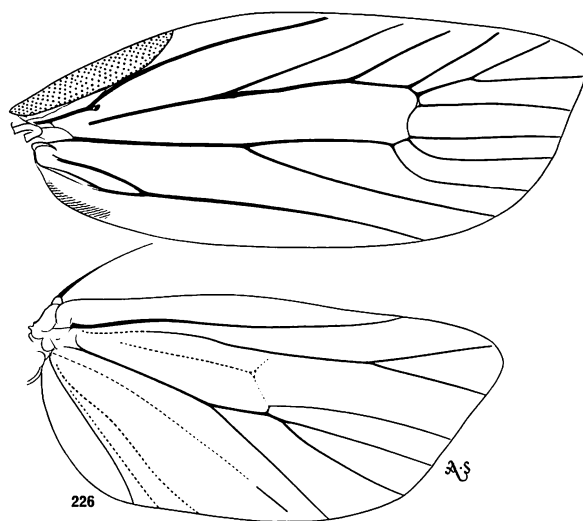


Figure 226—Male wing venation of *Spheterista cassia* (Swezey). Kaena Point, Oahu (slide Z.-IX-3-61-6).

## Kauai (eight species)

*flavopicta* (Walsingham)  
*fulva* (Walsingham)  
*glaucoviridana* (Walsingham)  
*infaustana* (Walsingham), Oahu, Molokai, Maui, Hawaii  
*ochreocuprea* (Walsingham)  
*oheoheana* (Swezey)  
*pleonectes* (Walsingham), Oahu, Hawaii (type)  
*pterotropiana* (Swezey)

## Oahu (seven species)

*cassia* (Swezey)  
*flavocincta* (Walsingham), Hawaii  
*infaustana* (Walsingham), Kauai (type), Molokai, Maui, Hawaii  
*pleonectes* (Walsingham), Kauai, Hawaii (type)  
*reynoldsiana* (Swezey)  
*tetraplasandra* (Swezey)  
*urerana* (Swezey)

## Molokai (two species)

*infaustana* (Walsingham), Kauai (type), Oahu, Maui, Hawaii  
*variabilis* (Walsingham), Maui

## Maui (two species)

*infaustana* (Walsingham), Kauai (type), Oahu, Molokai, Hawaii  
*variabilis* (Walsingham), Molokai (type)

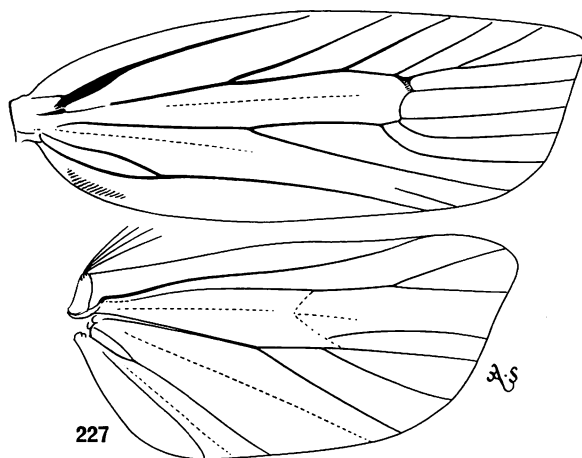


Figure 227—Female wing venation of *Spheterista cassia* (Swezey). Kaena Point, Oahu (slide Z-IX-3 61-7).

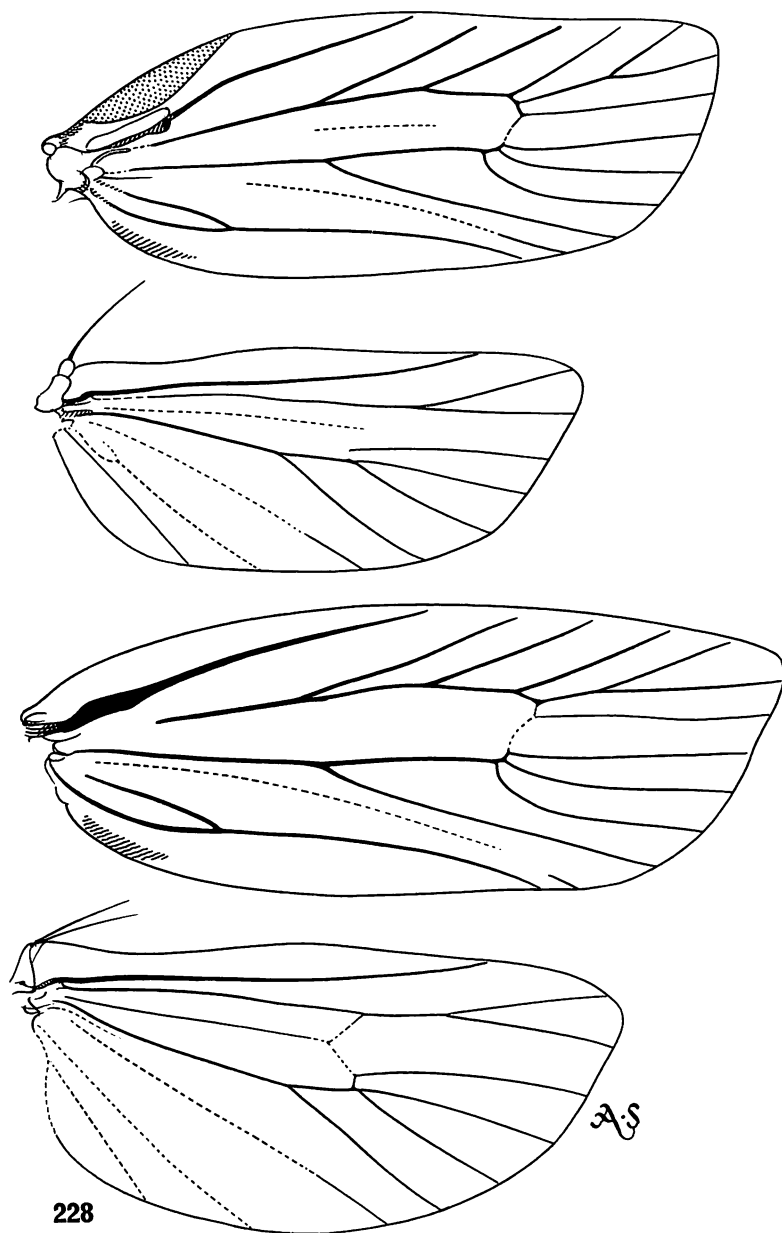


Figure 228—Wing venation of *Spheterista flavocincta* (Walsingham) (= *santalata* Swezey). Male from Waikakalana, Oahu (slide Z-XII-62-8). Female from Palolo, Oahu (slide Z-VII-62-9).

Lanai (no species recorded)

Hawaii (six species)

*argentinotata* (Walsingham)

*flavocincta* (Walsingham), Oahu

*infaustana* (Walsingham), Kauai (type), Oahu, Molokai, Maui

*pernitida* (Walsingham)

*pleonectes* (Walsingham), Kauai, Oahu

*xanthogona* (Walsingham)

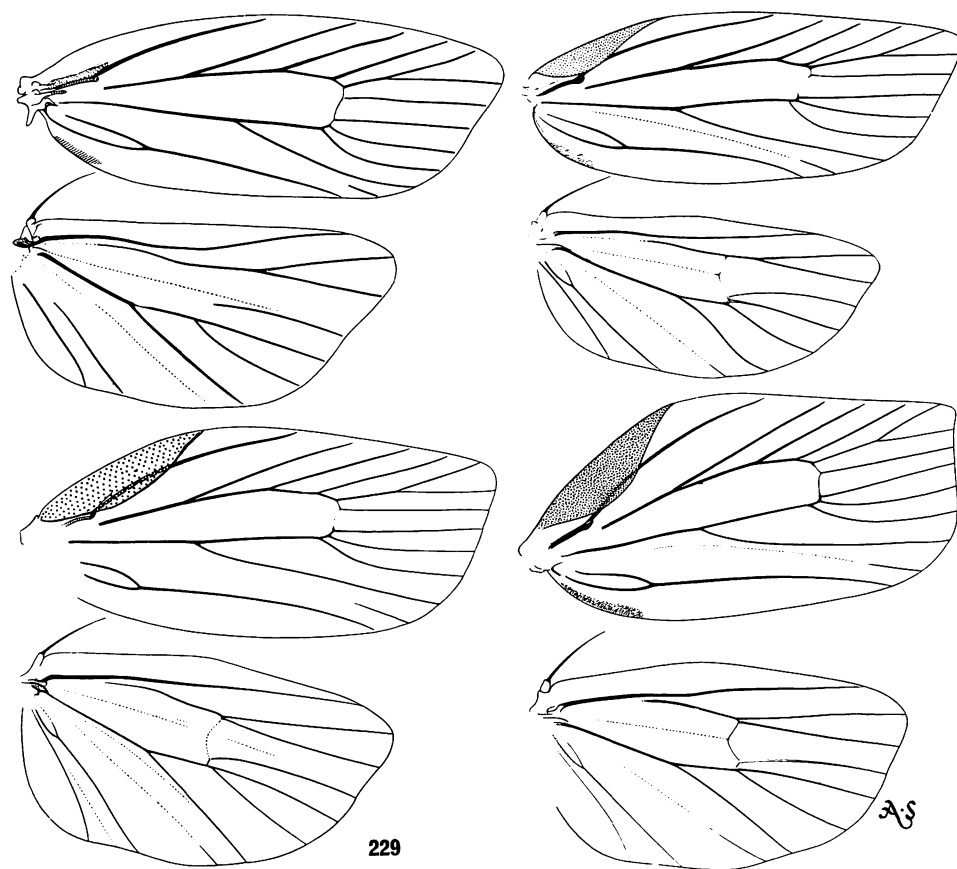


Figure 229—*Spheterista* wing venations. Top left, *infaustana* (Walsingham), paratype (BM slide 8609); Molokai, over 3,000 feet. Top right, *flavopicta* (Walsingham) from a paratype of the synonym *picta* (BM slide 7571); Kauai, 3,000 to 4,000 feet. Bottom left, *fulva* (Walsingham), paratype (BM slide 7572); Kauai, 3,000 to 4,000 feet. Bottom right, *ochreocuprea* (Walsingham), paratype (BM slide 7573); Kauai, 3,000 to 4,000 feet. Note that *infaustana* lacks a male costal fold, and note the differences in origins of veins 6 and 7 in the hindwings.

### HOSTPLANTS AND LARVAL HABITS OF SPHETERISTA

The hostplants of *argentinotata*, *fulva*, *glaucoviridana*, *ochreocuprea*, *pernitida*, *variabilis*, and *xanthogona* are unknown. The hostplants of the other species are as follows:

#### Urticaceae

*Pipturus*: *infaustana* (Walsingham), tip-borer and leaf-tier.

*Urera*: *urerana* (Swezey), twig-borer.

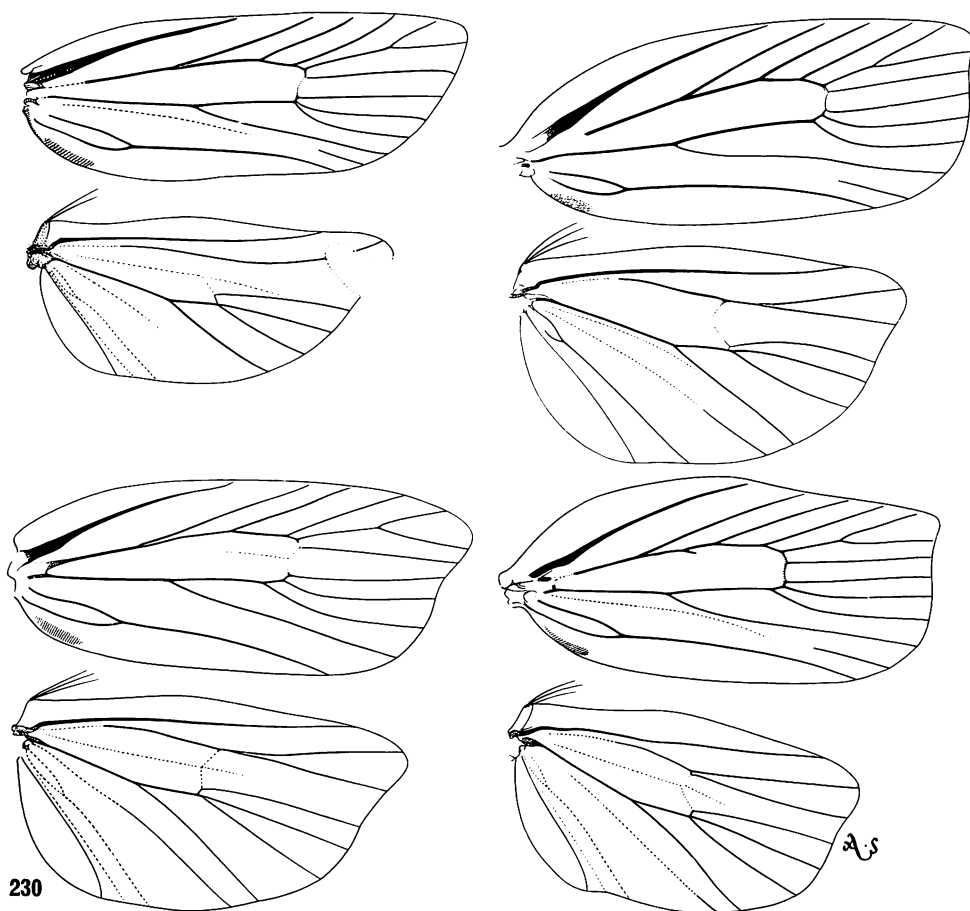


Figure 230—Wing venations of some female *Spheterista*. Top left, *ohoheana* (Swezey), paratype (slide Z-XII-62-6); Halemanu, Kauai. Top right, *pleonectes* (Walsingham), paratype (BM slide 7550); Kilauea, Hawaii. Bottom left, *pterotropiana* (Swezey), paratype (slide Z-XII-62-7); Halemanu, Kauai. Bottom right, *tetraplasandra* (Swezey), Milolii, Kauai (slide Z-XII-62-10).

## Santalaceae

*Santalum*: *flavocincta* (Walsingham), *flavopicta* (Walsingham), leaf-tiers.

## Leguminosae

*Cassia*: *cassia* (Swezey), leaf-tier.

## Araliaceae

*Cheirodendron*: *pleonectes* (Walsingham), leaf-tier

*Reynoldsia*: *reynoldsiana* (Swezey), leaf-tier

*Tetraplasandra* ( = *Pterotropia*): *oheoheana* (Swezey), from twigs; *pterotropiana* (Swezey), from terminal buds; *tetraplasandra* (Swezey), from fruits and leaves.

I regret that I have not had an opportunity to prepare a key to the species of this little-known, difficult assemblage.

***Spheterista argentinotata*** (Walsingham), **new combination** (figs. 234, moth; 255, female genitalia).

*Epagoge* (?) *argentinotata* (Walsingham), 1907*b*: 711, pl. 12, fig. 10.

*Capua argentinotata* (Walsingham) Meyrick, 1913*b*: 15.

Endemic. Hawaii (type locality: Olaa).

Hostplant: unknown.

Only two females of this species are known to me.

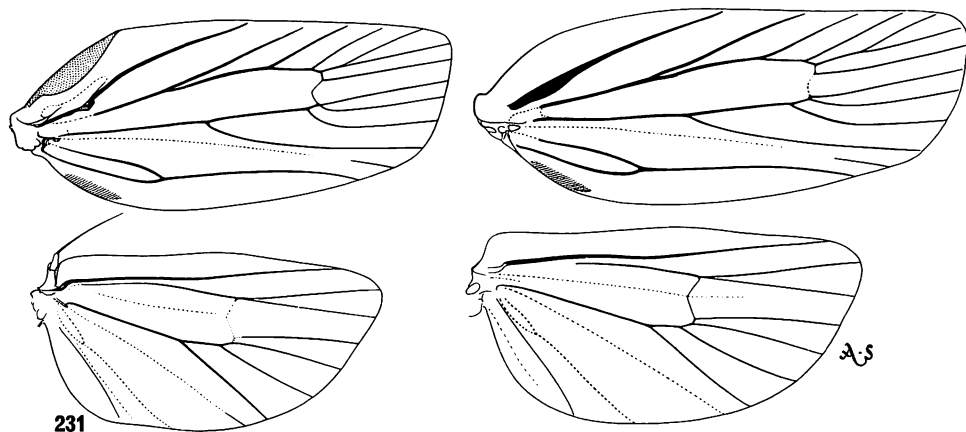


Figure 231—Wing venation of *Spheterista reynoldsiana* (Swezey). Left, male paratype (slide Z-XII-62-11). Right, female paratype (frenulum lost) (slide Z-XII-62-12). Both specimens are from Wailupe, Oahu.



***Spheterista cassia* (Swezey), new combination** (figs. 226–227, wing venation; 232, pupa; 234, moth; 245, male genitalia; 257, female genitalia).

*Capua cassia* Swezey, 1912b:183.

Edemic. Oahu (type locality: Kaena Point).

Hostplant: *Cassia gaudichaudii*.

Parasite: *Sierola* species.

Although the type locality is at the far northwestern end of the Waianae Mountains, part of the type series came from Niu near the southeastern end of the Koolau Mountains. Hence, the species can be expected to be found over almost all of Oahu where its hostplant grows.

The larvae feed singly, eating the lower epidermis and parenchyma, leaving the upper epidermis; with a web the leaflet is folded together for a hiding place, often along the midrib, sometimes a portion of the margin of the blade is folded over, or contiguous leaflets fastened together for this purpose.

The full-grown larva is about 9 mm. in length, uniform leaf-green; head concolorous, eyes black and a black spot at the postero-ventral angle; anal comb of green spines.

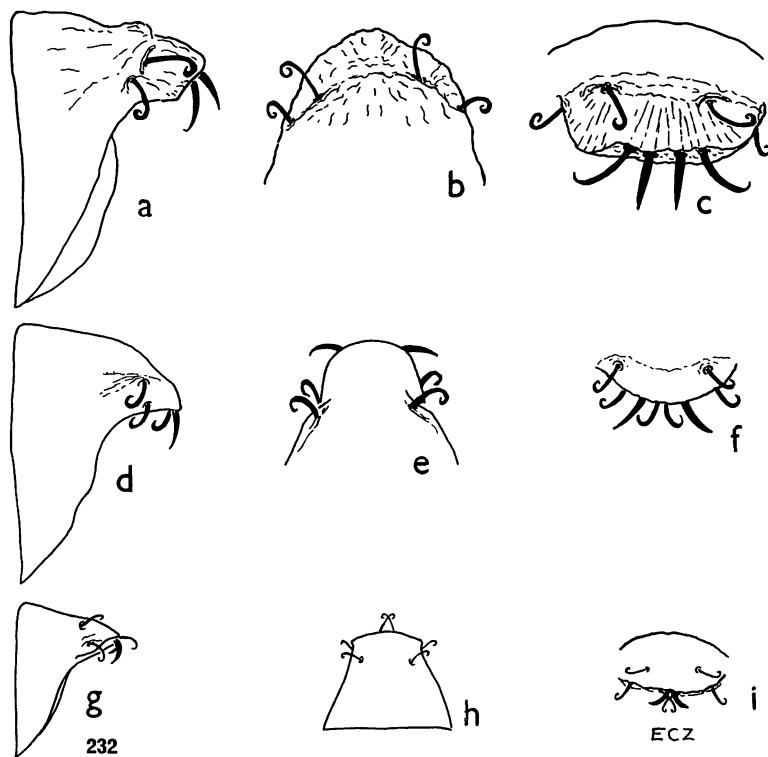


Figure 232—Caudae of *Spheterista* pupae. *a, b, c*, lateral, dorsal, and caudal aspects of *plerotropiana* (Swezey) from a paratype from Halemanu, Kauai. *d, e, f*, *urerana* (Swezey), from the lectotype male from Mt. Tantalus, Oahu. *g, h, i*, *cassia* (Swezey) from a male from Kaena Point, Oahu.

The pupa is formed in the same place where the larva has fed, in a slight cocoon. It is 5 mm. in length, greenish, wing-cases bright green, extending to apex of fourth abdominal segment; abdominal segments, except first, with two transverse dorsal rows of minute spines, the basal row on segments 3 to 8 larger; cremaster with a few hooked bristles fastened into the silk of cocoon.

A parasite larva (*Sierola* sp.) was found feeding on one of the moth larvae. It was feeding externally, and was about 2.5 mm. long, plump, greenish with white spots all over—perhaps the fat-bodies showing through. This larva spun a silken cocoon, from which the adult parasite emerged in 12 days. (Swezey, 1912b:183-184.)

The caudal process of the pupa has two strongly hooked dorsal setae that arise from simple sockets which are not surrounded by rugae or carinae. Laterad of each of these setae is a similar seta which is placed in a sulcus in the lateral margin of the caudal process. Beneath the middle of the caudal margin of the caudal process are four setae. Of these four setae, each lateral seta projects caudad and is visible from above, but the two middle setae are bent cephalad, are not visible from above, and their apices are not curled.

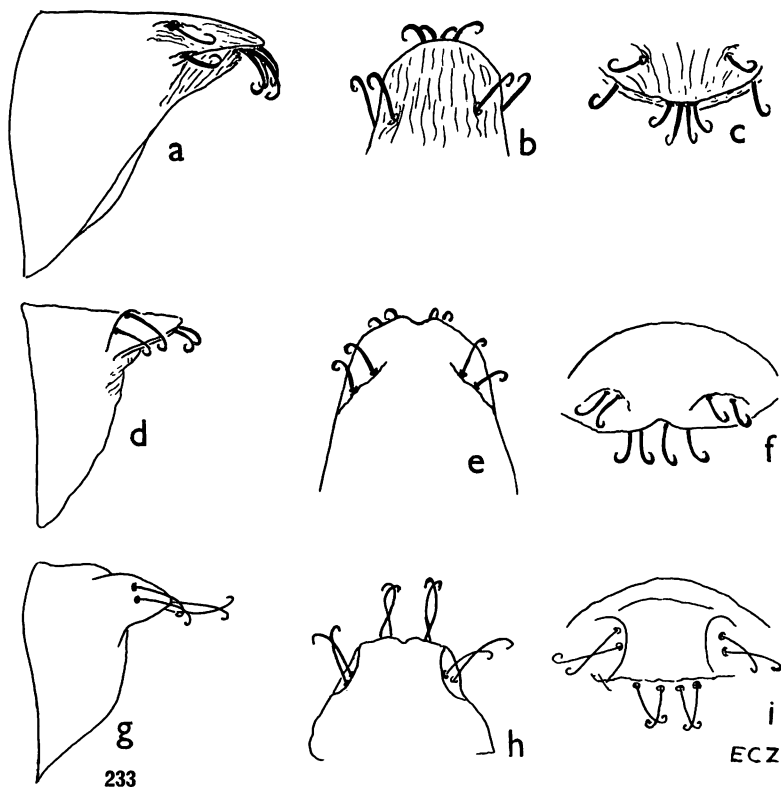


Figure 233—Caudae of pupae of *Spheterista* and *Pararrhaptica*. a, b, c, lateral, dorsal, and caudal aspects of *Spheterista tetraplasandra* (Swezey) from a female from Milolii, Kauai. d, e, f, *Spheterista reynoldsiana* (Swezey) from a female from Wailupe, Oahu. g, h, i, *Pararrhaptica dermatopa* (Meyrick), Mt. Olympus, Oahu.

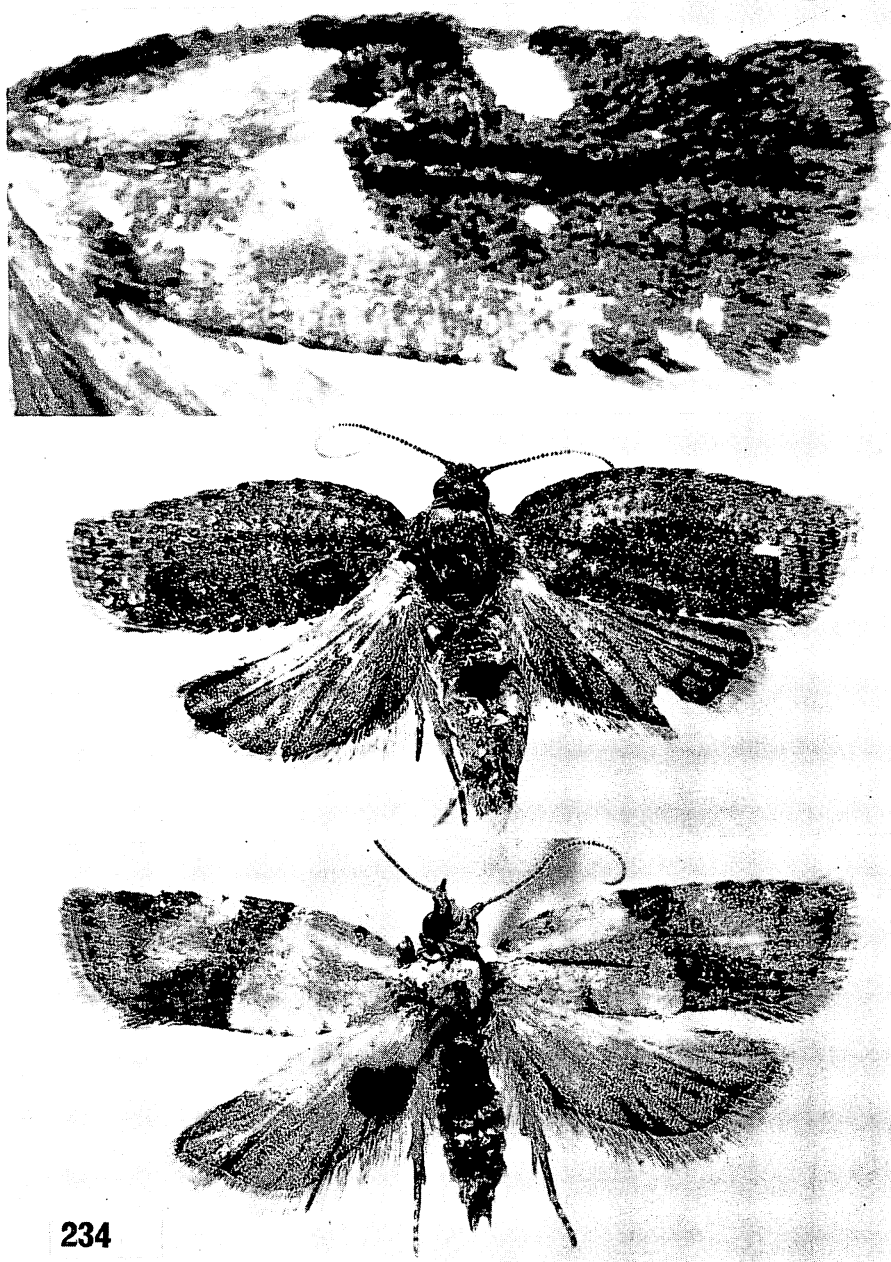
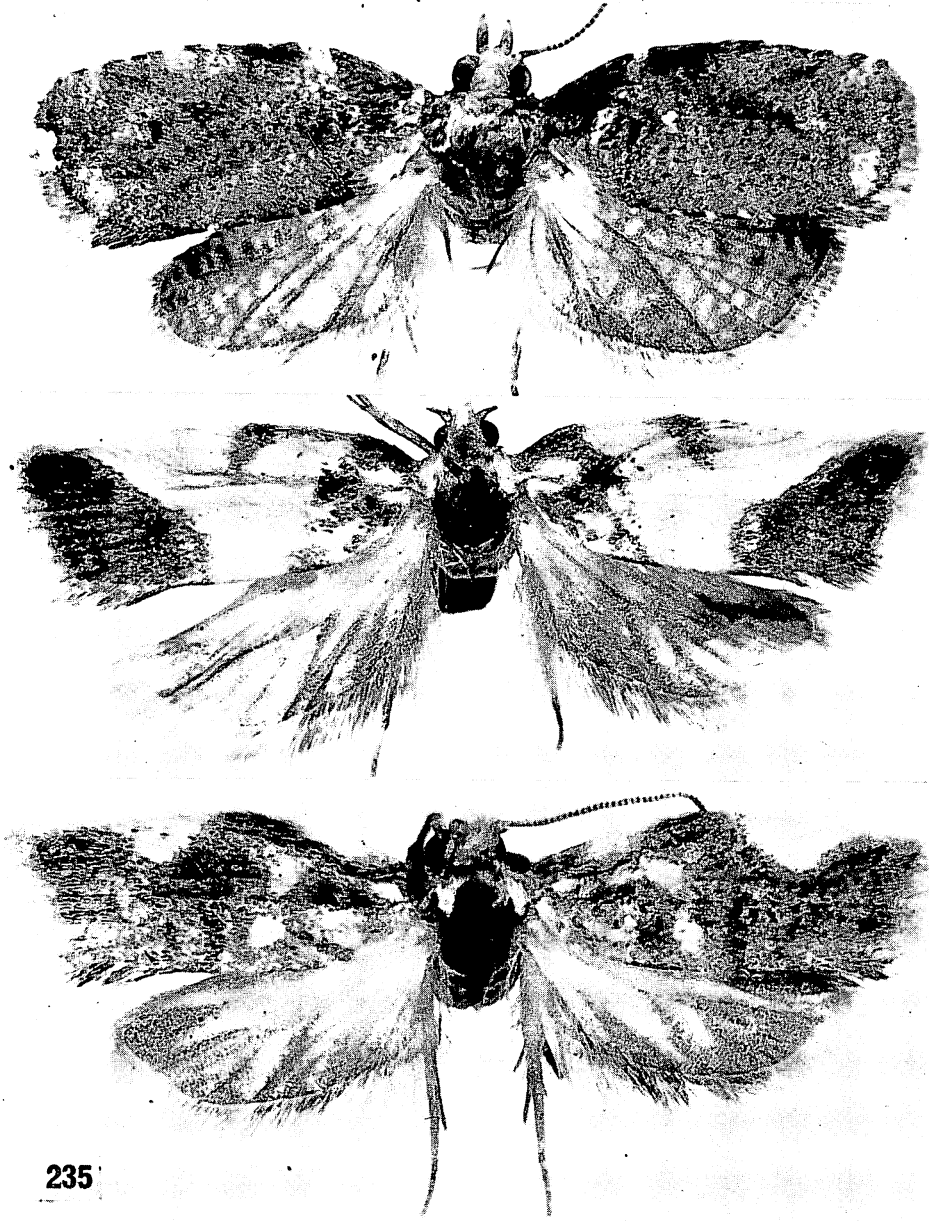


Figure 234—*Spheterista*. Top, *argentinotata* (Walsingham), holotype; Olaa, Hawaii (abdomen lost); forewing 7 mm., the pale areas are shiny squamae and not holes. Middle, *pleonectes* (Walsingham) from the holotype of the synonymous *asaphopsis* Meyrick; Mt. Kaala, Oahu; forewing 8 mm. Bottom, *cassia* (Swezey), holotype; Kaena Point, Oahu; forewing 5.25 mm.



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Figure 235—*Spheterista*. Top, *pleonectes* (Walsingham), from the holotype male of the synonymous *castaneana* (Walsingham) (BM slide 1981); Kauai, 3,000 to 4,000 feet; forewing 8.5 mm. Middle, *flavopicta* (Walsingham), holotype female (BM slide 1971); Kauai, 3,000 to 4,000 feet; expanse 17 mm.; the pale areas are bright canary yellow. Bottom, the same species from the male holotype of the synonymous *picta* Walsingham (BM slide 1961); Kauai, 3,000 to 4,000 feet; expanse 15 mm.

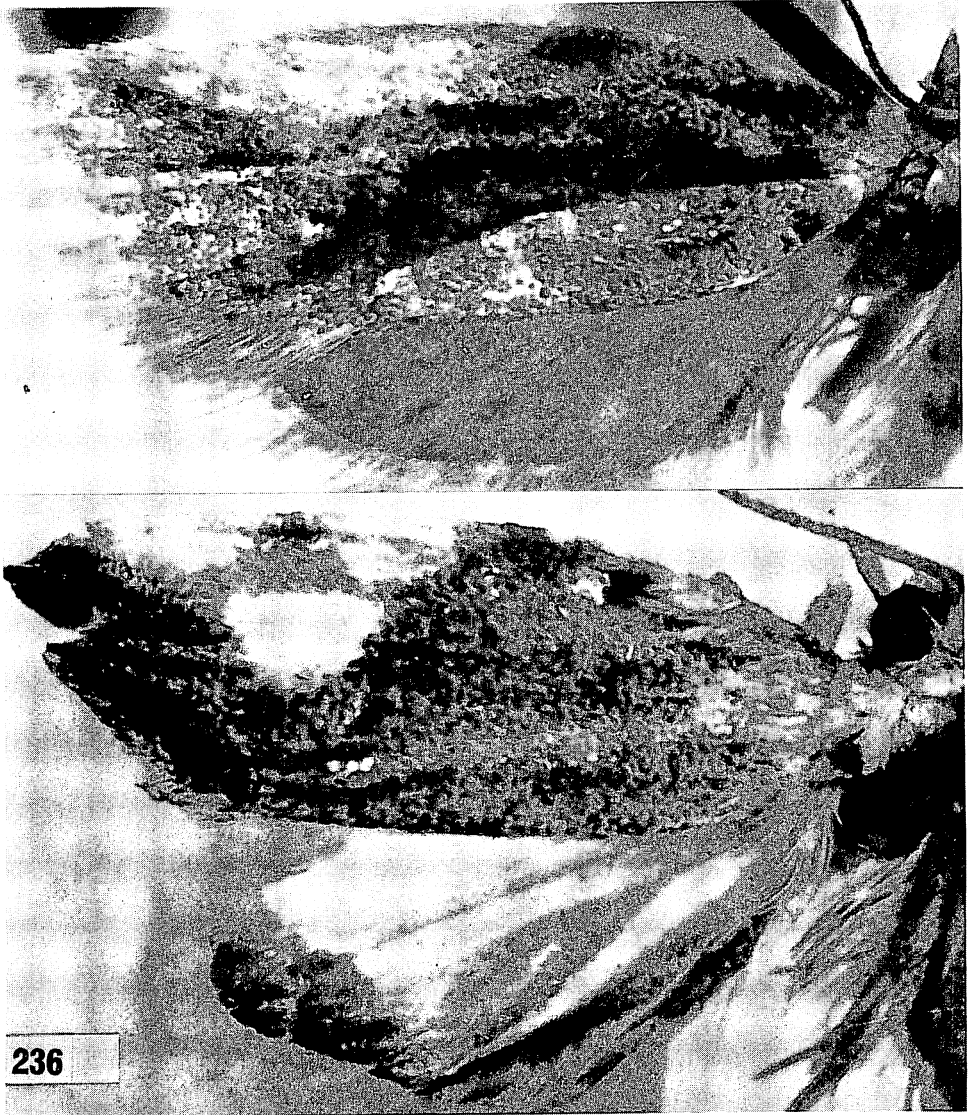


Figure 236—*Spheterista flavocincta* (Walsingham). Top, holotype female (BM slide 1960); Kona, 4,000 feet, Hawaii; forewing 7.5 mm.; the pale costal area on the forewings is orange bordered by metallic fuscous. Bottom, the same species from the male holotype of the synonymous *trigonifer* Walsingham (BM slide 1970); Kona, 4,000 feet, Hawaii; forewing 5 mm.; the pale triangular area beyond the middle of the forewing is white, the darker area bordering it costal is orange, and the pale costal areas are mostly cream. The apex of the hindwing appears to be dark because the end of the wing has been rolled downward and is thus not evenly illuminated.

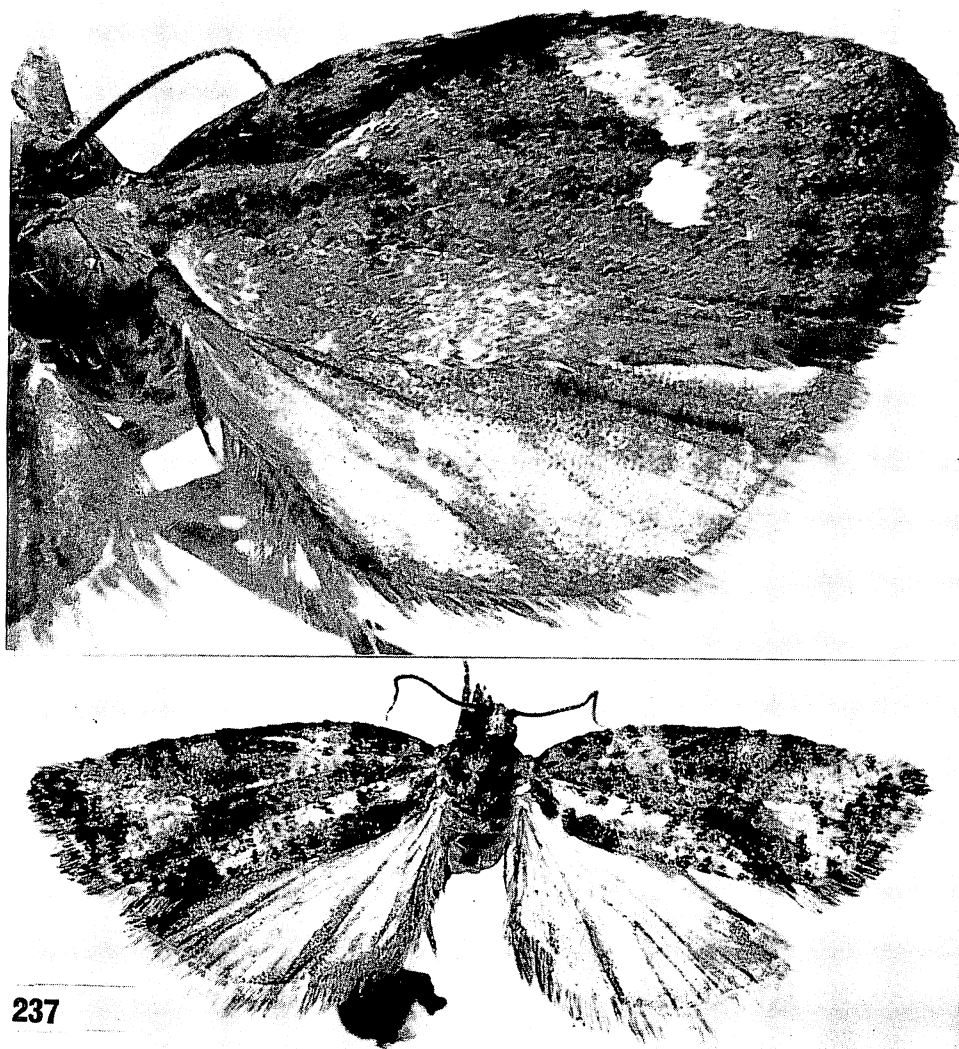


Figure 237—*Spheterista*. Top, *fulva* Walsingham, holotype male (BM slide 1980); Kauai, 3,000 to 4,000 feet; forewing 9 mm. Compare the similar-appearing *ochreocuprea* in figure 238. Bottom, *glaucoviridana* (Walsingham), holotype female (BM slide 1972); Kaholuamano, 4,000 feet, Kauai; expanse 16.5 mm.

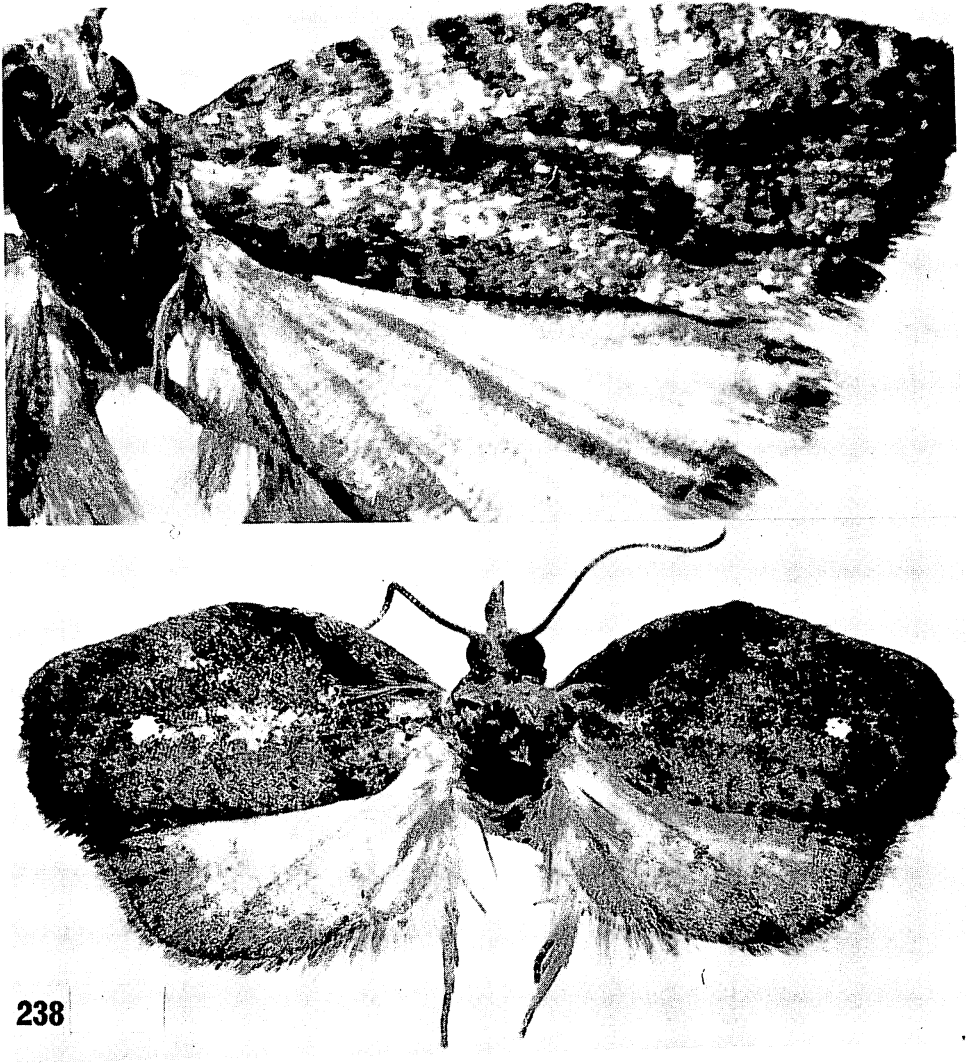


Figure 238—*Spheterista*. Top, *infaustana* (Walsingham), allotype male (BM slide 1914); Kauai, 3,000 to 4,000 feet. Forewing 5 mm. long; it lacks a costal fold. Bottom, *ochreocuprea* (Walsingham), holotype male (BM slide 3849); Kauai, 3,000 to 4,000 feet. Forewing 9 mm. long; note the strong costal fold. Compare the similar, but specifically distinct, *fulva* on figure 237.

***Spheterista flavocincta*** (Walsingham), **new combination** (figs. 228, wing venation; 236, 242, moth; 247, male genitalia; 259, 265, female genitalia).

*Capua* (?) *flavocincta* Walsingham, 1907b:704, pl. 11, fig. 27.

*Capua flavocincta* Walsingham, Meyrick, 1913b:15.

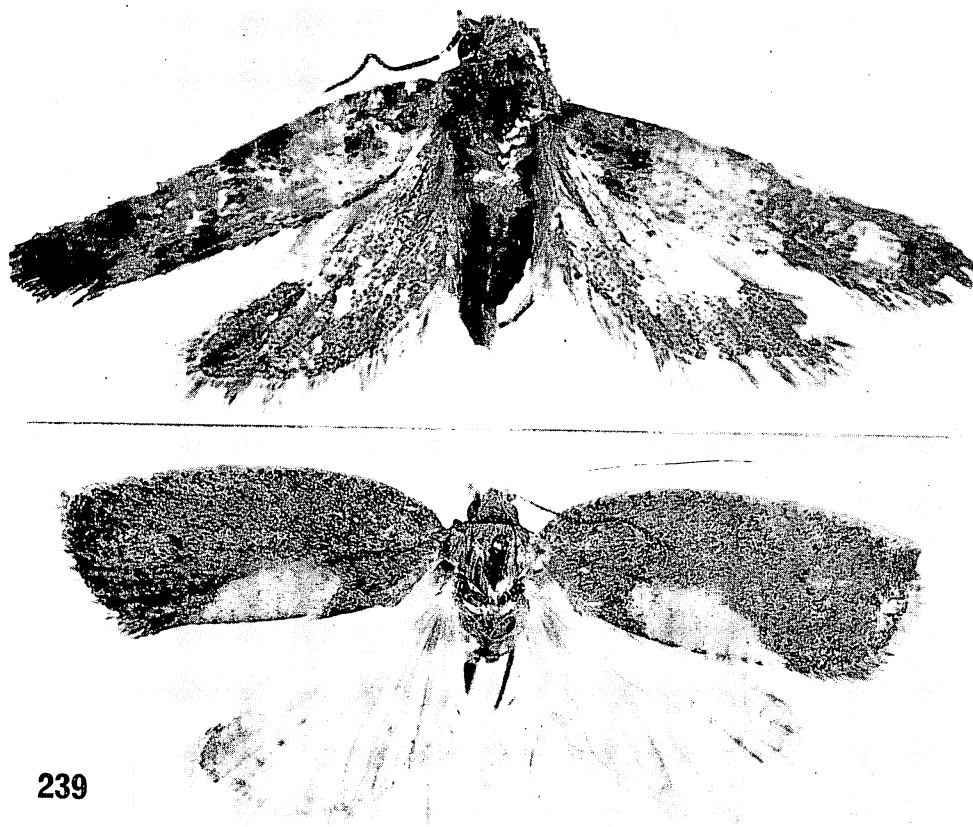
*Capua trigonifer* Walsingham, 1907b:704, pl. 11, fig. 28. Synonymy by Meyrick, 1913b:15.

*Capua santalata* Swezey, 1913f:276. **New synonym.**

Endemic. Oahu (type locality of *santalata*: Diamond Head, Honolulu), Hawaii (type locality of *flavocincta*: Kona; of *trigonifer*: Kona, 4,000 feet).

Hostplants: *Santalum freycinetianum*, *Santalum* species.

Parasite: *Trathala flavo-orbitalis* (Cameron).



239

Figure 239—*Spheterista*. Top, *oheoheana* (Swezey), paratype female; Halemanu, Kauai; expanse 10 mm. as mounted. The specimen is considerably abraded, poorly mounted, and the figure is thus misleading in appearance. Bottom, *pleonectes* (Walsingham), "cotype" female (BM slide 14308); Kilauea, Hawaii; expanse 26 mm.; mostly brownish with a large yellow macula on the posterior margin of each forewing.



The names *flavocincta*, *santalata*, and *trigonifer* apply to extremes of the color forms of this highly variable species. *Spheterista flavopicta* is a closely allied species, but its uncus is distinctly different, as the illustrations demonstrate. The moth is probably more widely distributed than the recorded locality data indicate, and it should be sought on sandalwood on other islands.

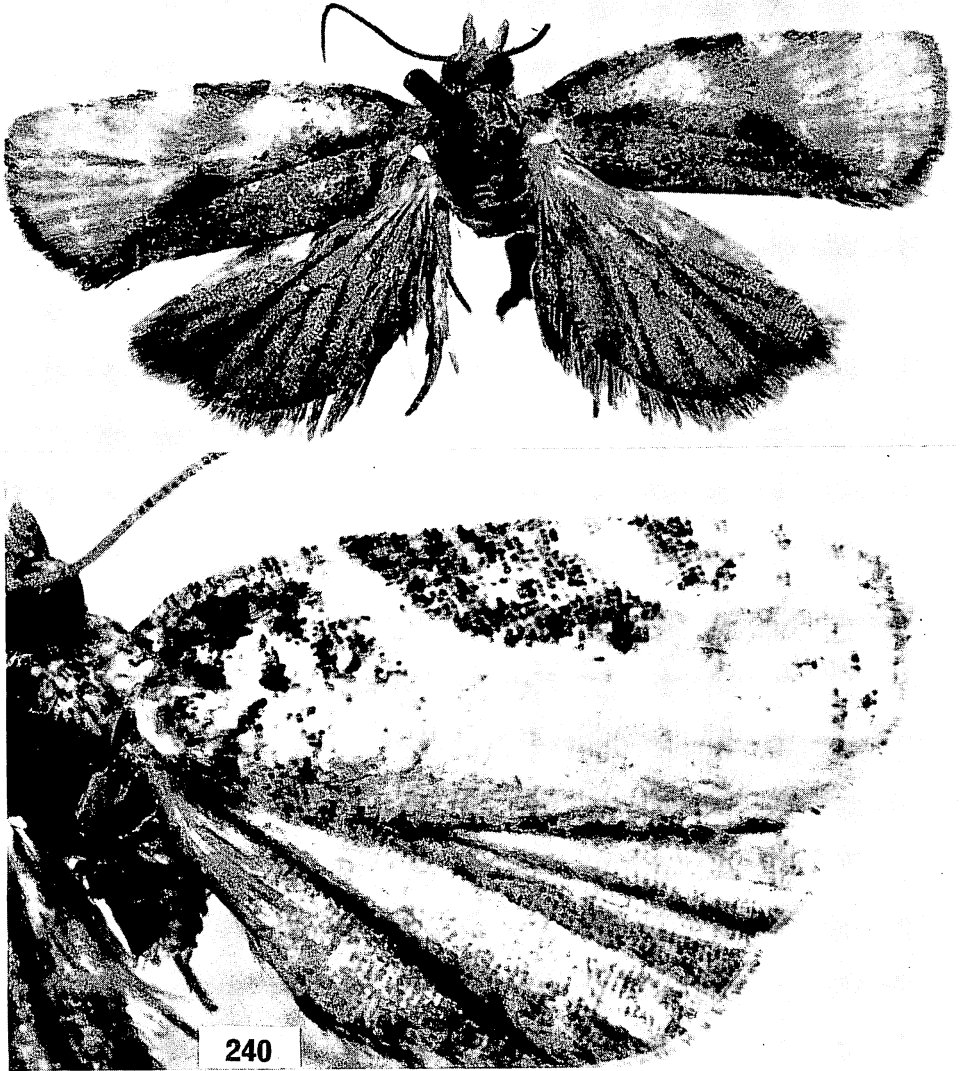


Figure 240—*Spheterista*. Top, *pernitida* (Walsingham), holotype female (BM slide 1918); Oloa, Hawaii, 2,000 feet; forewing 7 mm. long. Bottom, the male specimen (BM slide 1919) from Hilo, 2,000 feet, Hawaii, mentioned by Walsingham at the bottom of p. 710 of *Fauna Hawaiiensis* as being "closely allied to *pernitida*" (this may not be true). Forewing 6.5 mm.; lacking a male costal fold. See figure 249 for genitalia.

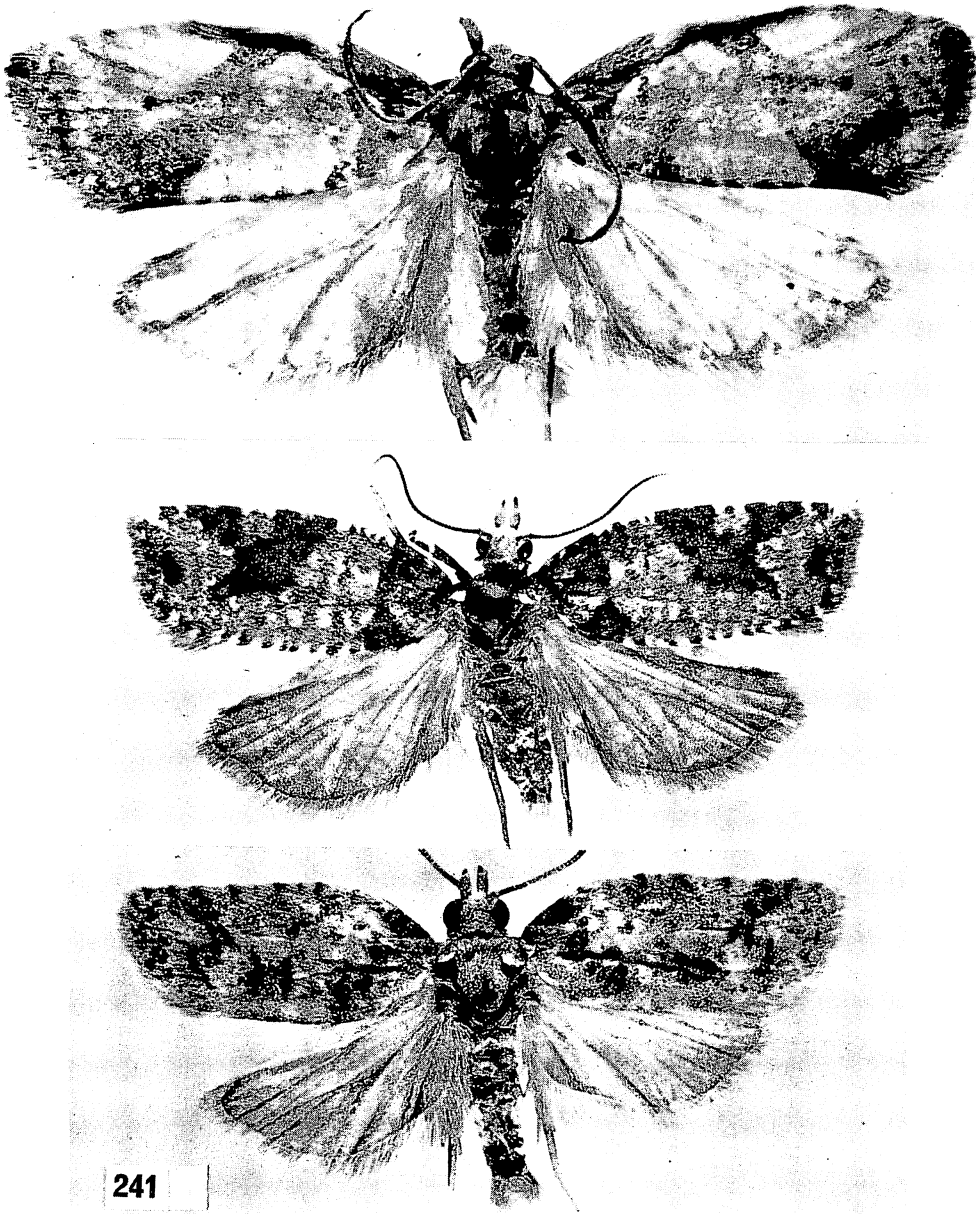


Figure 241—*Spheterista*. Top, *pleonectes* (Walsingham), holotype male (BM slide 5549); Kilauea, Hawaii; expanse 9 mm. Middle, *pterotropiana* (Swezey), paratype female; Halemanu, Kauai; forewing 10 mm. long. Bottom, *reynoldsiana* (Swezey), holotype male; forewing 7 mm. long.

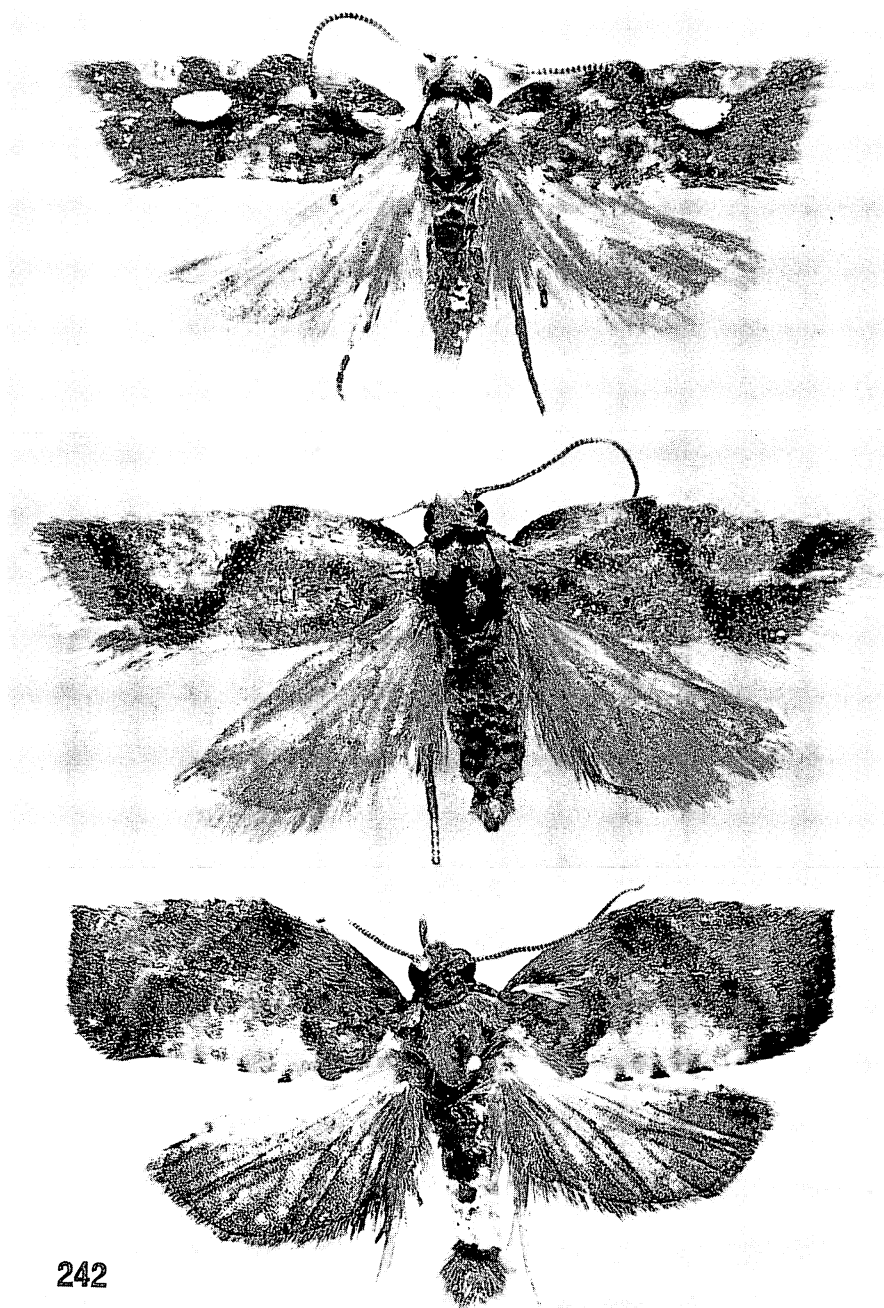
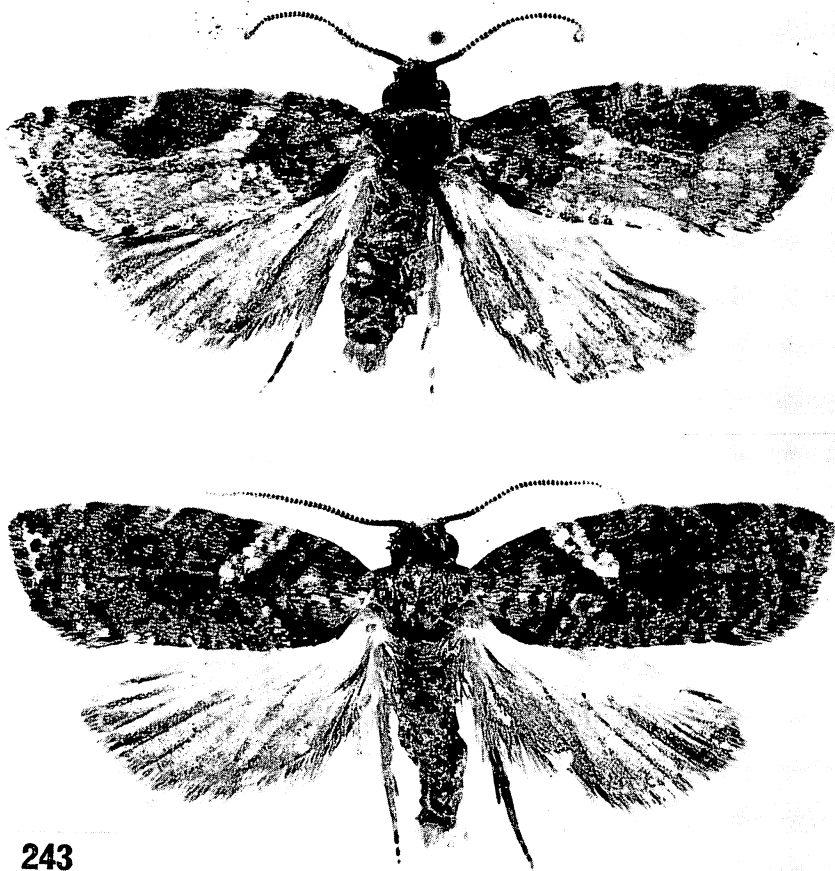


Figure 242—*Spheterista*. Top and middle, *flavocincta* (Walsingham) from the holotype male (top) and allotype female (middle) of the synonymous *santalata* Swezey; Diamond Head, Oahu; forewing 5 mm. long on holotype, 5.5 mm. on allotype. Bottom, *tetraplasandra* (Swezey), holotype male; Kaumuahona, Oahu; forewing 8 mm. long.

The form of this beautiful little moth which Dr. Swezey called *santalata* was not described in *Fauna Hawaiiensis*, but there are 33 specimens under the Walsingham manuscript name "*Capua dictyodes*" in the British Museum. Two of these were collected by Dr. Perkins on Oahu in 1900, and the other 31 were taken by him in the northwest Koolau Mountains in July 1901.

The caterpillars of this small moth occur on webbed leaves of nearly all species of *Santalum* on Oahu, practically everywhere the plant is found. (Swezey, 1954: 185.)

Full-grown caterpillar about 8 mm.; pale green; head concolorous, eyes black and a black dot at postero-ventral angle; anal comb of 6 pale stiff bristles.



243

Figure 243—*Spheterista urerana* (Swezey). Top, paralectotype male (here designated); forewing 5.5 mm. long. Bottom, lectotype male (here designated) (slide Z-I-26-67); forewing 5.75 mm. long. Both specimens are from Mt. Tantalus, Oahu. There is no costal fold on the forewing of the male. These two specimens were originally mounted in these relative positions on a single piece of cork, and the mount was labeled "Type". They evidently were taken to be a male and a female, but they are both males. They demonstrate the great variability in the species. The top example bears a superficial appearance in color pattern to *Pararrhaptica notocosma* (Meyrick).



Figure 244—*Spheterista*. Top, *variabilis* (Walsingham), holotype male (BM slide 9536 Clarke); Kahanui Molokai; forewing 10 mm., with a strong male costal fold. Bottom, *xanthogona* (Walsingham), holotype female (BM slide 1916); Kona, 5,000 feet, Hawaii; forewing 6 mm. long.

Pupa 5 mm.; pale greenish or yellowish; wing-sheaths and posterior leg-sheaths extend about to apex of fourth abdominal segment, antennae-sheaths not quite so long; two transverse rows of short backwardly-directed spines on abdominal segments 3-7, one row on segments 2 and 8; cremaster with two strong downwardly-curved hooks wide apart, and a few hooked bristles. The pupa is formed within the folded-over edge of a leaf. The pupal period is about a week. (Swezey, 1913*f*:277.)

**Spheterista flavopicta** (Walsingham), **new combination** (figs. 229, wing venation; 235, moth; 246, male genitalia; 259, female genitalia; col. pl. 1:6, 7, 8).

*Capua* (?) *flavopicta* Walsingham, 1907*b*:703, pl. 11, fig. 25; female.

*Capua picta* Walsingham, 1907*b*:703, pl. 11, fig. 26; male. Synonymy by Meyrick, 1913*b*:15.

Endemic. Kauai (type locality of both *flavopicta* and *picta*: 3,000 to 4,000 feet). Hostplant: *Santalum*.

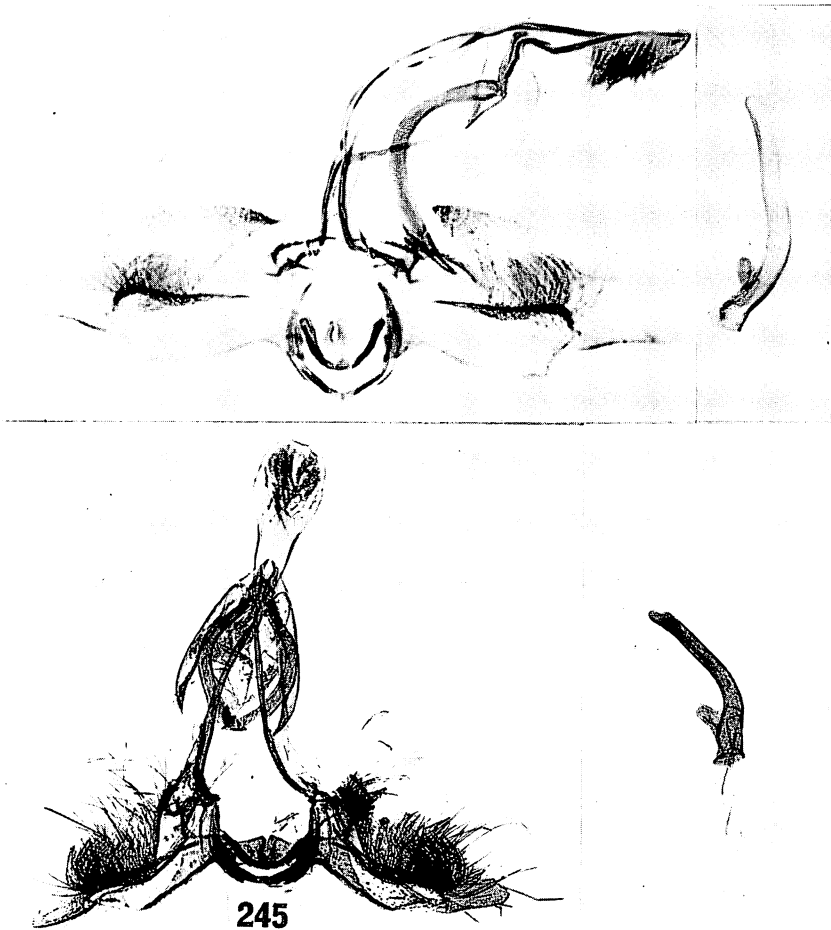
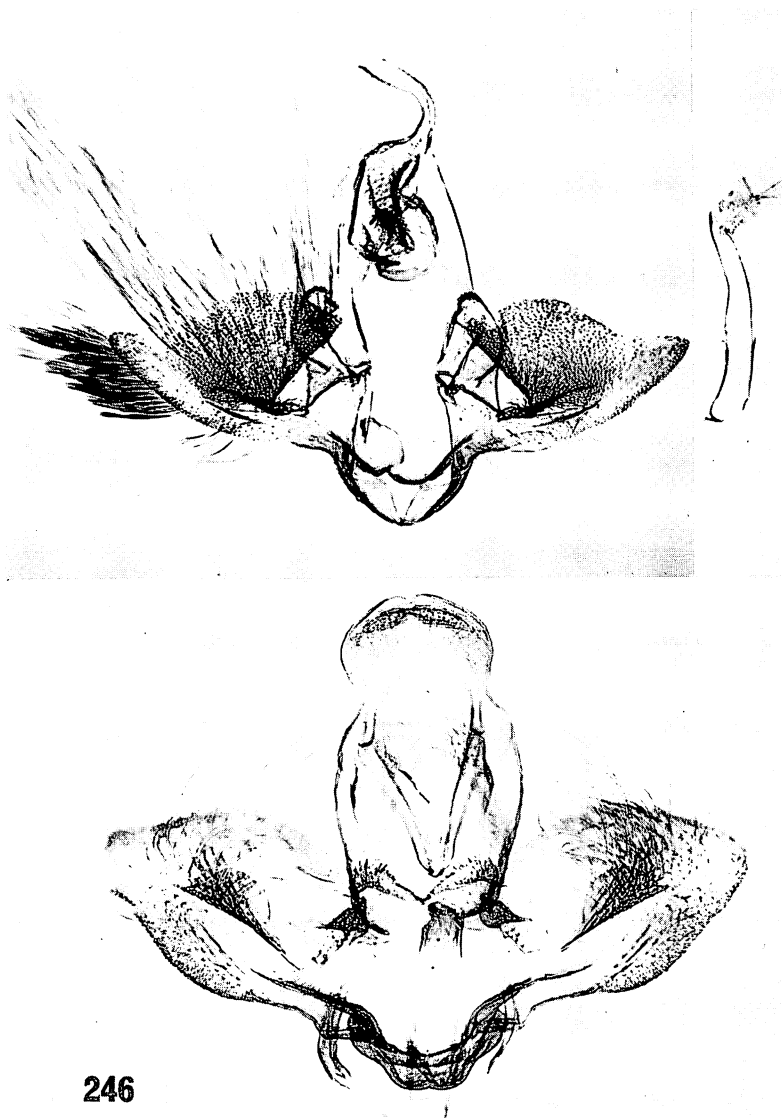


Figure 245—Male genitalia of *Spheterista cassia* (Swezey). Top, from a specimen determined by Dr. Swezey (slide JDB 2); Lihue, Kauai; ex *Cassia*. Bottom, from a paratype from Kaena Point, Oahu (slide Z-IX-3-61-6).



246

Figure 246—Male genitalia of *Spheterista*. Top, *pleonectes* (Walsingham) from the holotype of the synonymous *castanea* (Walsingham) (BM slide 1981); Kauai, 3,000 to 4,000 feet. See other figures of *pleonectes* on figure 250. Bottom, *flavopicta* (Walsingham) from the holotype of the synonym *picta* Walsingham (BM slide 1961); Kauai, 3,000 to 4,000 feet.

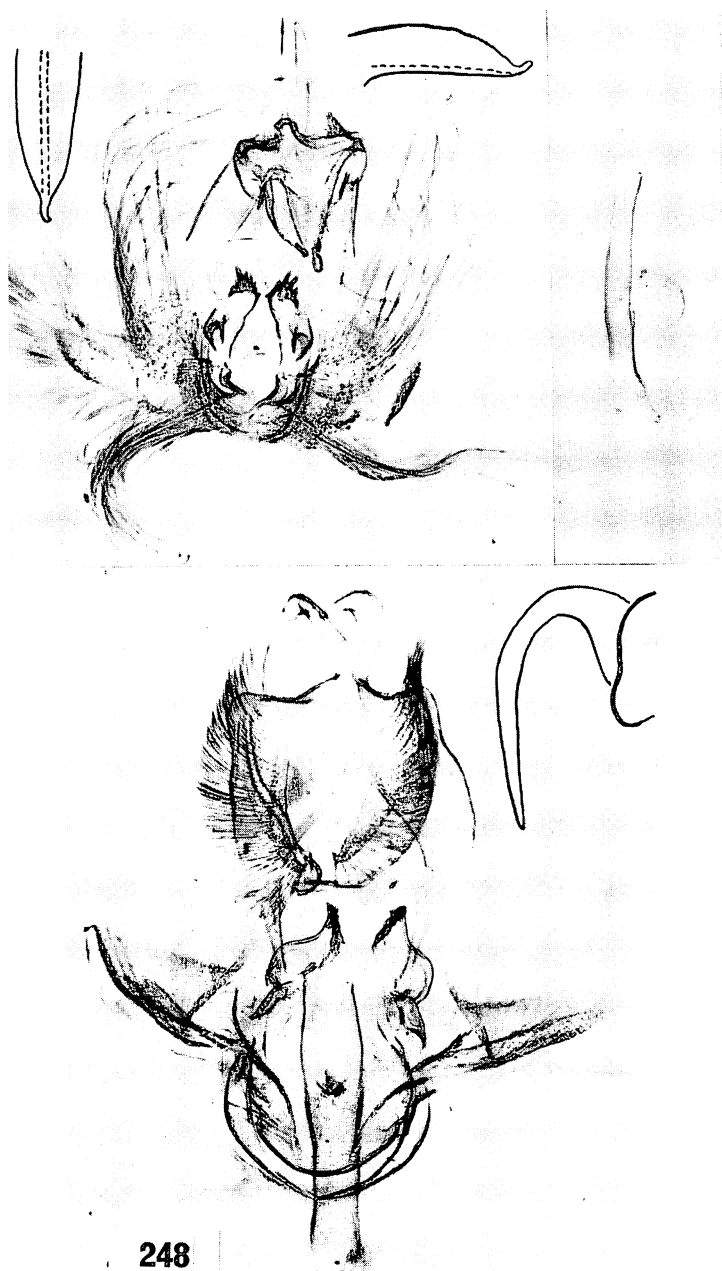
Dr. Swezey (1943:282), who evidently was not aware of Meyrick's having merged *picta* and *flavopicta* in 1913, said, upon collecting the male form *picta* and the female form *flavopicta*, "These might be the same species. They were both reared from caterpillars on *Santalum* leaves, Kumuwela, Aug. 13, 1925. There is a similar difference in wing pattern of the sexes of *Capua santalata* Sw. on Oahu."

This moth is a close ally of the other sandalwood leaf-tier, *flavocincta*, which is known from Oahu and Hawaii.



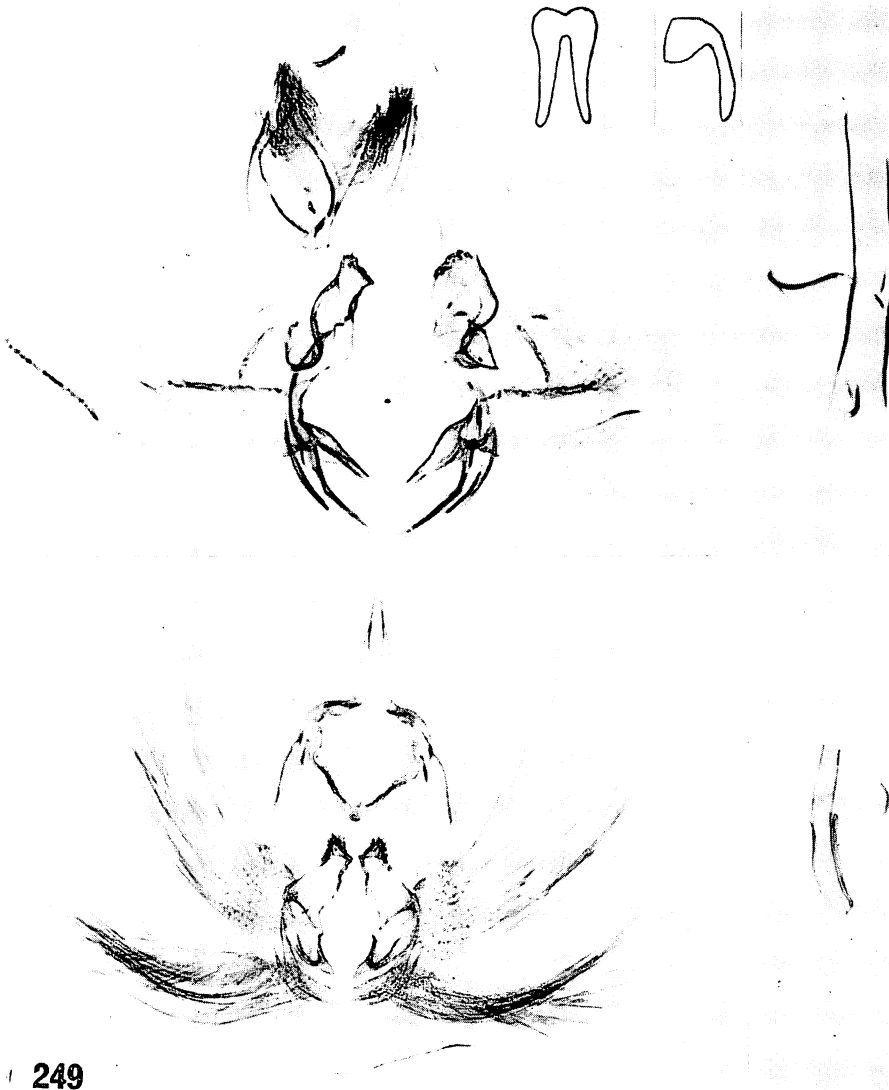
Figure 247—Male genitalia of *Spheterista flavocincta* (Walsingham). Top, from the holotype of the synonymous *trigonifer* Walsingham (BM slide 1970); Kona, 4,000 feet, Hawaii. Bottom, the same species from a specimen of the synonymous *santalata* Swezey, determined by Dr. Swezey (slide JDB 5); Opauala, Oahu; ex *Santalum*; the aedeagus is mounted in a different position.





248

Figure 248—*Spheterista* male genitalia. Top, *infaustana* (Walsingham), allotype (BM slide 1914); Kauai, 3,000 to 4,000 feet. The apex of the uncus is broken so I have added dorsal and lateral aspect sketches of a paratype (Busck slide 111; Walsingham specimen 27454); setae omitted and not to the same scale. Bottom, *plerotropiana* (Swezey), paratype (slide JDB 1); Halemanu, Kauai. I have added a sketch of the uncus as seen from the side with setae omitted and at a different scale. Note the strongly developed socii and the broad top of the tegumen. The slide was broken in transit after the photograph was taken, and I have remounted the specimen in a different position.



249

Figure 249—Male genitalia of *Spheterista*. Top, *oheoheana* (Swezey), determined by Dr. Swezey (slide JDB 4); Halemanu, Kauai. The apex of the uncus and part of the right valva are missing. I have sketched the caudal and lateral aspects of the uncus of another paratype (not to the same scale and with setae omitted) and have inserted the drawings. The socii are strongly developed. Bottom, *Spheterista* species from the specimen mentioned by Walsingham at the bottom of p. 710 of *Fauna Hawaiiensis* as being possibly allied to *pernitida* (BM slide 1919); see the moth illustrated on figure 240.

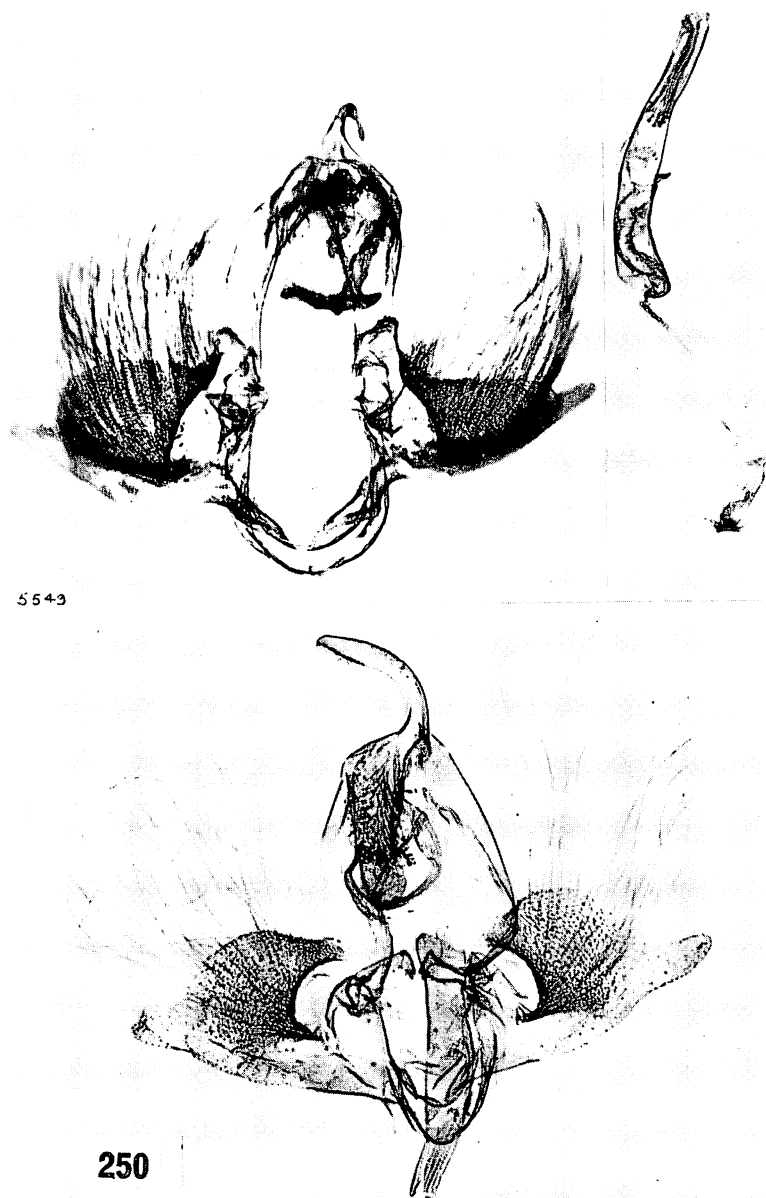


Figure 250—Male genitalia of *Spheterista pleonectes* (Walsingham). Top, from the holotype (BM slide 5549); Kilauea, Hawaii. Bottom, from a paratype of the synonym *asaphopsis* Meyrick (Busck slide 126); Mt. Kaala, Oahu. Compare figure 246, top.

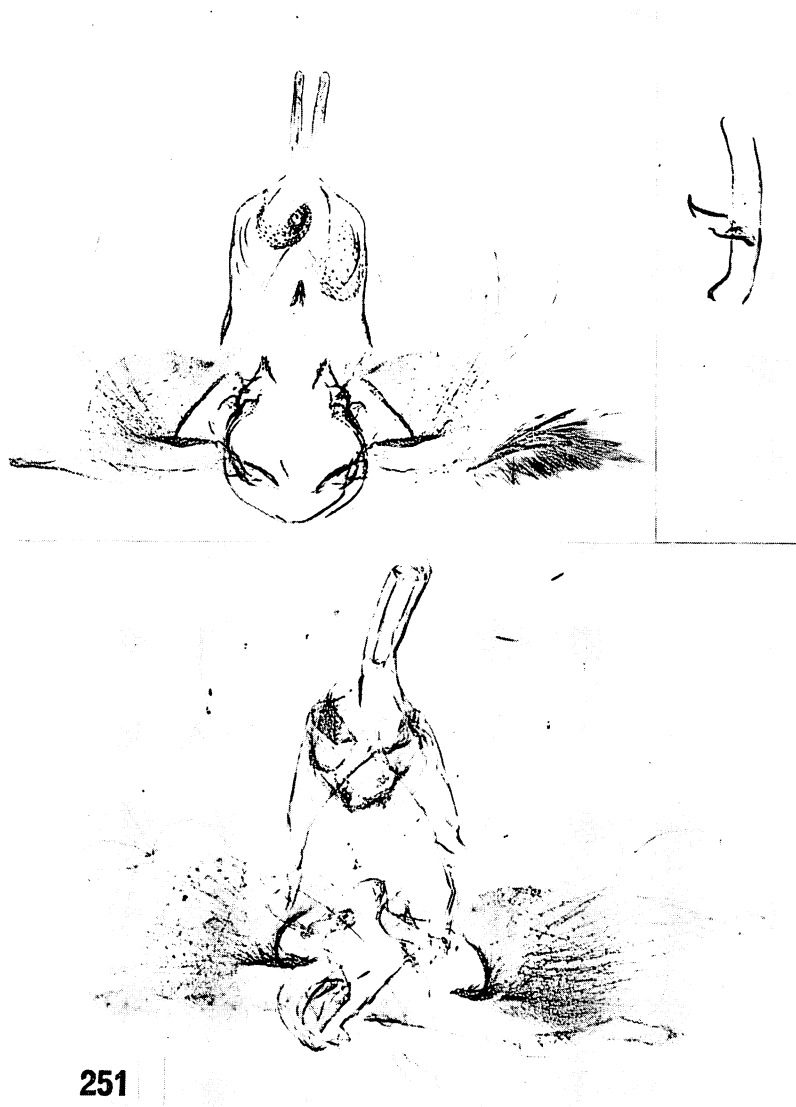


Figure 251—*Spheterista* male genitalia. Top, *fulva* (Walsingham), holotype (BM slide 1980); Kauai, 3,000 to 4,000 feet. Bottom, *tetraplasandra* (Swezey), paratype (Busck slide 143); Oahu. The genitalia of these two species resemble those of *ochreocuprea*, but there are differences in uncus, transtilla, and aedeagus.

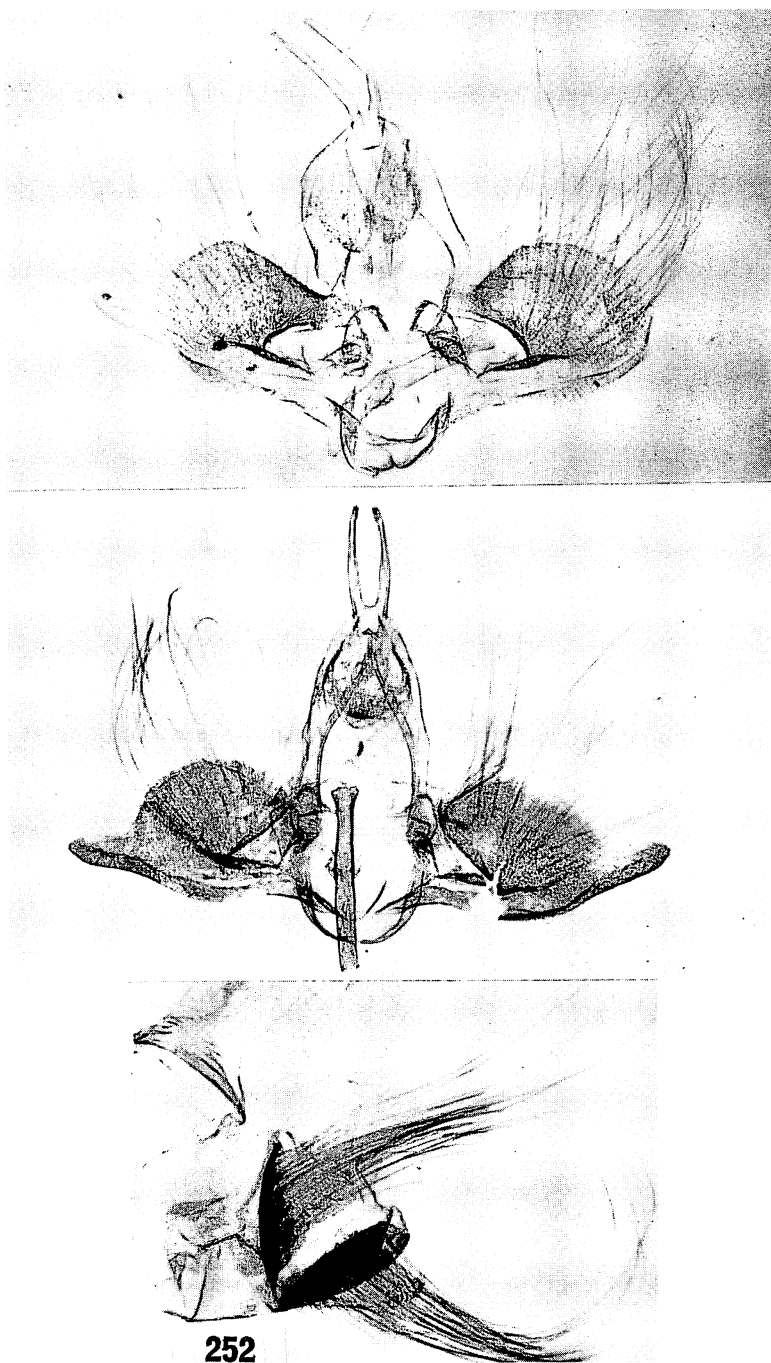
**252**

Figure 252—*Spheterista ochreocuprea* (Walsingham) male genitalia. Top, from a paratype (Busck slide 110; Walsingham specimen 27262); Kauai, 3,000 to 4,000 feet. Middle, from the holotype (BM slide 3849) from the same locality. Bottom, hair tufts on the eighth abdominal segment from the holotype.

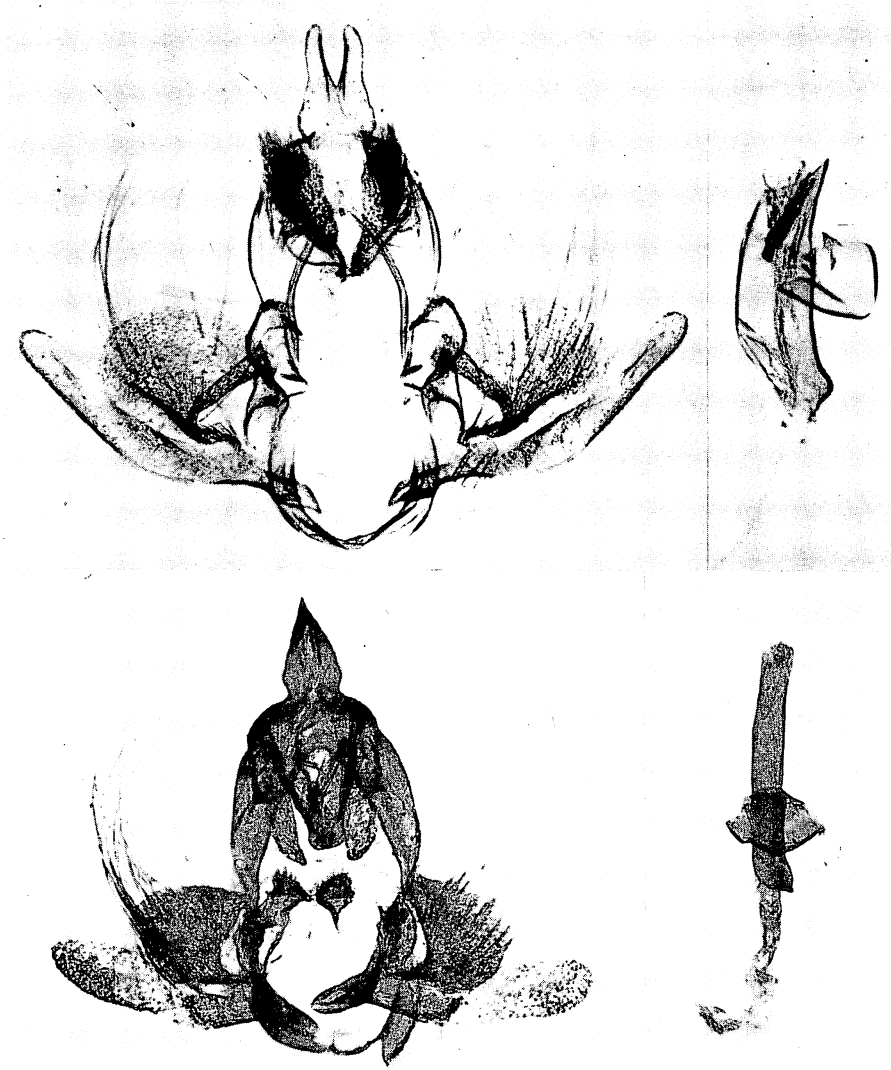
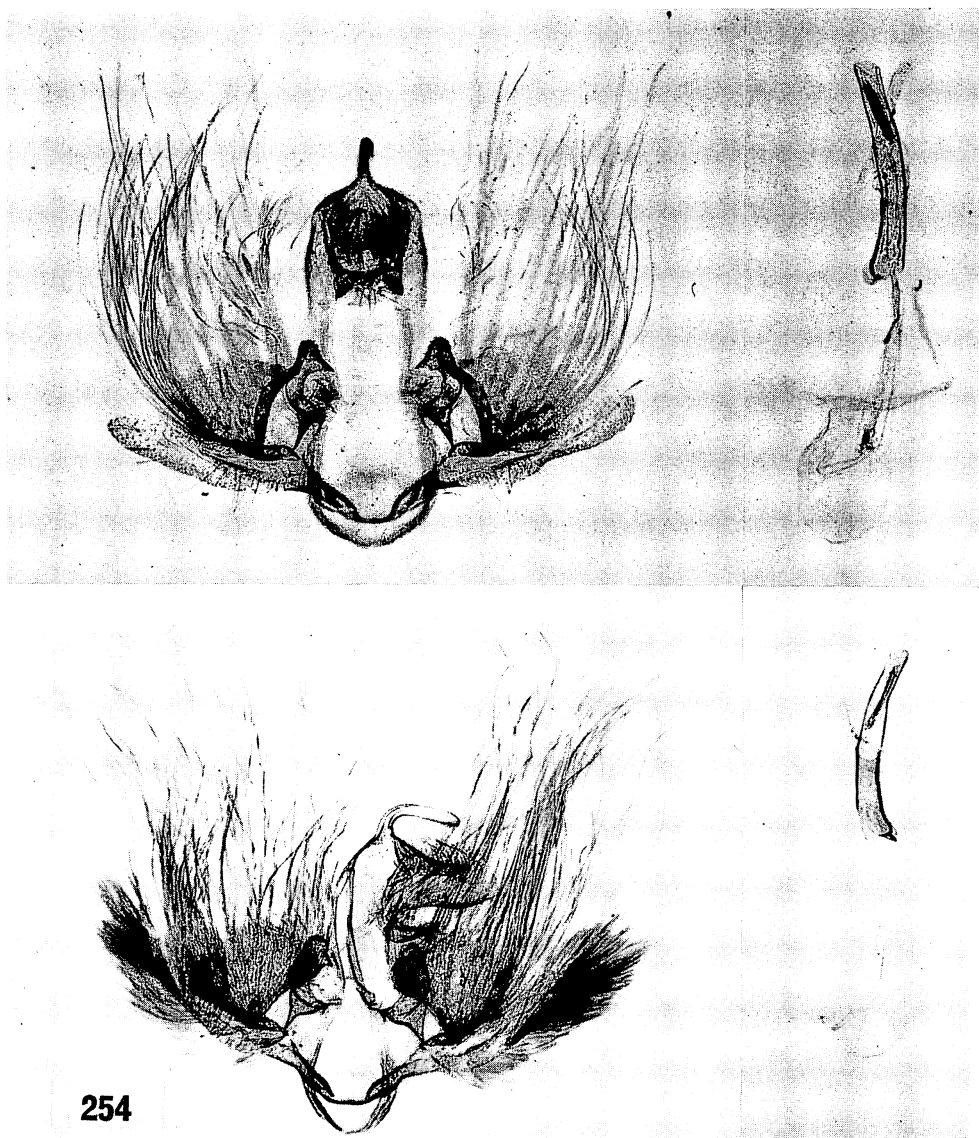
**253**

Figure 253—Male genitalia of *Spheterista*. Top, *reynoldsiana* (Swezey), paratype (slide Z-XII-62-11); Wailupe, Oahu. Bottom, *urerana* (Swezey), lectotype (slide Z-I-26-67); Mt. Tantalus, Oahu.



254

Figure 254—Male genitalia of *Spheterista variabilis* (Walsingham). Top, holotype (BM slide 9536 Clarke); Kahanui, Molokai. Bottom, from a paratype (BM slide 1973) called "var. D" by Walsingham; Molokai, over 4,500 feet. This figure shows the uncus, socius, and gnathus in lateral aspect.

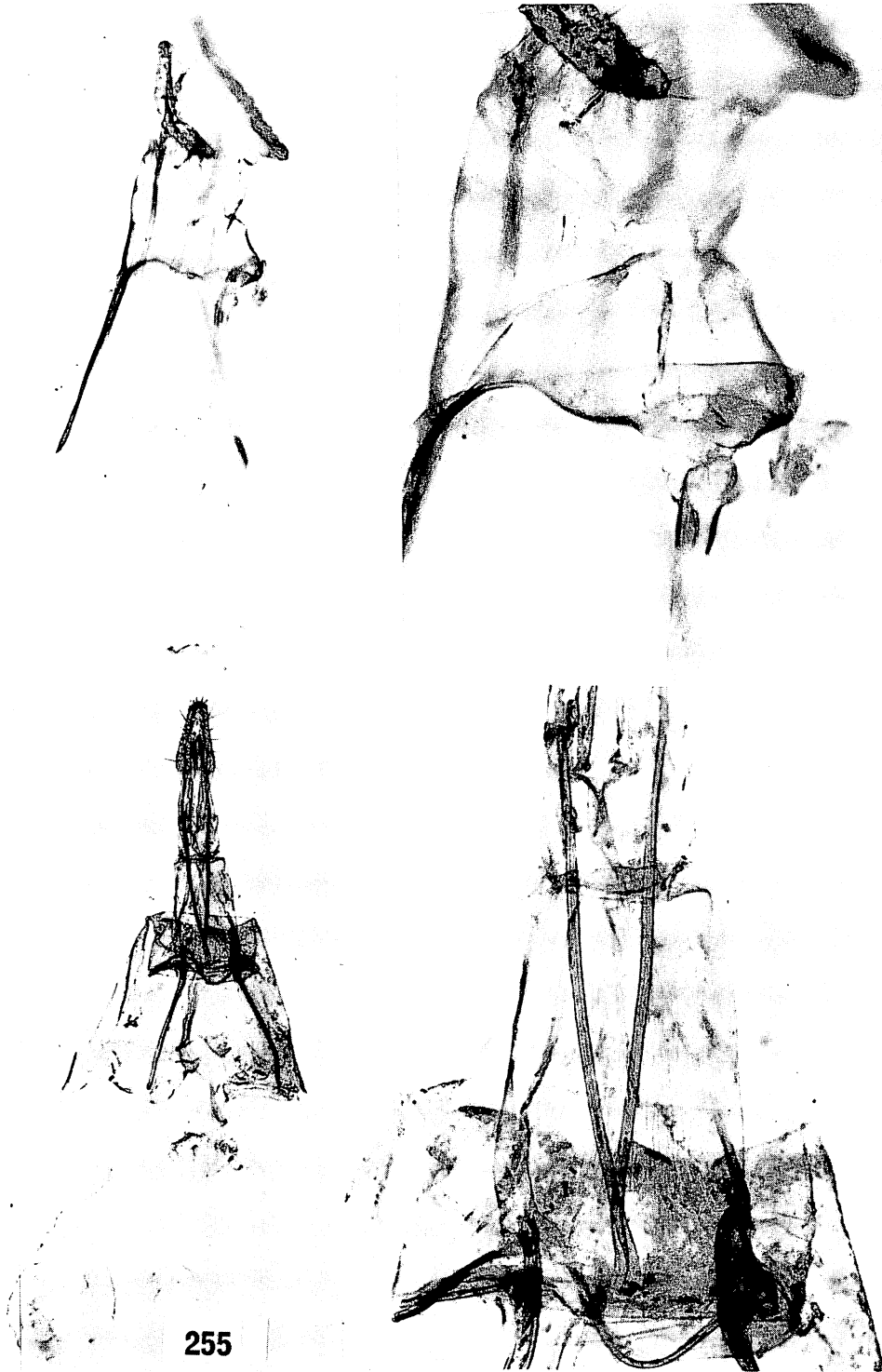


Figure 255—Female genitalia of *Spheterista*. Top, *argentinotata* (Walsingham), paratype (BM slide 1917); Hilo, 2,000 feet, Hawaii. Bottom, *pleonectes* (Walsingham), paratype (BM slide 7550); Kilauea, Hawaii.



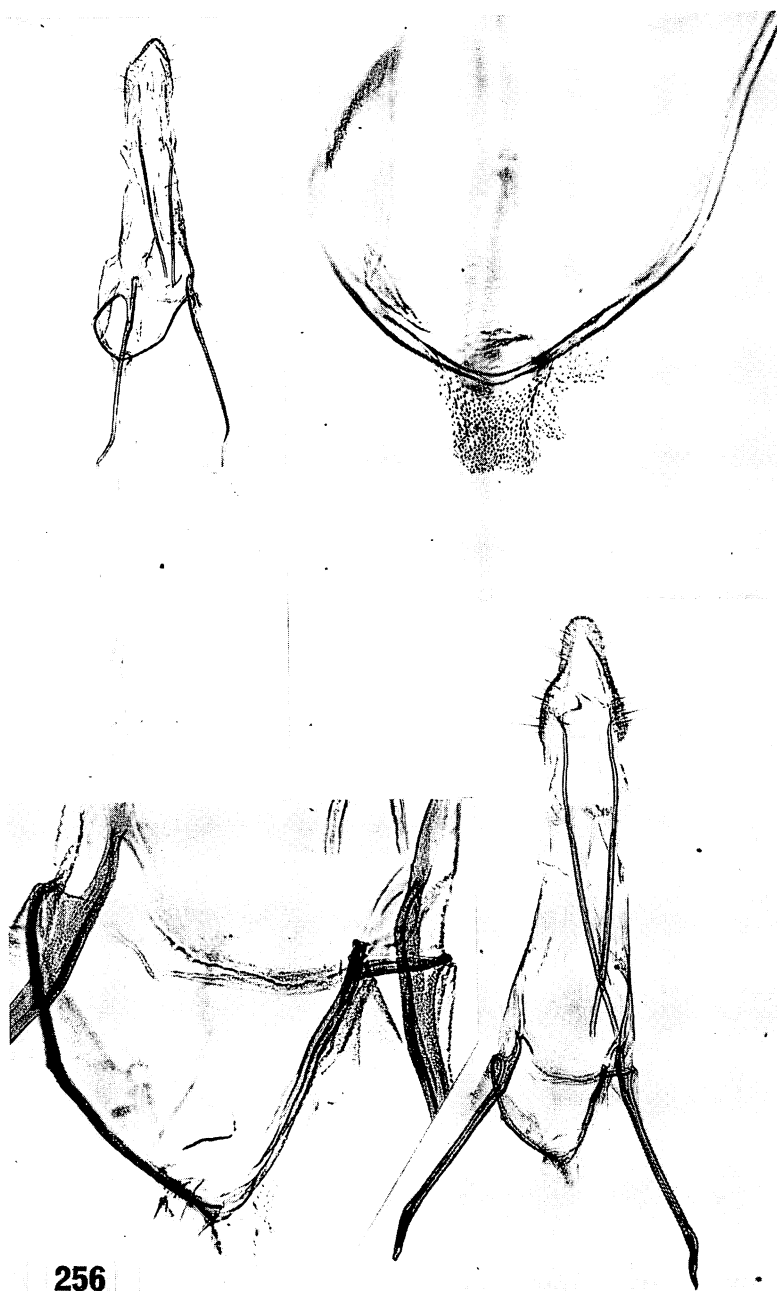
**256**

Figure 256—Female genitalia of *Spheterista*. Top, *pleonectes* (Walsingham) from the lectotype of the synonymous *asaphopis* Meyrick (BM slide 3894); Waianae, Oahu. The dotted area below the ostium is part of the torn ventral integument and may be misleading. Compare figure 263. Bottom, same species from the synonymous *castanea* Walsingham, holotype (BM slide 1982); Lihue, 4,000 feet, Kauai.

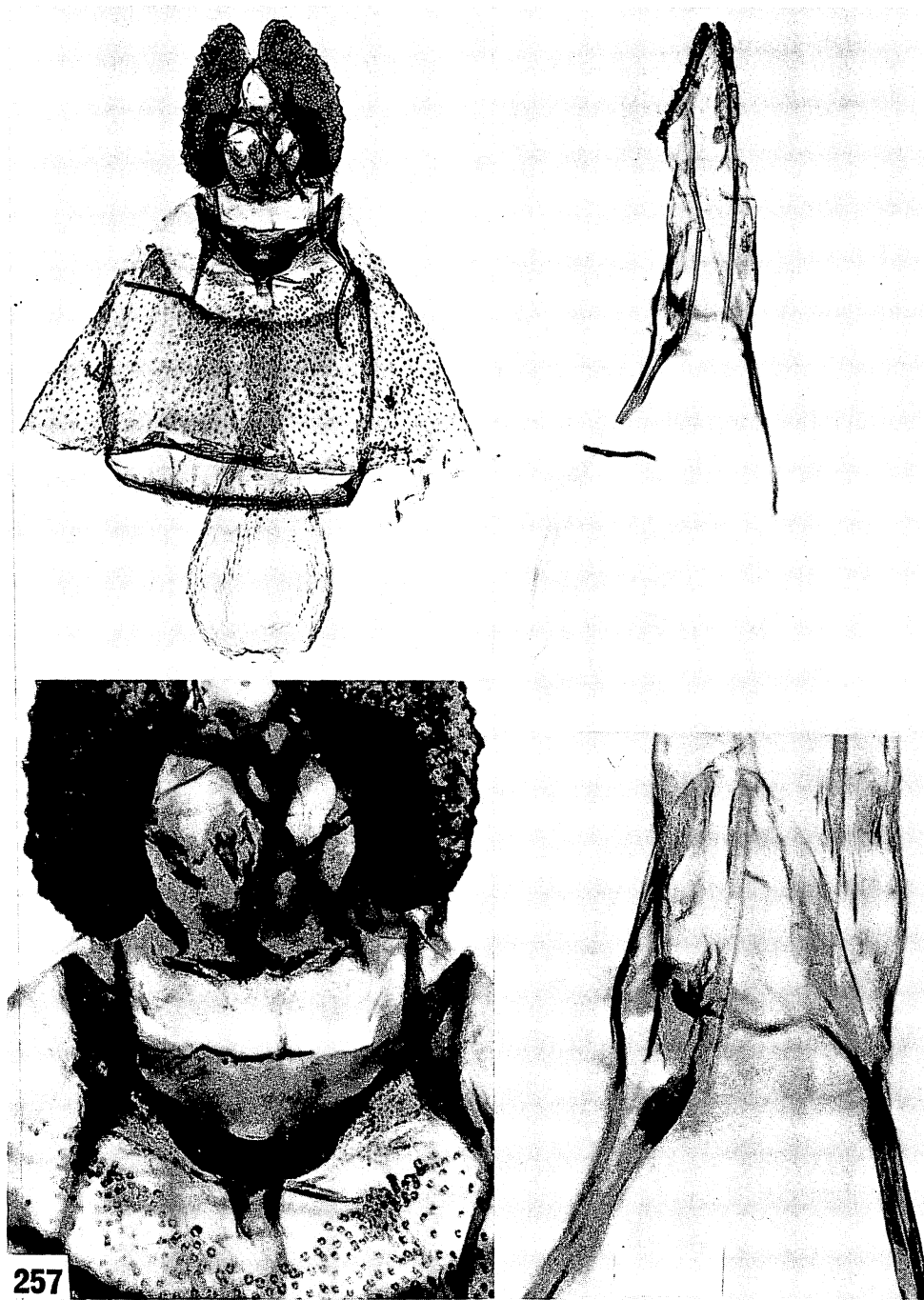


Figure 257—Female genitalia of *Spheterista*. Left, top and bottom, *cassia* (Swezey) (slide Z-IX-3-61-7); Kaena Point, Oahu. Note the short posterior apophyses; compare other species and note general resemblance to *xanthogona* in figure 267. Right, top and bottom, *infaustana* (Walsingham), holotype (BM slide 1915); Kauai, 3,000 to 4,000 feet; see also figure 258.

**Spheterista fulva** (Walsingham), (figs. 229, wing venation; 237, moth; 251, male genitalia).

*Capua fulva* Walsingham, 1907b:708, pl. 12, fig. 6.

*Capua fulva* variety *B* Walsingham, 1907b:708.

*Spheterista fulva* (Walsingham) Meyrick, 1913b:16.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham (1907b:709) said: "It is not impossible that these may be varieties of *Capua ochreocuprea*, but the unicolorous dark hindwings appear to separate them." *Spheterista fulva* is specifically distinct from *ochreocuprea*, and in addition to the differences noted in the coloration of the hindwings, the shapes of the forewings differ, and there are differences in the genitalia. The rather similar white spot on the forewing of each species may lead one to assume that they are the same species at first sight, but study will reveal obvious differences between the two species. I have not seen the female.

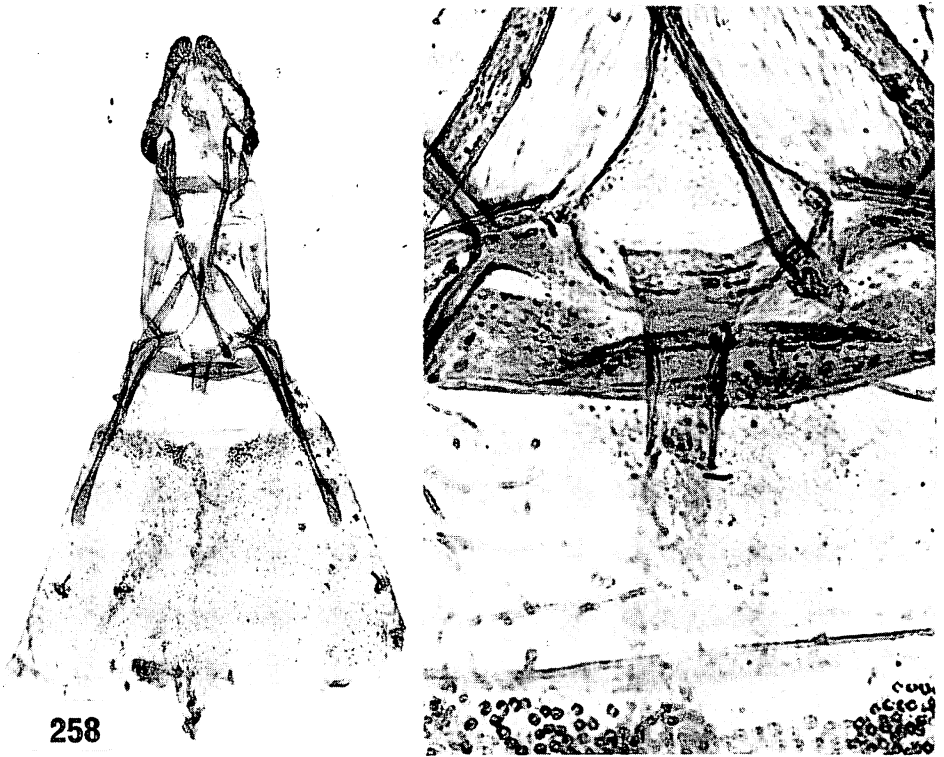


Figure 258—Female genitalia of *Spheterista infaustana* (Walsingham), paratype (BM slide 14314); Kauai, 3,000 to 4,000 feet. See also figure 257.

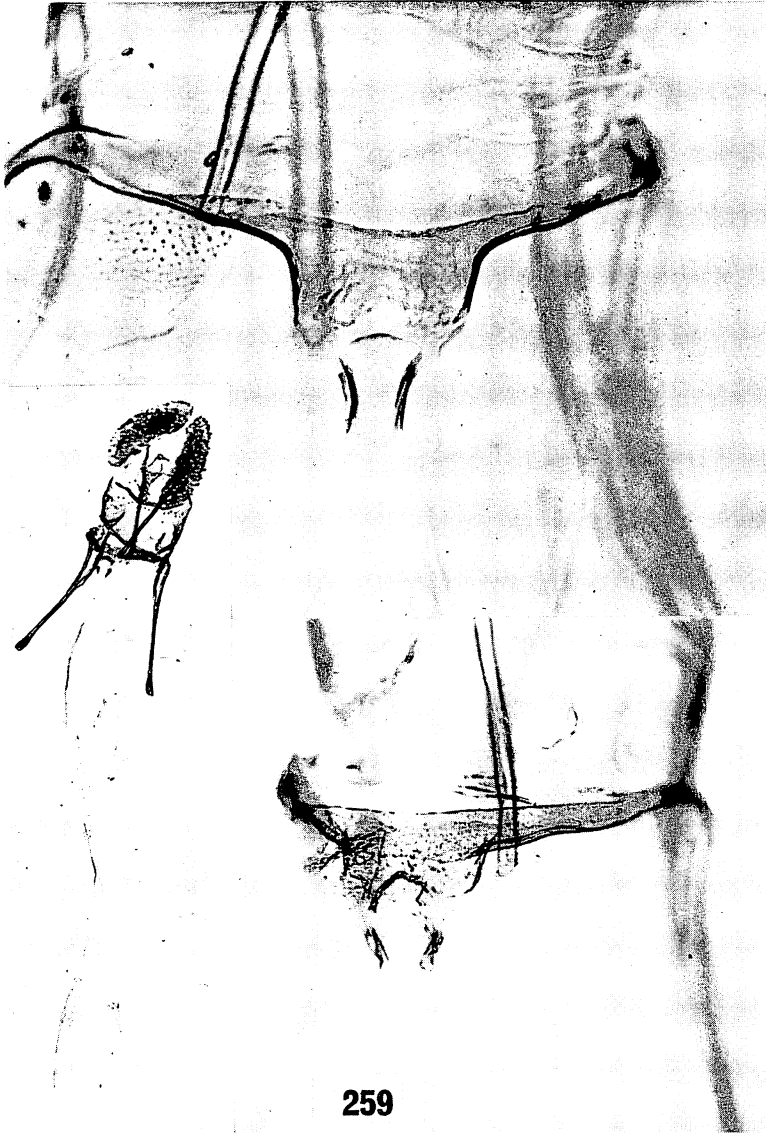


Figure 259—Female genitalia of *Spheterista*. Top, *flavocincta* (Walsingham), holotype (BM slide 1960); Kona, 4,000 feet, Hawaii. This species has a short ovipositor; the genitalia are rather similar to those of *flavopicta*. Bottom, left and right, *flavopicta* (Walsingham), holotype (BM slide 1971); Kauai, 3,000 to 4,000 feet.

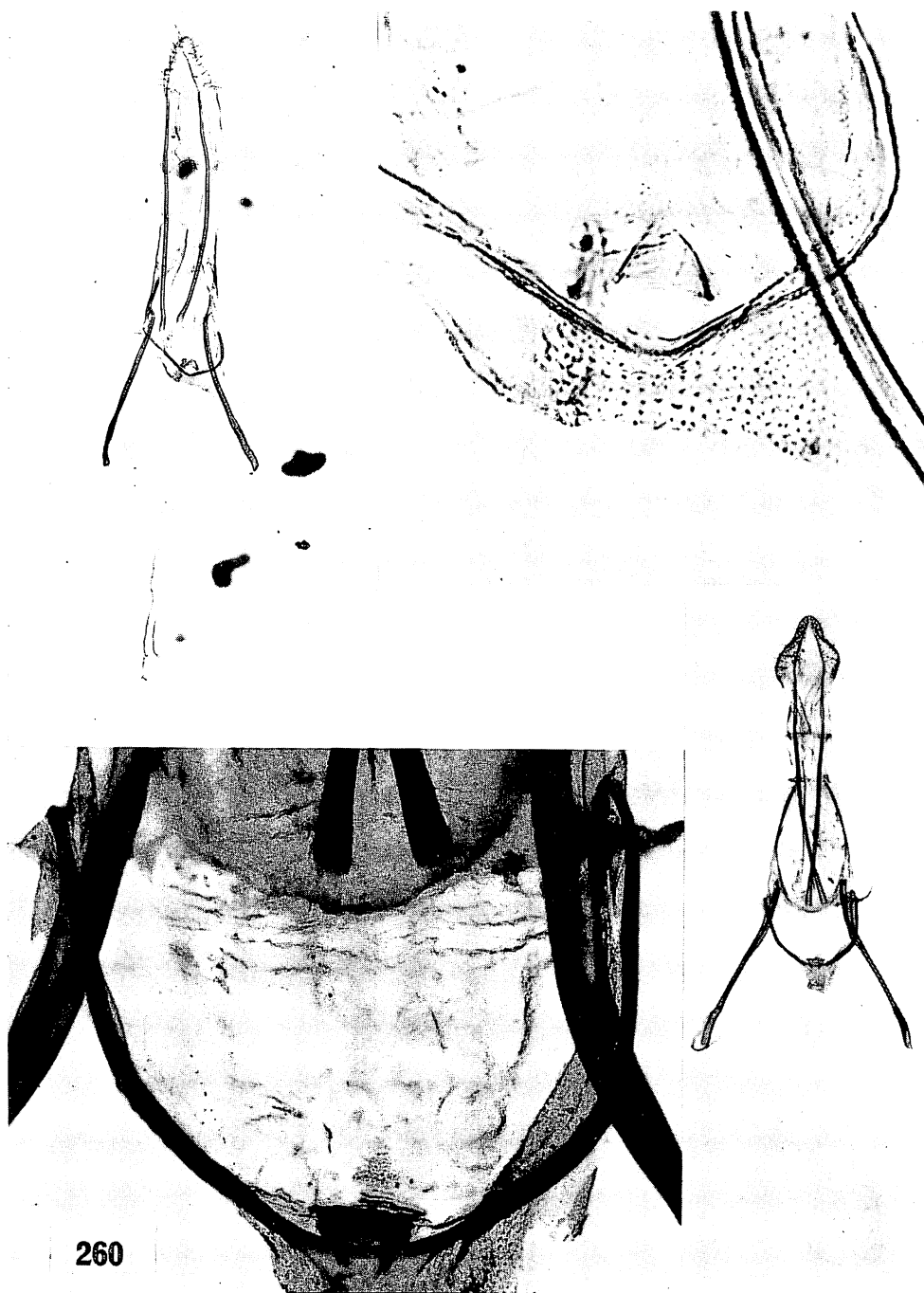


Figure 260—Female genitalia of *Spheterista*. Top, *glaucoviridana* (Walsingham), holotype (BM slide 1972); Kaholuamano, 4,000 feet, Kauai. Bottom, *variabilis* (Walsingham); paratype (BM slide 1974); Molokai, 4,000 feet.

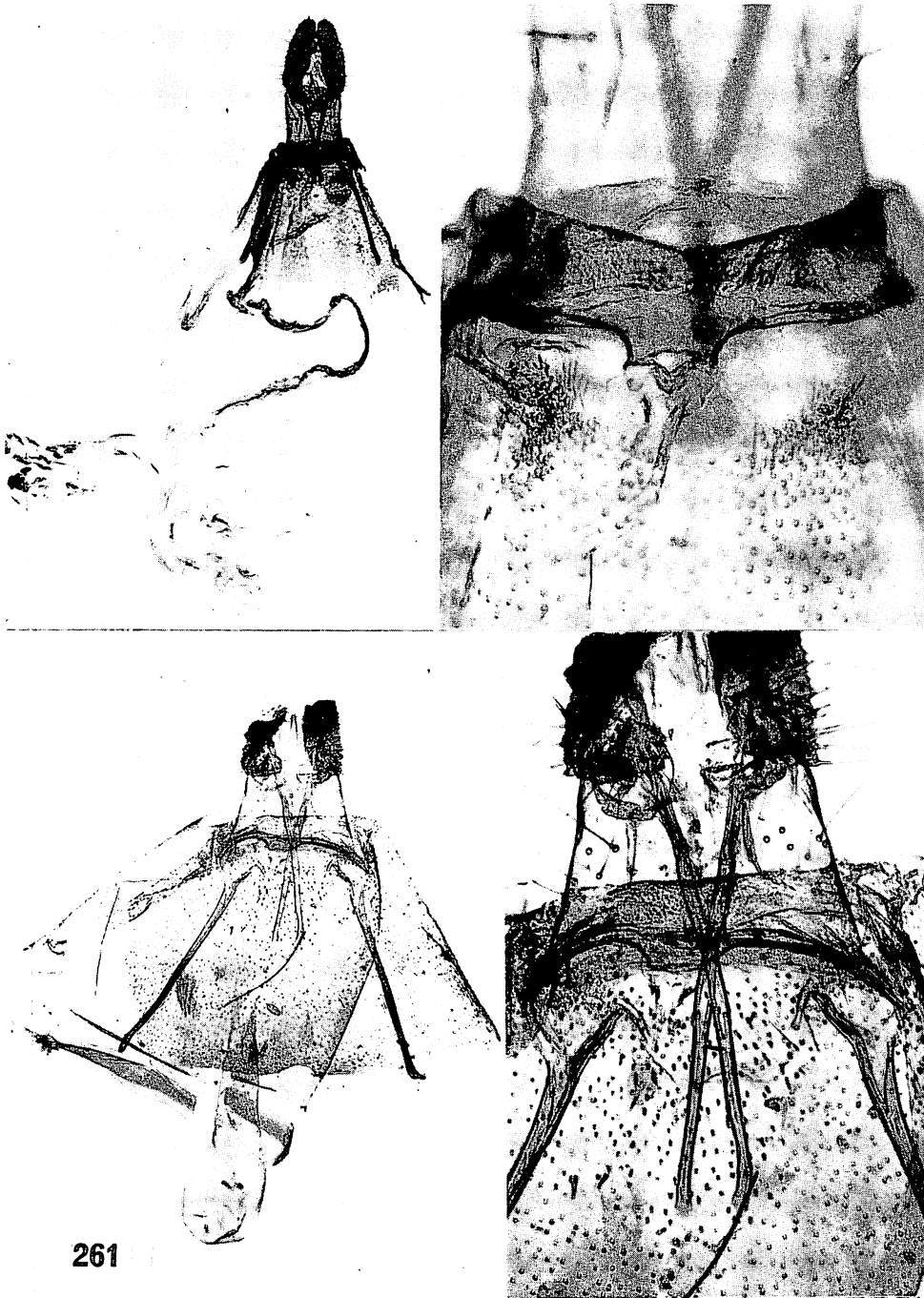


Figure 261—Female genitalia of *Spheterista*. Top, *ochreocuprea* (Walsingham), allotype (BM slide 3755); Kauai, 3,000 to 4,000 feet. Note that the bursa copulatrix is torn away and lost; this figure may be misleading if wrongly interpreted. Bottom, *tetraplasandra* (Swezey); Milolii, Kauai (slide Z-XII-62-10).

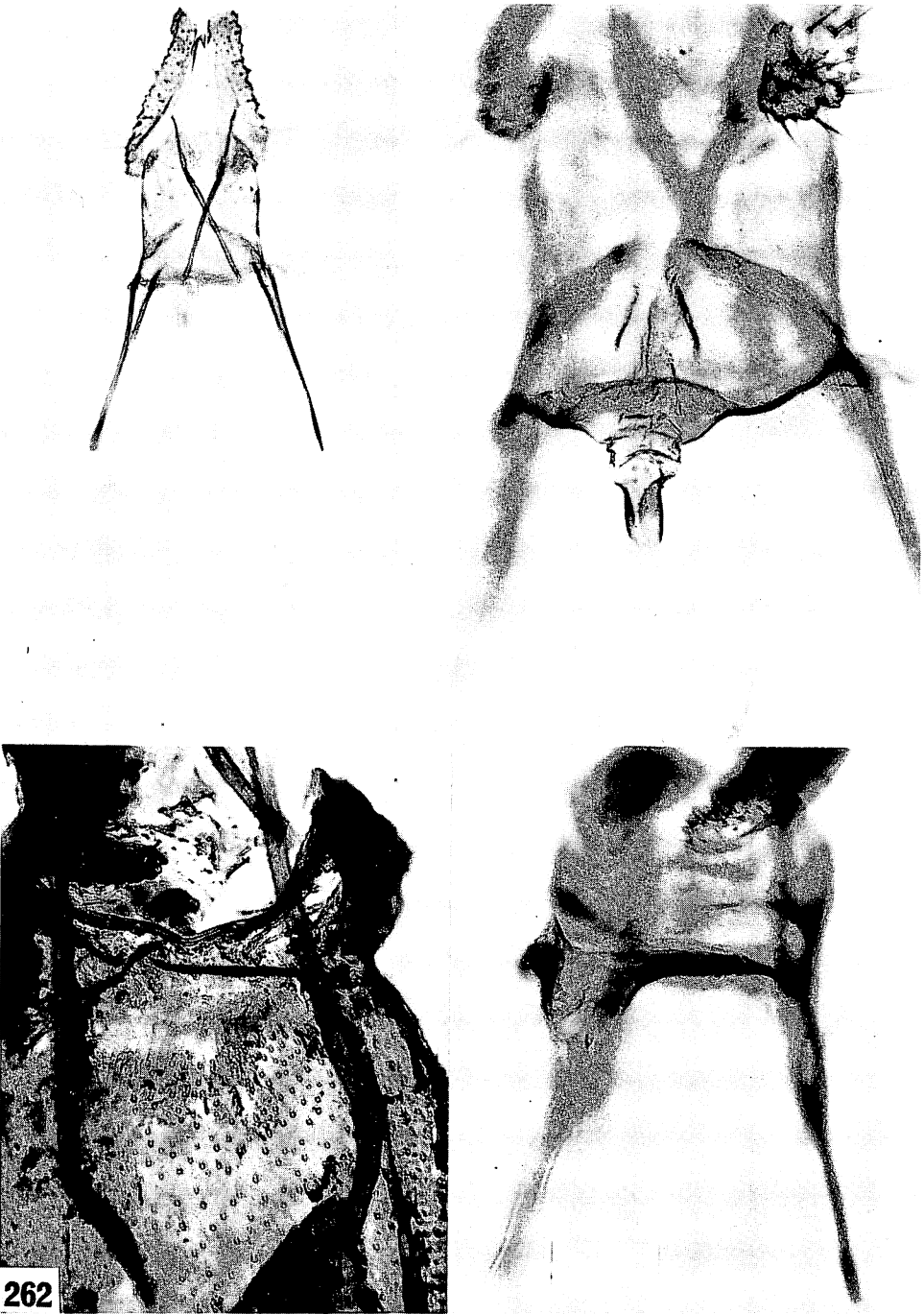


Figure 262—Female genitalia of *Spheterista*. Top, left and right, *pernitida* (Walsingham), holotype (BM slide 1918); Olaa, 2,000 feet, Hawaii. Bottom left, region of the ostium of *oheoheana* (Swezey), paratype, moldy and decomposed (slide Z-XII-62-6); Halemanu, Kauai; the posterior apophyses are long. Bottom right, *xanthogona* (Walsingham), holotype (BM slide 1916); Kona, 4,000 feet, Hawaii; see the better illustration of the paratype in figure 267.

**Spheterista glaucoviridana** (Walsingham), (figs. 237, moth; 260, female genitalia).

*Capua* (?) *glaucoviridana* Walsingham, 1907*b*:706, pl. 12, fig. 3.

*Spheterista glaucoviridana* (Walsingham) Meyrick, 1913*b*:16.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This species is known only from the female holotype.

**Spheterista infaustana** (Walsingham), **new combination** (figs. 229, wing venation; 238, moth; 248, male genitalia; 257–258 female genitalia).

*Epagoge infaustana* Walsingham, 1907*b*:709, pl. 12, fig. 7.

*Capua infaustana* (Walsingham), Meyrick, 1913*b*:13.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Molokai, Maui, Hawaii.

Hostplant: *Pipturus*.

Parasites: *Horogenes blackburni* (Cameron), *Pristomerus hawaiiensis* Perkins, *Sierola epagogeana* Fullaway, *Trathala flavo-orbitalis* (Cameron).

Dr. Swezey was the first to find this species on Oahu (Dr. Perkins had collected it on the other islands), and in 1923 (*Proc. Hawaiian Ent. Soc.* 5:181) he reported that he "had previously reared a few specimens from larvae boring in the tips of twigs of *Pipturus* on Tantalus. One tree was found in Makaleha Valley on which were hundreds of larvae. They were feeding on the leaves, skeletonizing them, and hiding in webbed-together leaves at the tip, or a bit of the turned-over edge. They pupated in similar places."

**Spheterista ochreocuprea** (Walsingham) (figs. 229, wing venation; 238, moth; 252, male genitalia; 261, female genitalia; col. pl. 2:3).

*Capua ochreocuprea* Walsingham, 1907*b*:708, pl. 12, fig. 5.

*Capua ochreocuprea* variety *B* Walsingham, 1907*b*:708.

*Spheterista ochreocuprea* (Walsingham) Meyrick, 1913*b*:16.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

This species is closely allied to and superficially resembles *fulva*, but it is distinct. The uncus is more deeply cleft in *ochreocuprea* and the armature of the transtilla differs. See other comparative notes under *fulva* above.

**Spheterista oheoheana** (Swezey), **new combination** (figs. 230, wing venation; 239, moth; 249, male genitalia; 262, female genitalia).

*Capua oheoheana* Swezey, 1933*b*:301.

Endemic. Kauai (type locality: Halemanu).

Hostplant: *Tetraplasandra* (= *Pterotropia*) *kauaiensis* ("ohe ohe").

Parasite: *Sierola* species.

The larvae and pupae of the type series were collected from dead twigs.



***Spheterista pernitida*** (Walsingham), **new combination** (figs. 240, moth; 262, female genitalia).

*Epagoge* (?) *pernitida* Walsingham, 1907*b*: 710, pl. 12, fig. 9.

*Capua pernitida* (Walsingham) Meyrick, 1913*b*: 15.

Endemic. Hawaii (type locality: Oloa, 2,000 feet).

Hostplant: unknown.

Only the female holotype is known.

I have listed at the end of the discussion of this genus as "*Spheterista* species?" the species mentioned by Walsingham at the bottom of p. 710 of *Fauna Hawaiiensis* as known from one worn male only.

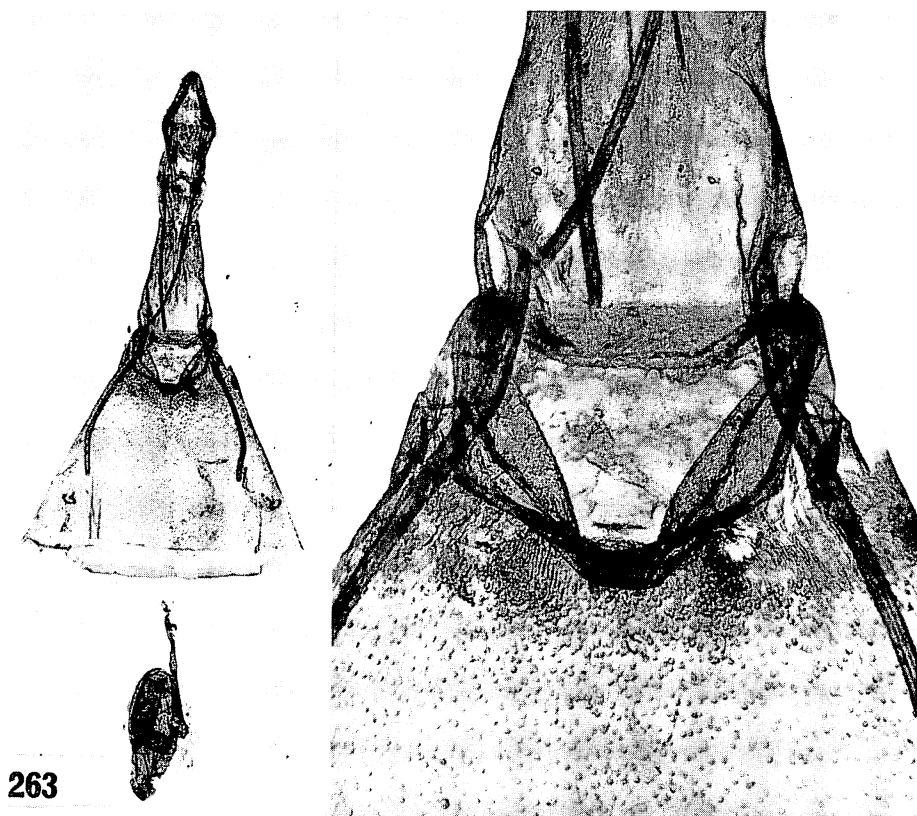


Figure 263—Female genitalia of *Spheterista pleonectes* (Walsingham), "cotype" (BM slide 14308); Kilauea, Hawaii.

**Spheterista pleonectes** (Walsingham) (figs. 230, wing venation; 234–235, 239, 241 [type], moth; 246, 250, male genitalia; 255–256, 263 female genitalia; col. pl. 1:5).

*Capua pleonectes* Walsingham, 1907b:705, pl. 12, fig. 1.

*Spheterista pleonectes* (Walsingham) Meyrick, 1913b:16.

*Capua castaneana* Walsingham, 1907b:705, pl. 12, fig. 2. Type locality: Kauai, male, 3,000 to 4,000 feet; female, Lihue, 4,000 feet.

*Spheterista castaneana* (Walsingham) Meyrick, 1913:16. **New synonym.**

*Spheterista asaphopis* Meyrick, 1928c:96. Type locality: Mt. Kaala, Oahu.

**New synonym.**

Endemic. Kauai, Oahu, Hawaii (type locality: Kilauea).

Hostplant: *Cheirodendron gaudichaudii*.

Parasites: *Horogenes blackburni* (Cameron), *Pristomerus hawaiiensis* Perkins, *Trichogramma semifumatum* (Perkins).

Swezey (1954:49), speaking of *Spheterista pleonectes*, *castaneana*, and *asaphopis*, said: "The green larvae of these moths feed between webbed leaves of *Cheirodendron*, and appear to be attached to this tree. The species are variable, and the three could be considered a single species. Caterpillars (perhaps one of the above-named species) were found on *Cheirodendron* on Maui, but none was reared. Instead, these parasites emerged: *Horogenes blackburni* (Cameron) . . . and *Pristomerus hawaiiensis* Perkins. . . ."

Further studies, including examinations of the genitalia, show that *castaneana* and *asaphopis* are synonyms, as suggested by Dr. Swezey. I was not prepared, however, to discover that the male and female genitalia of the specimens of these brown forms are similar to those of the very different appearing moths described as *variabilis*. One can hardly believe that they are color forms of a single species, but that is what they appear to be. We may have here one of those extraordinary assemblages of remarkably distinct color forms as are found in some of the European *Acleris* such as *Acleris hastiana* (Linnaeus), *Acleris literana* (Linnaeus), and *Acleris cristana* (Denis and Schiffermüller) which have been studied carefully by British entomologists. John Bradley and Arthur Smith (1962:117) have published colored plates showing 20 color forms of *Acleris literana*, and the extremes shown there are as great as the differences displayed by the series of Hawaiian tortricids resting under the names *variabilis*, *pleonectes*, *castaneana*, and *asaphopis*. Although the genitalia of *pleonectes* and *variabilis* appear to be identical, none of the *pleonectes* forms have been found with the *variabilis* forms. For the present, therefore, it may be best to list them temporarily as distinct entities until further studies have been made. The brown *pleonectes* forms have been found on Kauai, Oahu, and Hawaii, whereas all of the *variabilis* specimens have been collected on the adjacent islands of Molokai and Maui.

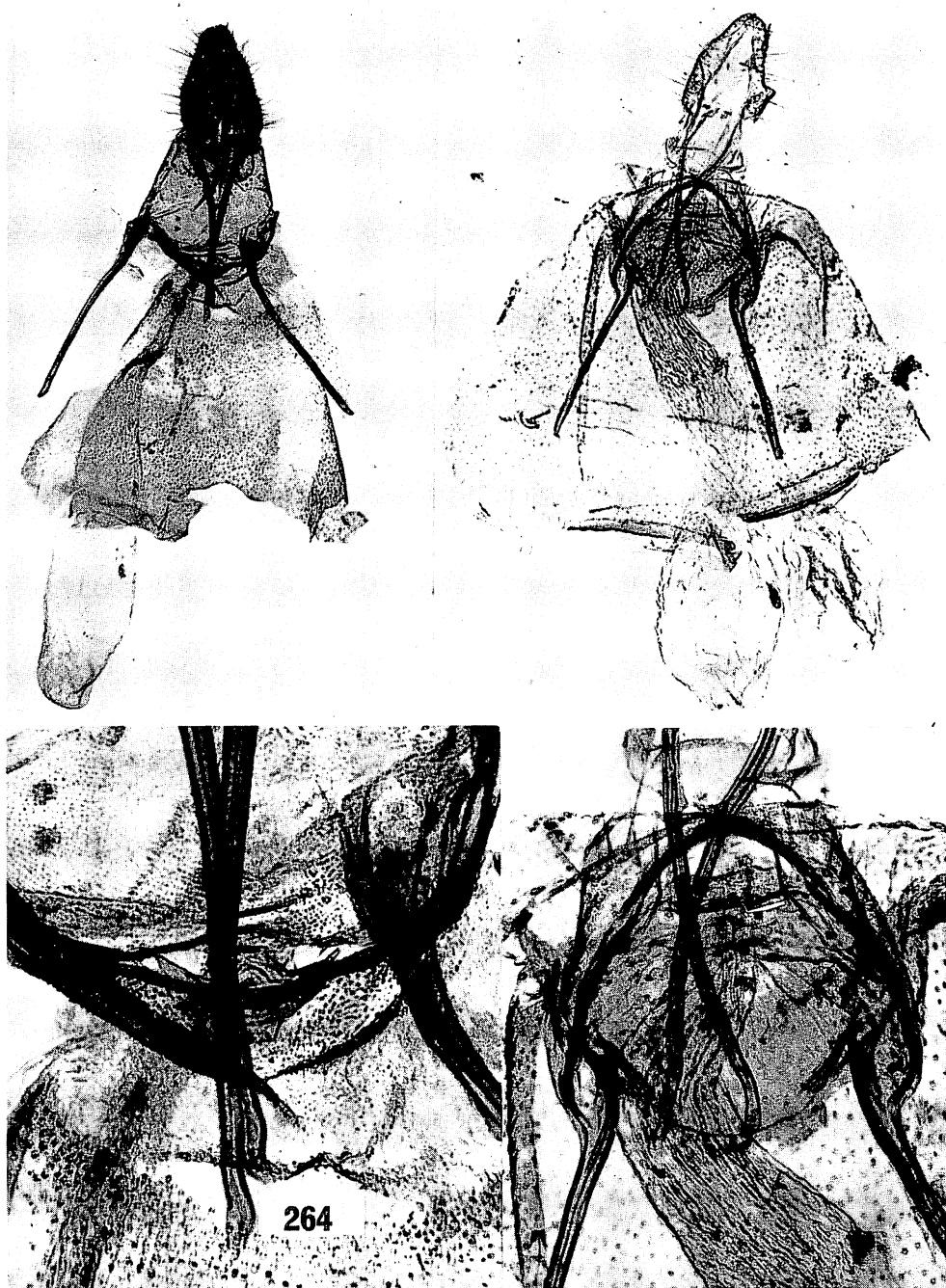


Figure 264—Female genitalia of *Spheterista*. Left, top and bottom, *plerotropiana* (Swezey), paratype (BM slide Z-XII-62-7); Halemanu, Kauai. Right, top and bottom, *reynoldsiana* (Swezey), paratype (slide Z-XII-62-12); Wailupe, Oahu. The signalike spots in the bursa are debris.

**Spheterista pterotropiana** (Swezey), **new combination** (figs. 230 wing venation; 232, pupa; 241, moth; 248, male genitalia; 264, female genitalia).

*Capua pterotropiana* Swezey, 1933b:301.

Endemic. Kauai (type locality: Halemanu).

Hostplant: *Tetraplasandra* (= *Pterotropia*) *kauaiensis*. The larvae of this beautiful green-marked species feed in the terminal buds of the hostplant.

The caudal process of the pupa has two widely spaced, strongly hooked, dorsal setae, each of which arises from beneath the edge of a transverse carina. Another similar seta arises on each side from beneath the lateral edge of the caudal process. Beneath the caudal edge of the caudal process are four stout, bent-tipped setae (not hooked or recurved).

**Spheterista reynoldsiana** (Swezey), **new combination** (figs. 231, wing venation; 233, pupa; 241, moth; 253, male genitalia; 264, female genitalia).

*Capua reynoldsiana* Swezey, 1920b:384, figured; 1954:180, fig. 31.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Reynoldsia sandwicensis*.

Parasites: *Brachymeria obscurata* (Walker), *Echthromorpha agrestoria fuscator* (Fabricius), *Ephialtes hawaiiensis* (Cameron), *Trathala flavo-orbitalis* (Cameron).

"The caterpillar is green and spins together leaves to feed between. It pupates in spun-together leaves. The pupa is brown, 7–10 mm. long, with the usual two dorsal transverse rows of minute spines or serrations on the abdominal segments." (Swezey, 1920b:385.)

The pupa has two strongly hooked setae situated dorsally on each side of the base of the caudal process, and each pair arises from beneath the edge of an oblique costate elevation. Beneath the caudal margin of the caudal process there are four stout setae, the median pair of which are each apically moderately hooked whereas the lateral setae have strongly curled apices.

**Spheterista tetraplasandra** (Swezey) (figs. 230, wing venation; 233, pupa; 242, moth; 251, male genitalia; 261, female genitalia).

*Capua tetraplasandra* Swezey, 1920b:385.

*Spheterista tetraplasandra* (Swezey) Swezey, 1933a:241.

Endemic. Oahu (type locality: Kaumuahona).

Hostplant: *Tetraplasandra*. The larvae have been found in the fruits and on the leaves of the hostplant.

The caudal process of the pupa has two long, hooked, dorsal setae which arise from elongate elevations. A similar seta is laterad to each of the dorsal setae, but it arises from beneath the lateral margin of the caudal process. From beneath the caudal margin of the caudal process arise four stout, hook-tipped setae.

***Spheterista urerana* (Swezey), new combination** (figs. 232, pupa; 243, moth; 253, male genitalia).

*Epagoge urerana* Swezey, 1915e:93.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: *Ureria sandwicensis*.

Dr. Swezey found the "larvae boring in twigs . . . near growing tip of new shoots." He described the larva and pupa as follows (1915e:93-94):

**LARVA.** Full-grown larva about 12 mm.; pale greenish, head pale testaceous, eyes black, lateral margin of head with a black line beginning a little back of eyes; cervical shield fusco-testaceous, tubercles distinctly slightly infuscated, those of line ii [D2] wider apart than those of line i [D1]; spiracles circular, dark margined; skin minutely roughened; anal comb of five stiff bristles.

**PUPA.** About 7 mm.; pale yellowish brown; wing-sheaths and posterior leg-sheaths extend to apex of 4th abdominal segment; antenna-sheaths shorter; segments 3-7 with two transverse rows of very fine backwardly directed spines, one row on segments 2, 8 and 9 . . . spiracles slightly raised. Pupa enclosed in cocoon made by rolled-over edge of dead leaf.

The pupa has two comparatively short, curved, hooked setae on each side of the caudal process. There are four apical setae: two heavy, divergent, sharp, thornlike, apical setae between and beneath which there are two stout, strongly recurved setae.

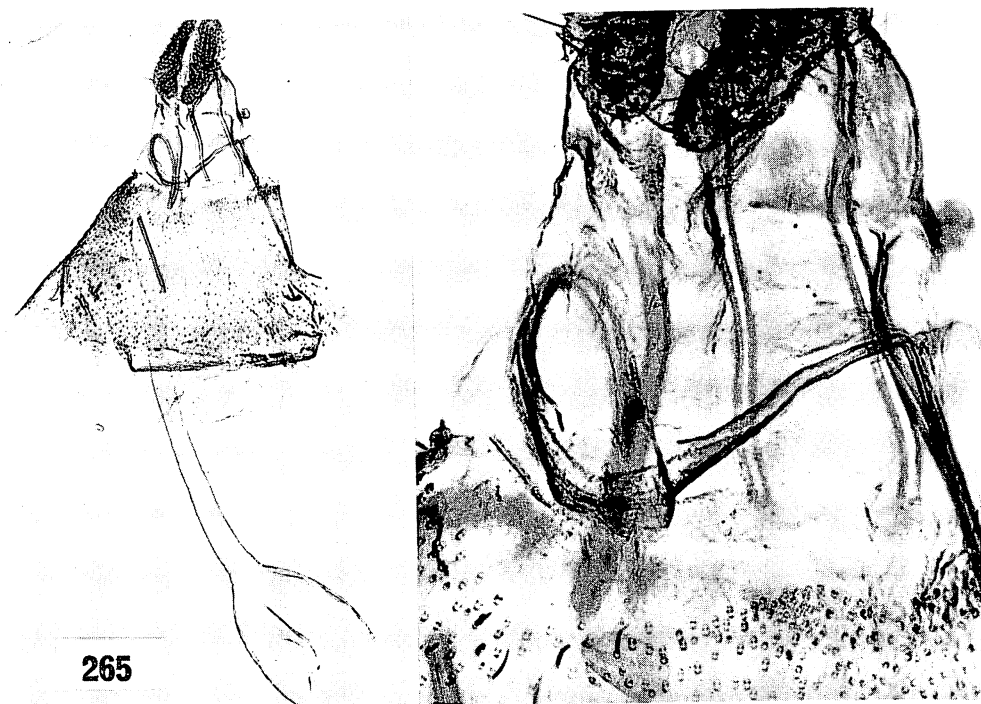


Figure 265—Female genitalia of *Spheterista flavocincta* (Walsingham) from a specimen of the synonym *santalata* Swezey; Palolo, Oahu (slide Z-XII-62-9).

This species was described from four specimens reared from larvae. There were two male examples on the cork mount marked "Type", and evidently Dr. Swezey considered them to be male and female. As my illustrations demonstrate, however, they are both males. I have designated the specimen nearest the pin as the lectotype male and have removed the other specimen from the mount and designated it as a paralectotype. The specimens are in Bishop Museum. I have not studied a female.

***Spheterista variabilis*** (Walsingham) (figs. 225, head, wing venation; 244, moth; 254, male genitalia; 260, 266, female genitalia; col. pl. 2:2).  
*Capua variabilis* Walsingham, 1907*b*:706, pl. 12, fig. 4. Molokai.  
*Capua variabilis* variety *B* Walsingham 1907*b*:707. Maui.  
*Capua variabilis* variety *C* Walsingham, 1907*b*:707. Maui.  
*Capua variabilis* variety *D* Walsingham, 1907*b*:707. Molokai.  
*Capua variabilis* variety *E* Walsingham, 1907*b*:707. Molokai.  
*Spheterista variabilis* (Walsingham) Meyrick, 1912*a*:2; 1913*b*:16, pl. 4, fig. 60. Clarke, 1958:228, pl. 114, figs. 1-1*d*.

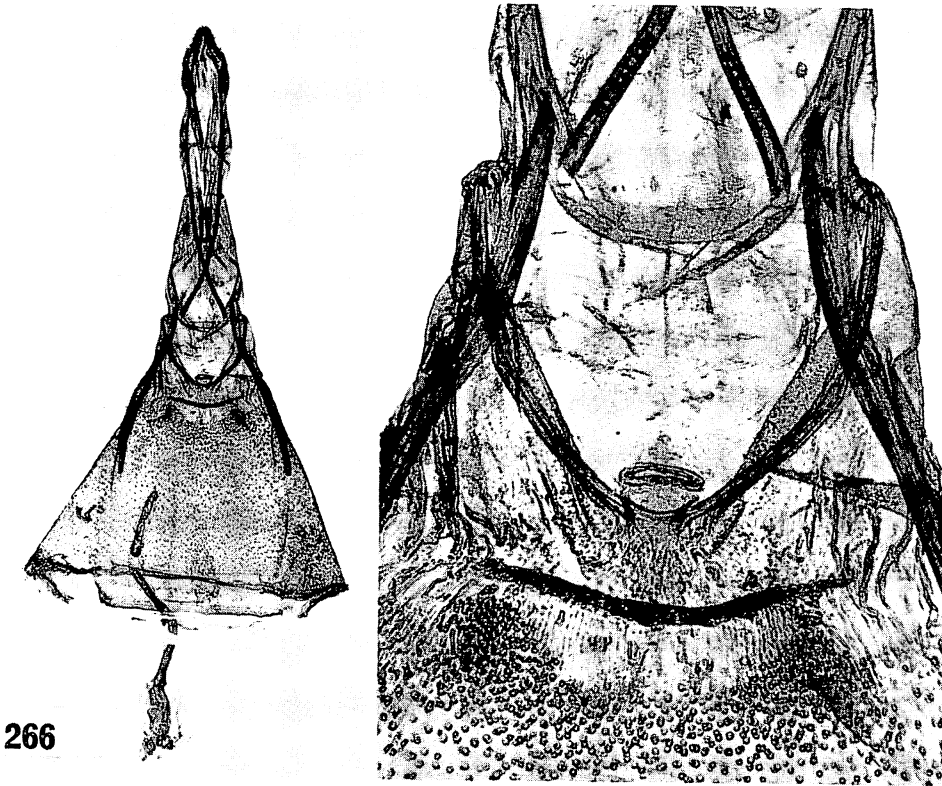


Figure 266—Female genitalia of *Spheterista variabilis* (Walsingham), paratype (BM slide 14309); Molokai, 4,000 feet.

Endemic. Molokai (type locality: Kahanui), Maui.

Hostplant: unknown, but presumed to be *Cheirodendron*.

This may be a color form of *pleonectes*, as astonishing as that may seem. See the discussion under *pleonectes*, above.

***Spheterista xanthogona*** (Walsingham), **new combination** (figs. 244, moth; 262, 267, female genitalia).

*Epagoge* (?) *xanthogona* Walsingham, 1907*b*:710, pl. 12, fig. 8.

*Capua xanthogona* (Walsingham) Meyrick, 1913*b*:14.

Endemic. Hawaii (type locality: Kona, 4,000 to 5,000 feet).

Hostplant: unknown.

Only two females of this moth are known. It is an unusual species whose status will remain uncertain until the male is discovered.



Figure 267—Female genitalia of *Spheterista xanthogona* (Walsingham); paratype (BM slide 14313); Kona, 4,000 feet, Hawaii.

**Spheterista species?** (figs. 240, moth; 249, male genitalia). Walsingham, 1907b: 710, bottom of page.

Endemic. Hawaii (Hilo, 2,000 feet).

The status of the species mentioned by Walsingham immediately following his discussion of *pernitida* remains uncertain. It may be an unnamed species. The male genitalia (BM slide 1919) are evidently unlike those of the other species I have studied, but, because the males of *argentinotata*, *glaucoviridana*, *pernitida*, and *xanthogona* are unknown to me, I cannot now form a conclusion regarding the single specimen.

### Genus **EPIPHYAS** Turner

*Epiphyas* Turner, 1927: 125. Type-species: *Epiphyas eucyrta* Turner, by original designation.

*Austrotortrix* Bradley, 1956: 101. Type-species: *Teras postvittana* Walker, by original designation. Synonymy by Common, 1961: 177.

Because of weaknesses in the original description, the generic name *Epiphyas* was misunderstood and mostly forgotten until Ian Common published his paper in 1961 (p. 177). Under the circumstances, Bradley was fully justified in erecting the now synonymous name *Austrotortrix*. Common gave a new and corrected description of the genus, and he assigned 32 Australian species to it.

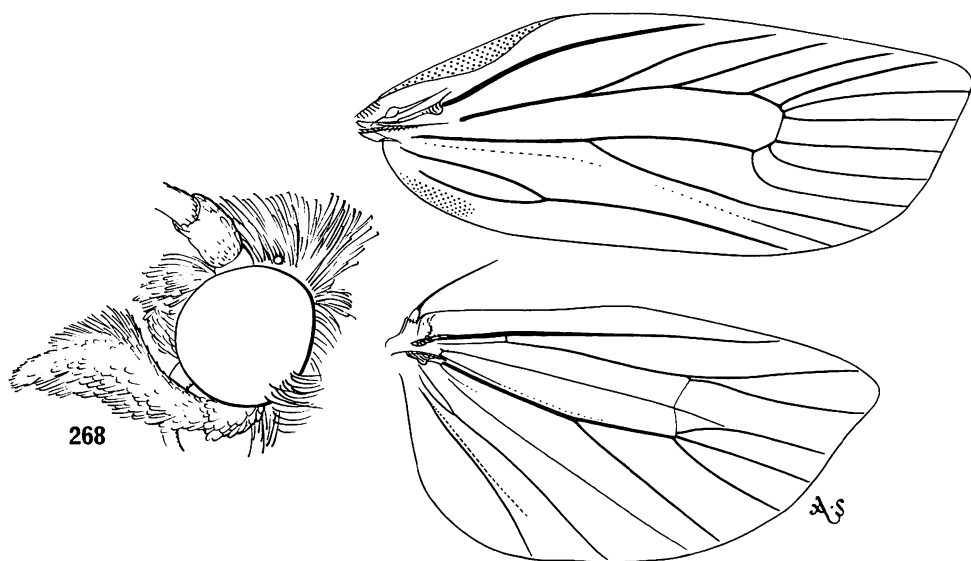


Figure 268—Head and wing venation of *Epiphyas postvittana* (Walker). Male specimens from Melbourne, Australia (BM slide 1957).



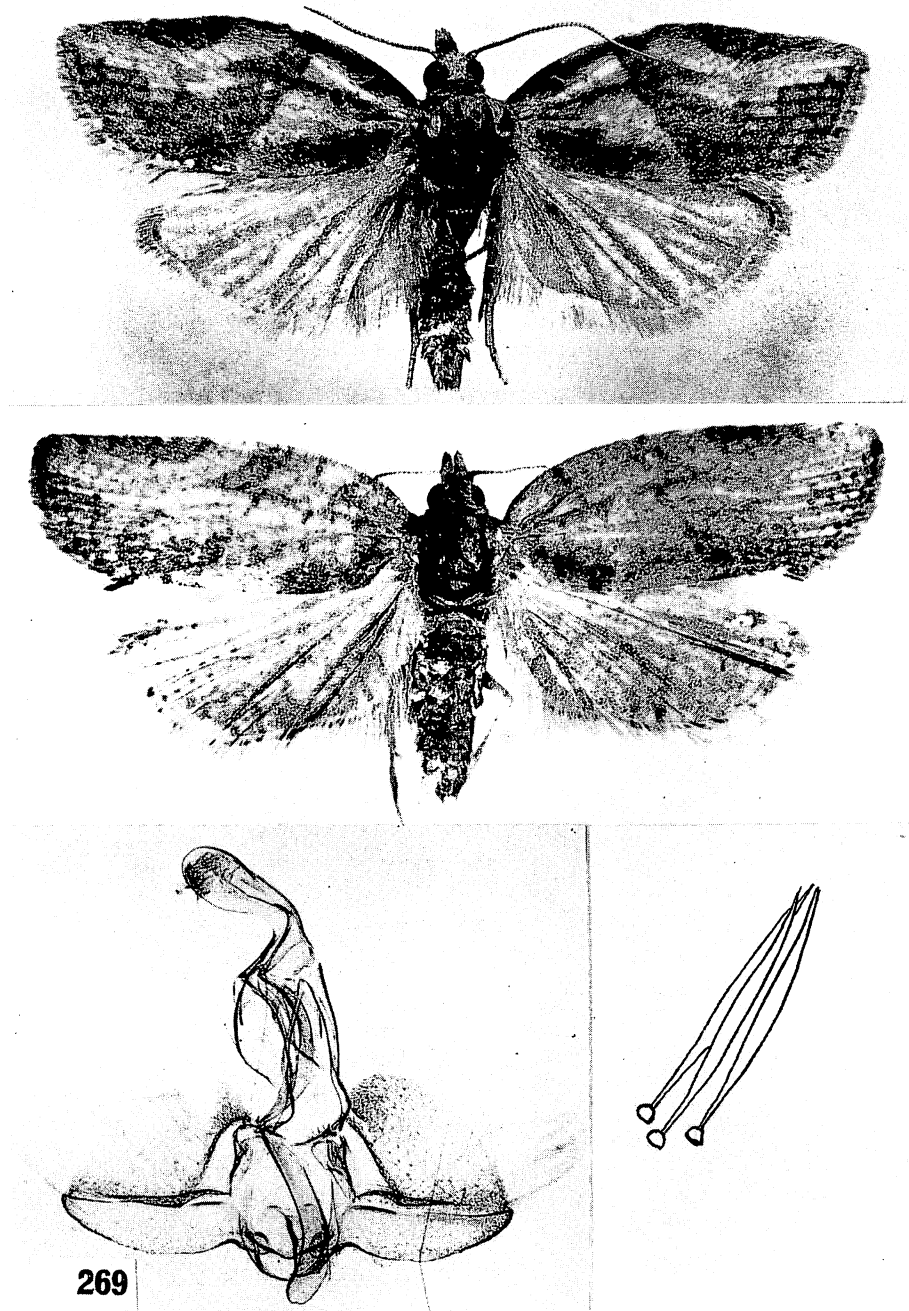


Figure 269—*Epiphyas postvittana* (Walker). Top, a specimen from Puu Kapele, Kauai, ex *Dodonaea*; forewing 9.5 mm. Middle, a paler specimen from Honolulu, ex *Citrus*; expanse 17.5 mm. Bottom left, male genitalia of a specimen from Melbourne, Australia (BM slide 1957); the aedeagus has lost the three long, rodlike, deciduous cornuti. A set of cornuti from a virgin male from Olinda, Maui are figured at the lower right at a larger scale; ex gorse.

Other species occur in New Zealand. Bradley said that "this genus has characteristics of the *Archips-Adoxophyes* group, and can be placed systematically near to *Isotenes* Meyrick and *Harmaloga* Meyrick." The genus also bears some resemblance to such genera as *Clepsis*. In the Hawaiian fauna the male genitalia resemble those of *Spheterista*, but the apophyses of the female genitalia are much shorter than are those of *Spheterista*. One introduced species represents the group in Hawaii.

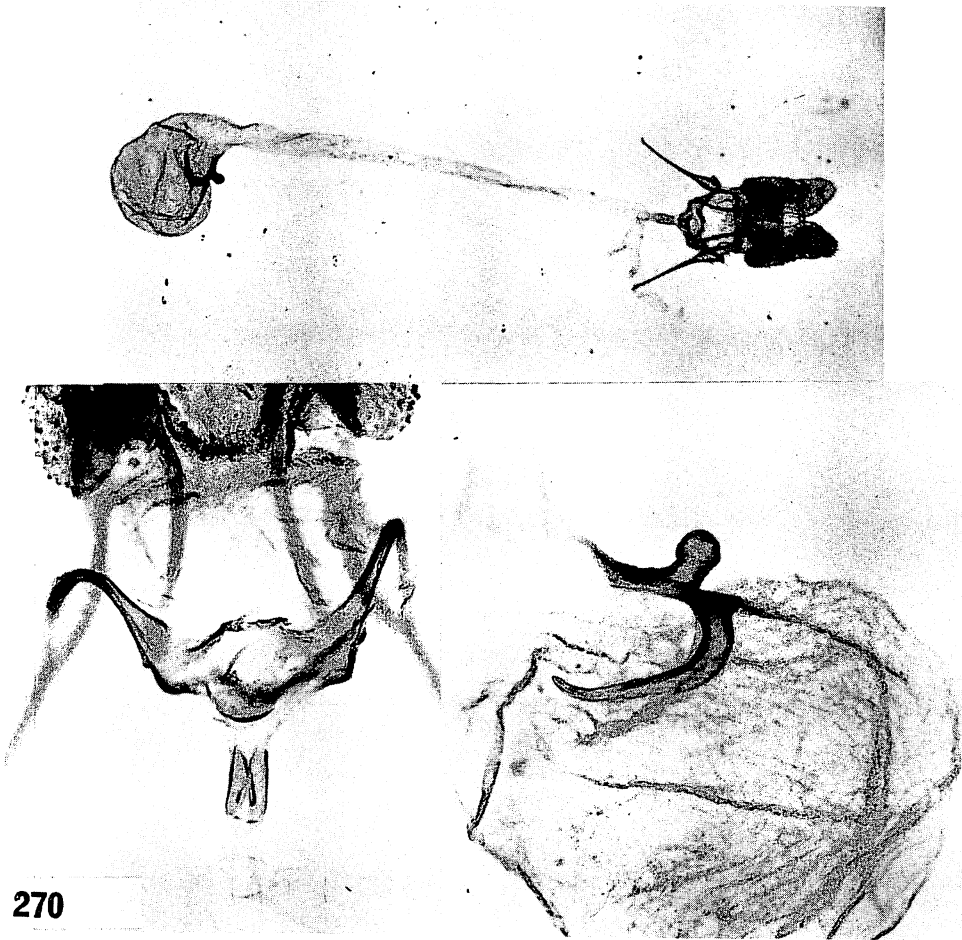


Figure 270—Female genitalia of *Epiphyas postvittana* (Walker), holotype (BM slide 1815); Sydney, Australia. (Courtesy of J. D. Bradley.)

**Epiphyas postvittana** (Walker) (figs. 268, head, wing venation; 269, moths, male genitalia; 270, female genitalia; 271–272, pupae).

*Teras postvittana* Walker, 1863:297.

*Teras scitulana* Walker, 1863:299.

*Teras basialbana* Walker, 1863:299.

*Teras secretana* Walker, 1863:300.

*Dichelia reversana* Walker, 1863:321.

*Dichelia retractana* Walker, 1863:322.

*Dichelia foedana* Walker, 1863:326.

*Dichelia vicariana* Walker, 1869:82. Synonymy by Meyrick, 1911a:84.

*Dichelia vicaureana*, misspelling by Bradley, 1956a:103.

*Archips postvittana* (Walker) Walsingham, 1907b:690, pl. 11, fig. 7.

*Tortrix pyrrhula* Meyrick, 1910c:226. Synonymy by Bradley, 1956a:103.

*Tortrix stipularis* Meyrick, 1910c:226.

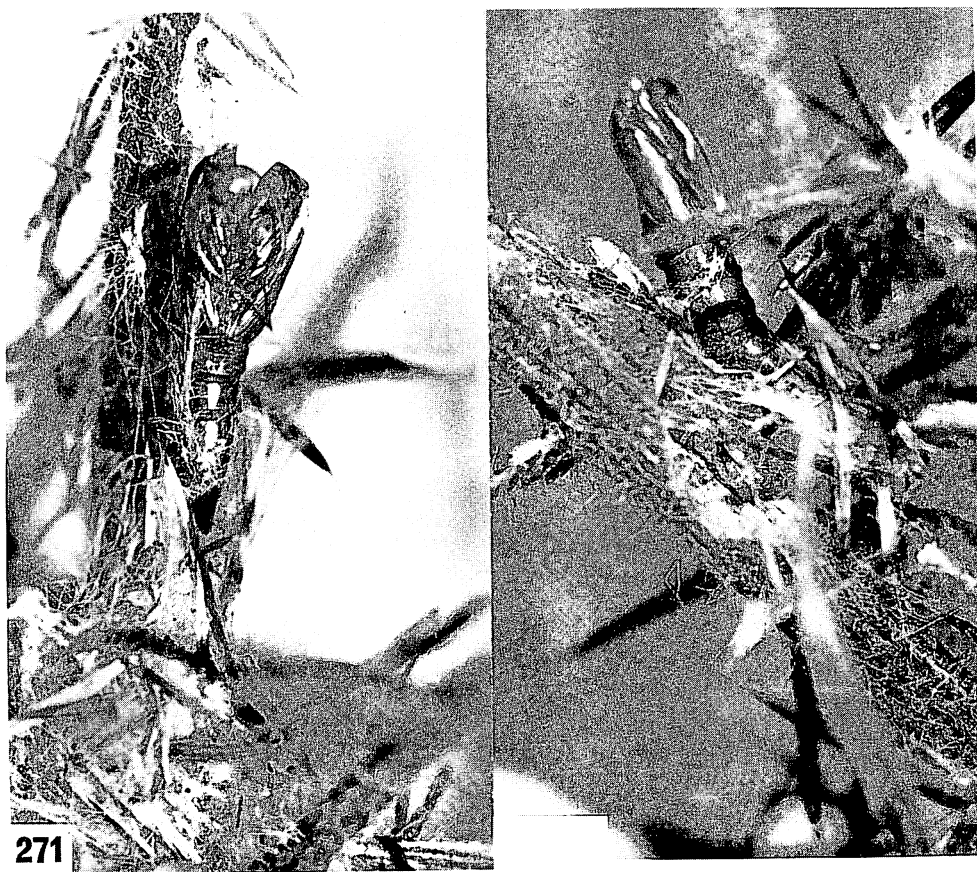


Figure 271—*Epiphyas postvittana* (Walker). Pupal skins on gorse; Olinda, Maui. (Photographs by D. J. Davis.)

*Tortrix oenopa* Meyrick, 1910c:230.

*Tortrix dissipata* Meyrick, 1922a:496. Synonymy by Bradley, 1956a:103.

*Tortrix postvittana* (Walker) Meyrick, 1913b:32.

*Tortrix phaeosticha* Turner, 1939(1938):76.

*Austrotortrix postvittana* (Walker) Bradley, 1956a:102.

*Epiphyas postvittana* (Walker) Common, 1961:180.

See Walsingham, 1907b:690, 736, Bradley, 1956:102 and Common, 1961:177, for details and synonymy. See Bradley, 1956:102–103, pls. 2 and 3 for redescription. See Balachowsky et al. 1966:582, for general discussion and biology. Dumbleton, 1939:309, ecology; 1940:322A, parasites. Evans, 1937:1, in Tasmania.

The light brown apple moth.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Described from Australia and known from Tasmania and New Zealand; it is now also established in England (Meyrick, 1937:256). It was first found in Hawaii by Dr. Perkins who collected it at Lihue, Kauai, in 1896.

Hostplants: the larvae are leaf-rollers on many kinds of plants including, in Hawaii, *Acacia* species, *Acacia koa*, *Citrus*, *Cucurbita pepo* (pumpkin), *Dodonaea viscosa*, *Euphorbia*, *Pipturus*, *Rubus hawaiiensis*, *Ulex europaeus* (gorse), *Santalum*, *Vaccinium*, *Wikstroemia foetida*, and *Wilkesia*. In Australia, Tasmania, and New Zealand it is considered an important pest of apples. A complex of forms occurs in Australia.

Parasites: *Bracon omiodivorum* (Terry), *Brachymeria obscurata* (Walker), *Echthromorpha agrestoria fuscator* (Fabricius), *Ephialtes hawaiiensis* (Cameron), *Trichogramma minutum* Riley.

Predators: *Odynerus nigripennis* Holmgren, *Odynerus* species.

The internal sac of the aedeagus bears two to four long, narrow, flattened cornuti. These are deciduous and may be missing from mated specimens, and this may lead one to consider that the specimens with the cornuti represent a different species from those which have lost them. When the cornuti are shed, however, the points of articulation can still be seen.

The moths may be confused with *Amorbia emigratella* Busck, but *postvittana* has ocelli which are lacking in *Amorbia*, the undersides of the hindwings are conspicuously spotted overall instead of being mostly immaculate as in *Amorbia*, and the second abdominal tergite lacks the conspicuous median pit near the base which is present in *Amorbia*. See the key to separate the larvae and pupae under the discussion of *Amorbia emigratella*, below.

This is a very common, highly variable moth. Some specimens are nearly concolorous, but others are conspicuously maculate. The attack of the larva resembles that of *Amorbia emigratella*, with which it may be confused. The larvae are green, as in *Amorbia*, but the prothorax does not have a black line on each lateral margin as does the larva of *Amorbia*.

It is of interest that, although the species is established in southwestern England, it has not been recorded there either from the apple tree or the common and widespread gorse. C. J. Davis and others have found heavy infestations of *Epiphyas postvittana* on gorse in the Hawaiian Islands. The common name used in the Islands, the light brown apple moth, is the same as that used in the Antipodes, and it is not altogether satisfactory.

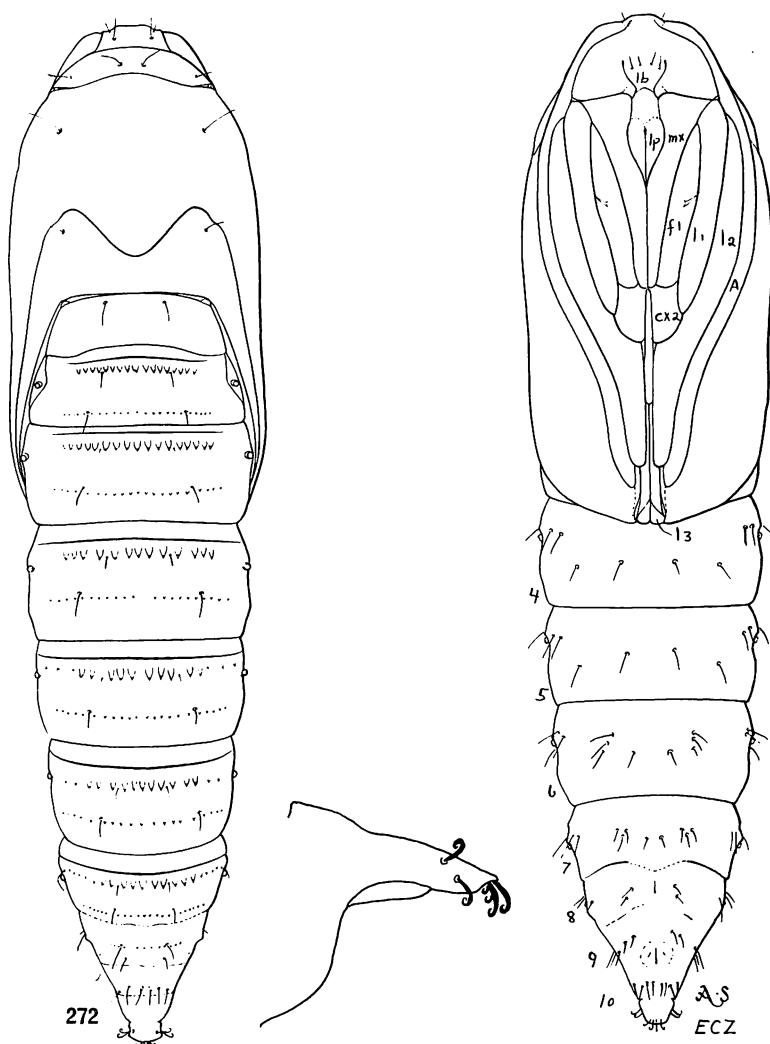


Figure 272—Pupa of *Epiphyas postvittana* (Walker) with an inset sketch of the cauda in left lateral aspect. Length 10.5 mm. Olinda, Maui; ex gorse. *cx2*, mesocoxa; *f1*, profemora; *lb*, labrum; *lp*, labial palpus; *l1*, *l2*, *l3*, legs; *mx*, galea of maxilla (proboscis); *W2*, hindwing.

Genus **PARARRHAPTICA** Walsingham

*Pararrhaptica* Walsingham, 1907b:689. Type-species: *Pararrhaptica perkinsiana* Walsingham, by original designation and monotypy.

This apparently endemic genus was described to include only its type, although Walsingham at the same time described a number of other species of the same genus which he mistakenly placed in *Eulia*. Meyrick (1913b:27) placed the type-species incorrectly in *Tortrix*, and he was followed by T. B. Fletcher (1929:163, 228) and Diakonoff (1939:223). Meyrick later described several species of this genus, but he assigned them to *Eulia*, and he said (1928c:96): "The species placed by Lord Walsingham in *Archips*, I refer to *Eulia*; no species of *Cacoecia* (= *Archips* Wals.) has been found in Hawaii." Dr. Swezey followed Meyrick and assigned the species he described to *Eulia*. In his original description, Walsingham said "Allied to *Archips*, Hb., but distinguished by the fringe of long hairs along the fold in the forewings."

In our present state of knowledge, it is difficult to place the genus in relation to other genera with any degree of accuracy. Superficially, it is not greatly unlike such genera as *Epiphyas* (= *Austrotortrix*) and *Spheterista*, but the valvae of the male genitalia are unusual. They are mostly thinly sclerotized, flexible, their apical parts curl upward and inward, and the inner faces of the curled

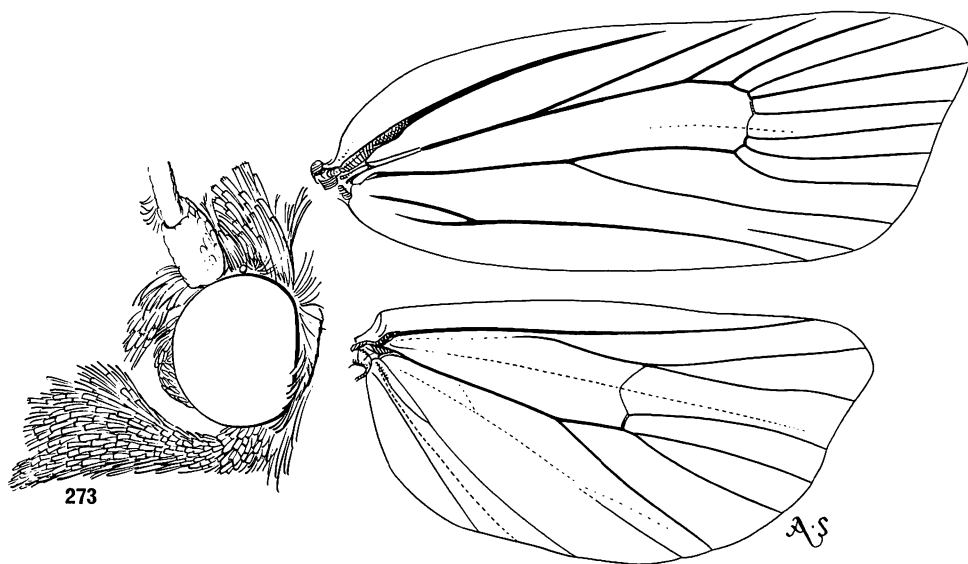


Figure 273—Head and wing venation of *Pararrhaptica perkinsiana* Walsingham. Head of the holotype; Haleakala, 5,000 feet, Maui; the dorsal vestiture on the labial palpus is expanded upward (probably artificially on the damaged type; the scales may normally be laid down and thus the palpus will appear narrower than is shown here). The wings are from a female paratype (BM slide 1948); Olinda, 4,000 feet, Maui; the frenulum has been broken off. There is much interspecific variation in the course of vein 3 in the forewings in this genus. The male has a weak costal fold. This is the type-species of *Pararrhaptica*.

areas are densely clothed with long, fine hair. These features can be best appreciated by examining the illustrations. The genitalia are not like those of *Eulia* or *Archips*. The males may or may not have a moderate costal fold on each forewing. Some females have a poorly developed signum in the bursa copulatrix. I do not know whence the genus has come.

See color plate 2, figure 5.

### DISTRIBUTION OF THE SPECIES OF PARARRHAPTICA

Arranged by type locality only, the following numbers are recorded on the main islands: Kauai, two; Oahu, six; Molokai, four; Maui, three; Lanai, one; Hawaii, three. Surely, many species await discovery and description. As now recorded, the distribution of the species is as follows (unless otherwise stated, the type locality is on that island under which each species is listed):

#### Kauai (three species)

*leopardella* (Walsingham)  
*longiplicata* (Walsingham)?, Oahu?, Maui (type), Lanai?, Hawaii?  
*lysimaehiae* (Swezey)

#### Oahu (eight species)

*capucina* (Walsingham), Molokai (type), Hawaii  
*chlorippa* (Meyrick)  
*dermatopa* (Meyrick)  
*leucostichas* (Meyrick)  
*longiplicata* (Walsingham)?, Kauai?, Maui (type), Lanai?, Hawaii?  
*lysimaehiana* (Swezey)  
*notocosma* (Meyrick)  
*pyncnomias* (Meyrick)

#### Molokai (six species)

*capucina* (Walsingham), Oahu, Hawaii  
*falerniana* (Walsingham)  
*perkinsiana* (Walsingham), Maui (type)  
*punctiferana* (Walsingham)?, Maui (type), Hawaii?  
*subsenescens* (Walsingham), Hawaii  
*trochilidana* (Walsingham)

#### Maui (three species)

*longiplicata* (Walsingham), Kauai?, Oahu?, Lanai?, Hawaii?  
*perkinsiana* (Walsingham), Molokai  
*punctiferana* (Walsingham), Molokai?, Hawaii?

#### Lanai (two species)

*fuscoviridis* (Walsingham)  
*longiplicata* (Walsingham)?, Kauai?, Oahu?, Maui (type), Hawaii?

Hawaii (seven species)

*capucina* (Walsingham), Molokai (type)

*fuscocinerea* (Swezey)

*lichenoides* (Walsingham)

*longiplicata* (Walsingham)?, Kauai?, Oahu?, Maui (type), Lanai?

*punctiferana* (Walsingham)?, Molokai?, Maui (type)

*sublichenoides* (Swezey)

*subsenescens* (Walsingham)?, Molokai (type)

It is noteworthy that Dr. Perkins found only one species on Oahu, but after the *Fauna Hawaiiensis* was published, Dr. Swezey found six new species on Oahu. Dr. Perkins found more species on Molokai than on any of the other islands.

## HOSTPLANTS OF PARARRHAPTICA

The hostplant is known for only eight of the 19 known species of *Pararrhaptica*, and six of these have *Myrsine* (Myrsinaceae) as hostplant. The other two species feed upon *Lysimachia* (Primulaceae).

***Pararrhaptica capucina*** (Walsingham), **new combination** (figs. 274, head, wing venation; 277*h*, ovipositor lobes; 278, moth; 285, male genitalia; 292, female genitalia).

*Tortrix* (?) *capucina* Walsingham, 1907*b*:701, pl. 11, fig. 23.

*Archips capucina* (Walsingham) Walsingham, 1907*b*:736.

*Eulia capucina* (Walsingham) Meyrick, 1913*b*:38; 1928*c*:96.

Endemic. Oahu, Molokai (type locality: 4,000 feet), Hawaii.

Hostplant: unknown.

Dr. Swezey told me that his records (1915*g*:101, 106) of parasitism of this species by *Sierola* and *Horogenes blackurni* (Cameron) were probably made in error and that his material reported from Oahu as this species was evidently misidentified.

***Pararrhaptica chlorippa*** (Meyrick), **new combination** (figs. 278, moth; 286, male genitalia).

*Eulia chlorippa* Meyrick, 1928*c*:98.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Myrsine* (= *Suttonia*) *lessertiana*.



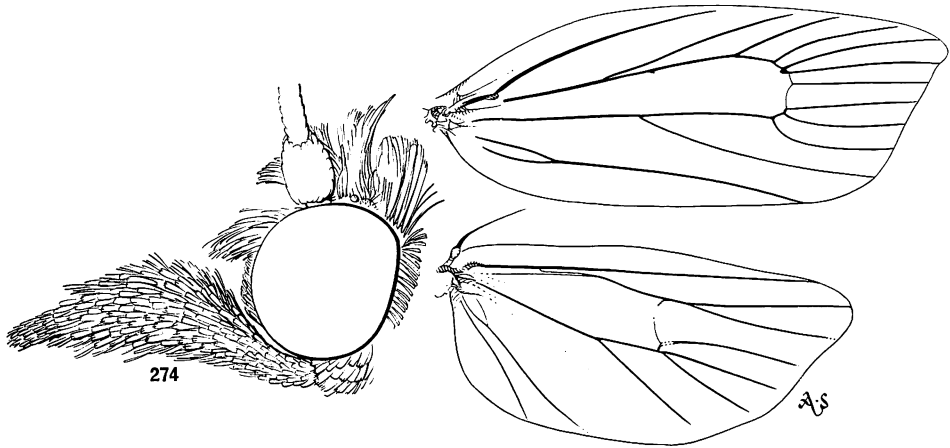


Figure 274—Head and wing venation of *Pararrhaptica capucina* (Walsingham) from a specimen from the northwest Koolau Mts., Oahu (BM slide 1897).

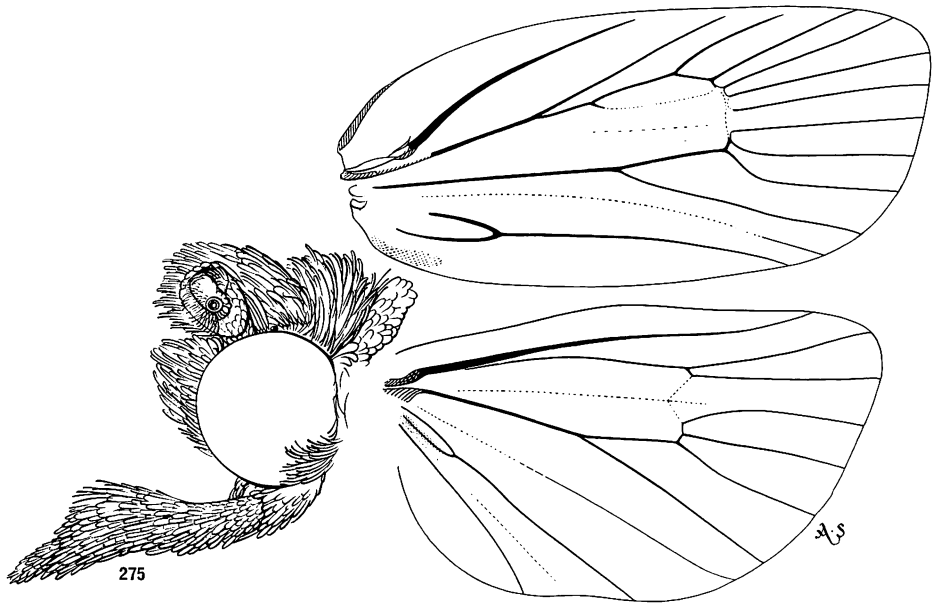


Figure 275—Head and wing venation of *Pararrhaptica fuscoviridis* (Walsingham), holotype male (BM slide 1910); Lanai, 2,000 feet. Note the separate origins of veins 4 and 5 in the hindwing. Compare the connate condition of *longiplicata* on figure 276 and the stalked arrangement of *perkinsiana* on figure 273 and *capucina* on figure 274.

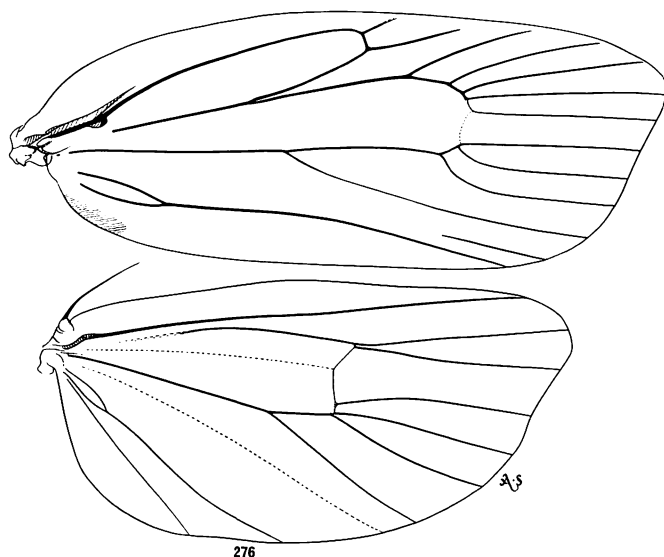


Figure 276—Wing venation of *Pararrhaptica longiplicata* (Walsingham), paratype male (BM slide 8039); Waianae Mts., 2,000 to 3,000 feet, Oahu. The crossvein between veins 11 and 12 in the forewing is evidently an abnormality.

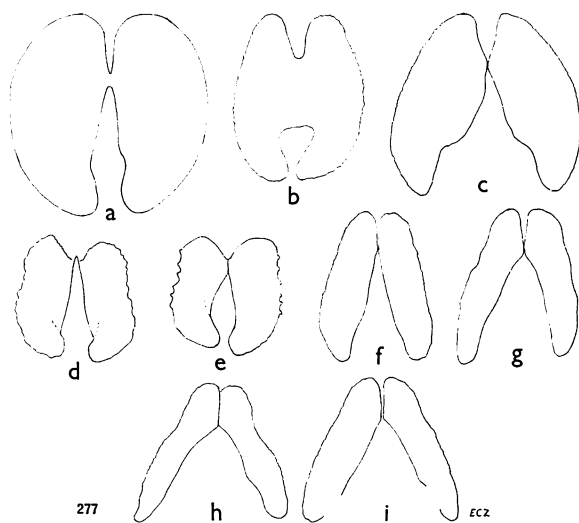


Figure 277—Outline sketches of the ovipositor lobes of some species of *Pararrhaptica*. *a*, a species formerly incorrectly considered a paratype of *fuscoviridis* by Walsingham (BM slide 1911), see the text for comment; *b*, *subsenescens* (Walsingham), holotype (BM slide 1906); *c*, *leucosticha* Meyrick, lectotype (BM slide 9542 Clarke); *d*, *lichenoides* (Walsingham), holotype (BM slide 1907); *e*, *trochilidana* (Walsingham), holotype (BM slide 1913); *f*, *perkinsiana* Walsingham, paratype (BM slide 1948); *g*, *punctiferana* (Walsingham), paratype (BM slide 1967); *h*, *capucina* (Walsingham), holotype (BM slide 1896); *i*, *longiplicata* (Walsingham), paratype (BM slide 1969). *a*–*e*, all to the same scale; *f*–*i*, drawn to a larger scale.

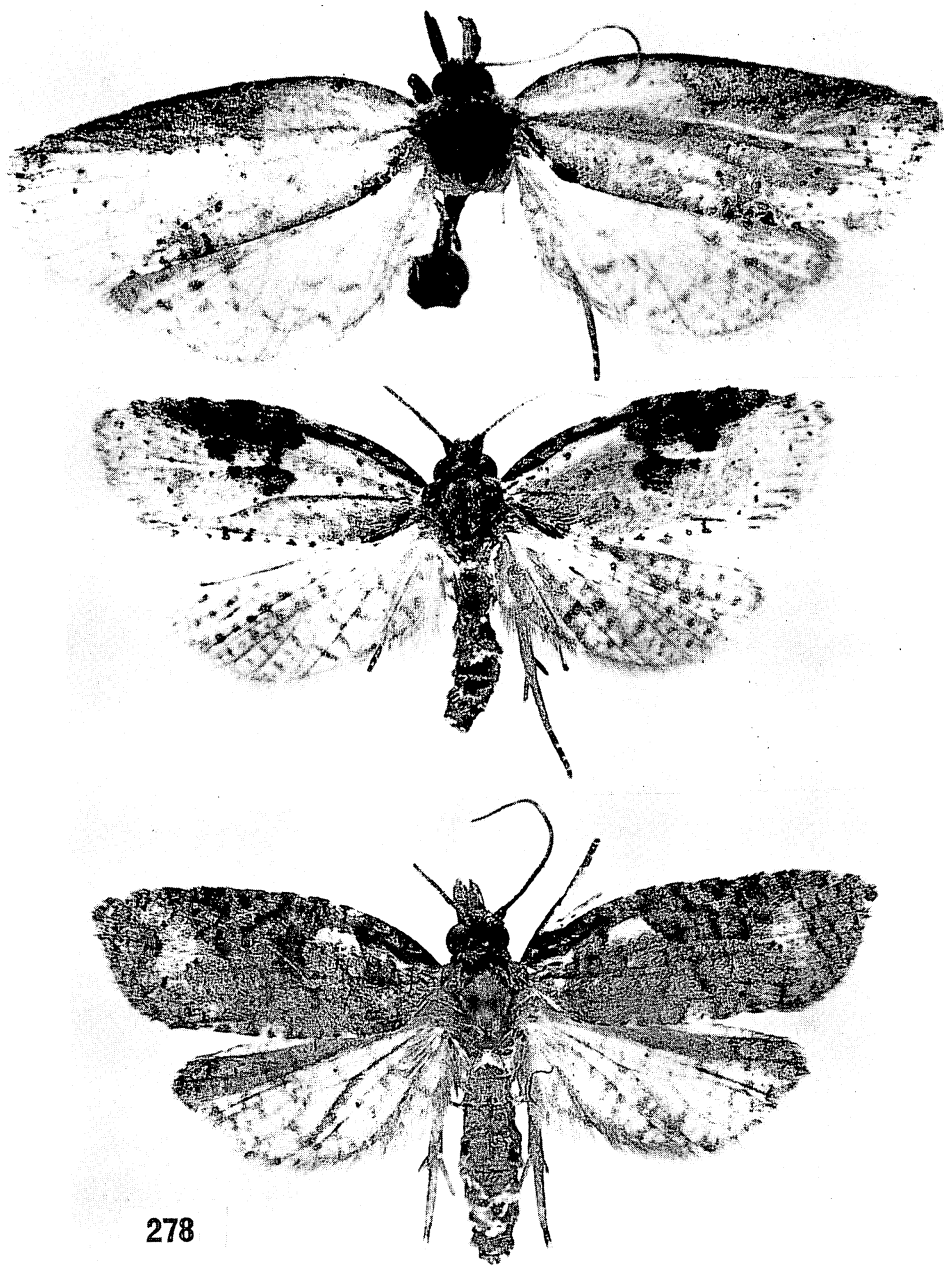
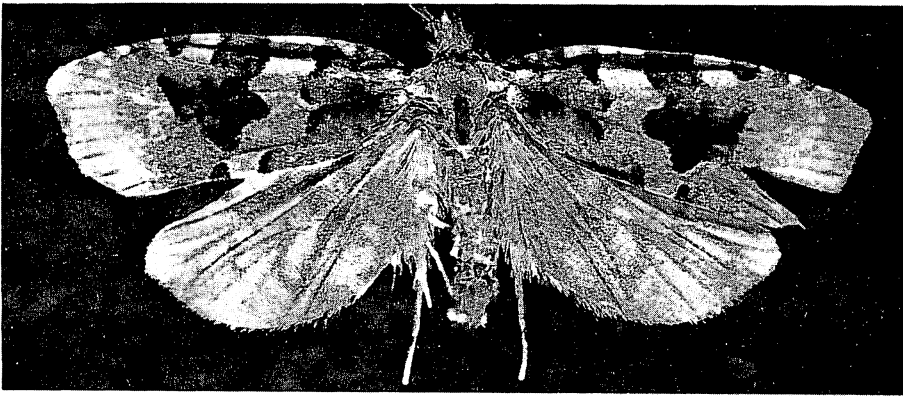


Figure 278—*Pararrhaptica*. Top, *capucina* (Walsingham), holotype female (BM slide 1896); Molokai, 4,000 feet; expanse 22 mm. Middle, *chlorippa* (Meyrick), holotype male (slide Z-IX-5-61-G); Mt. Olympus, Oahu; forewing 8 mm. Bottom, *dermatopa* (Meyrick), holotype male; Mt. Tantalus, Oahu; forewing 9 mm.



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Figure 279—*Pararrhaptica*. Top, *falerniana* (Walsingham), holotype female (abdomen lost); Molokai, 4,000 feet; expanse 24 mm. This print is too pale. Middle, *fuscocinerea* (Swezey), holotype male (slide Z-IX-3-61-1); Kilauea, Hawaii; forewing 9 mm. Bottom, *fuscoviridis* Walsingham, holotype male (BM slide 1910); Lanai, 2,000 feet; forewing 12 mm.

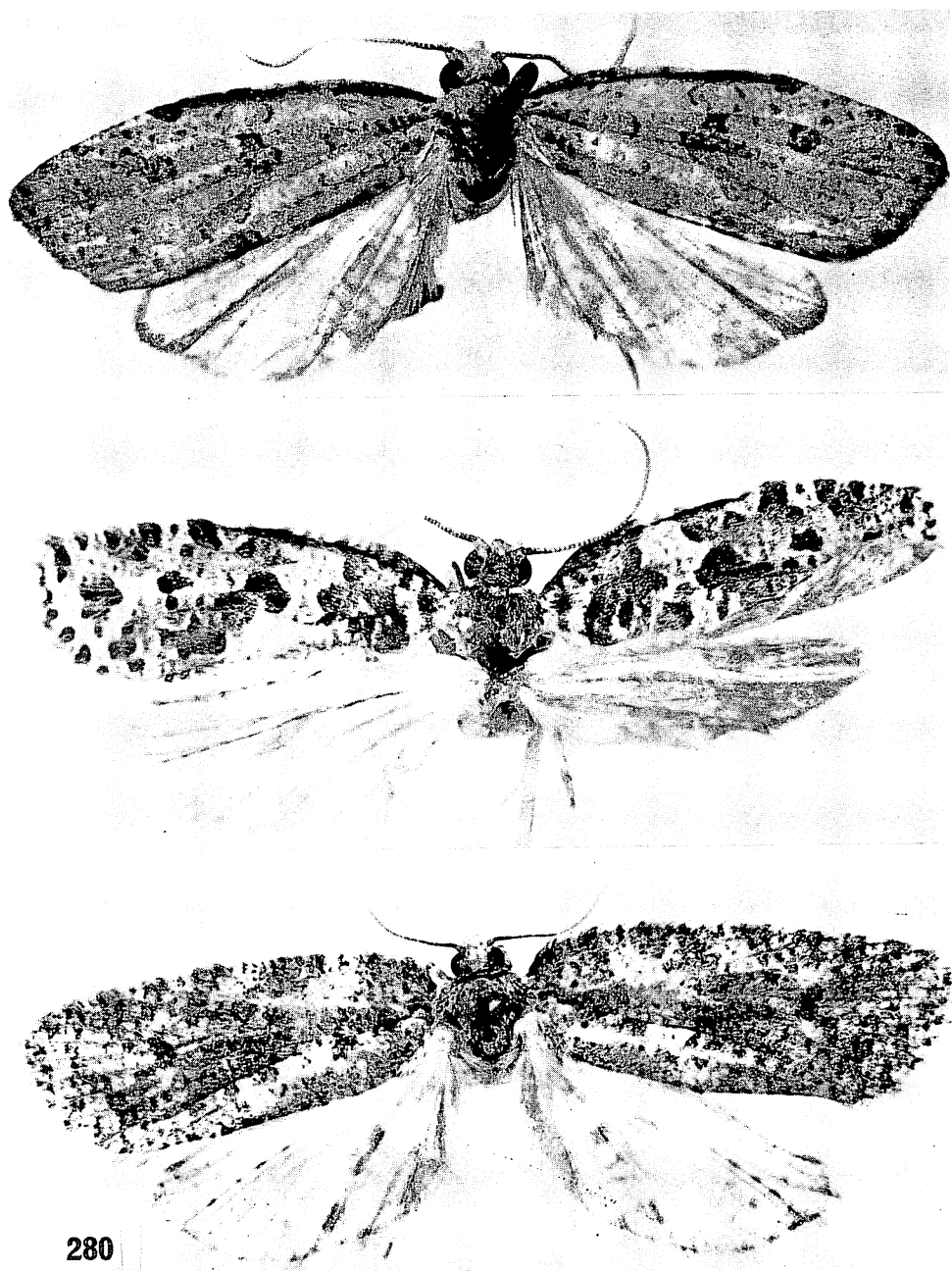


Figure 280—*Pararrhaptica*. Top, *leopardella* (Walsingham), holotype male (BM slide 1965); Kaholua-mano, 4,000 feet, Kauai; expanse 20 mm. Middle, *leucostichas* (Meyrick), a male ex *Myrsine* shoots, Honolulu; expanse 27 mm. Bottom, *lichenoides* (Walsingham), holotype female (BM slide 1907); Kilauea, Hawaii; expanse 32 mm. Note the narrow costal folds on the males.

***Pararrhaptica dermatopa*** (Meyrick), **new combination** (figs. 233, pupa; 278, moth; 285, male genitalia).

*Eulia dermatopa* Meyrick, 1928c:96.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: *Myrsine* (= *Suttonia*) *lessertiana*.

The pupa has two long, hooked, lateral setae beneath each carinate lateral edge of the caudal process (there are no middorsal setae), and there are four similar setae under the caudal edge of the caudal process.

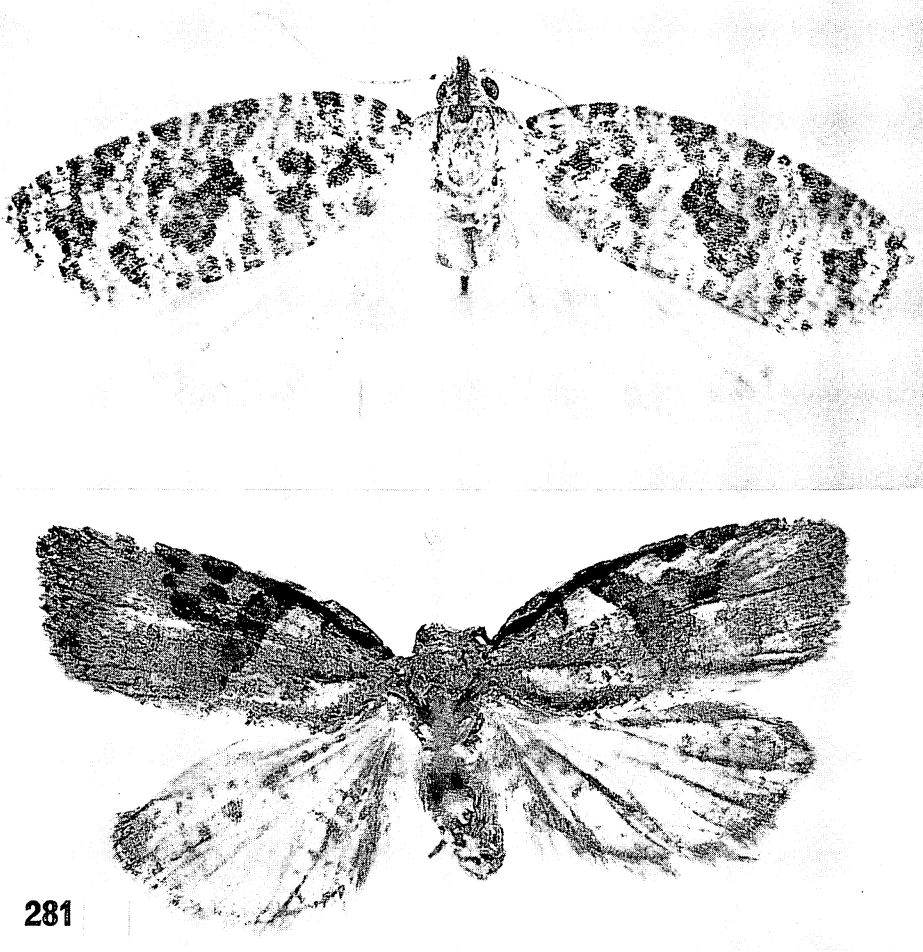


Figure 281—*Pararrhaptica*. Top, the specimen Walsingham considered to be a paratype of *fuscoviridis*, but it is not that species. It is a greyish, black, and green species that resembles *lichenoides*, but its genitalia are different. Walsingham called it a male, but it is a female. Northwest Koolau Mts., Oahu (BM slide 1911); expanse 25 mm. Bottom, *lysimachiae* (Swezey), holotype male (slide Z-IX-5-61-E); Kalalau Trail, Kauai; forewing 8 mm.

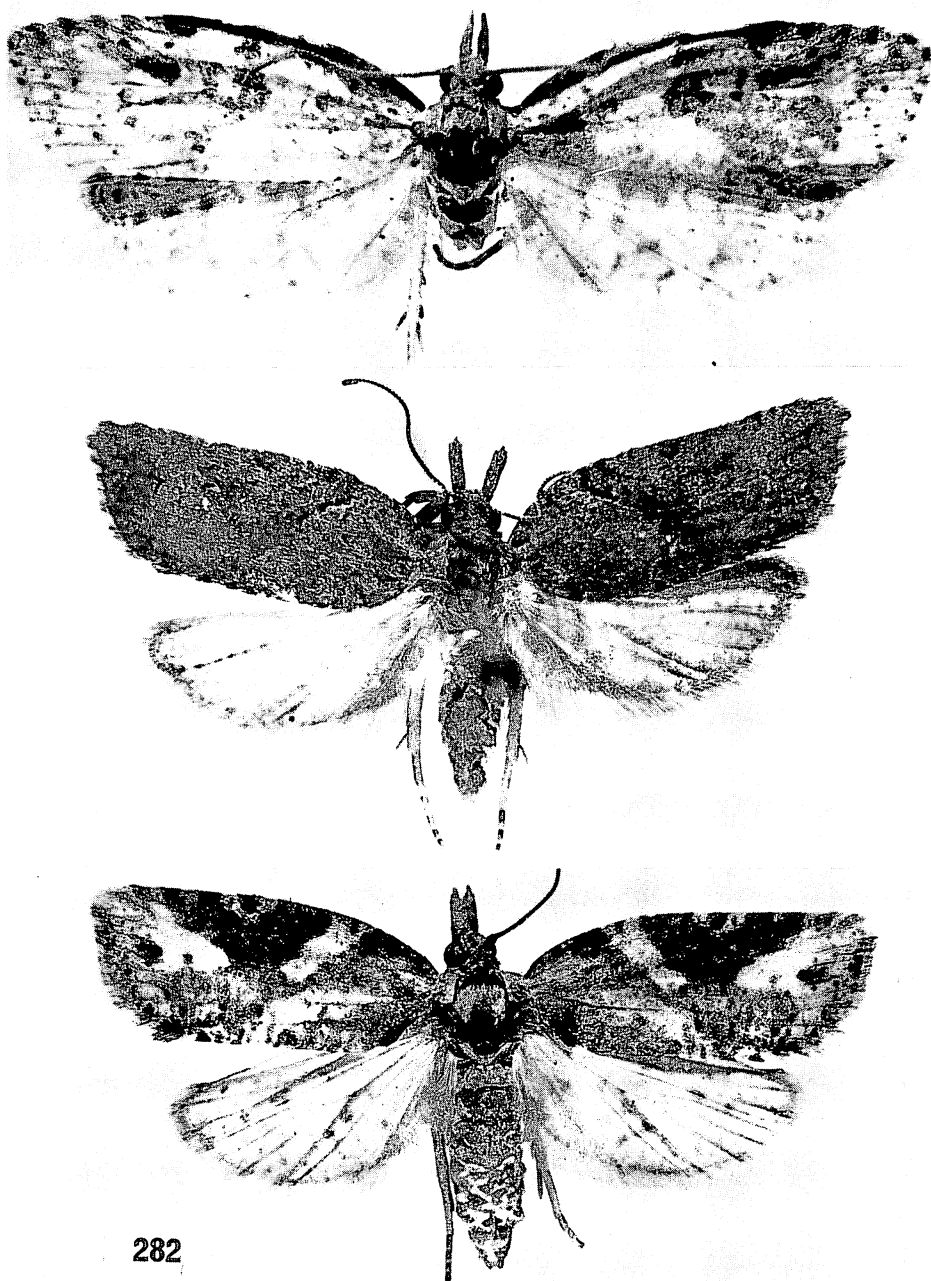


Figure 282—*Pararrhaptica*. Top, *longiplicata* (Walsingham), holotype male (BM slide 1968); Haleakala, 5,000 feet, Maui; forewing 11 mm. Middle, *lysimachiana* (Swezey), holotype female (slide Z-IX-5-61-H); Hapapa, Waianae Mts., Oahu; forewing length 7 mm. Bottom, *notocosma* (Meyrick), paratype female; Mt. Olympus, Oahu; forewing 11 mm.

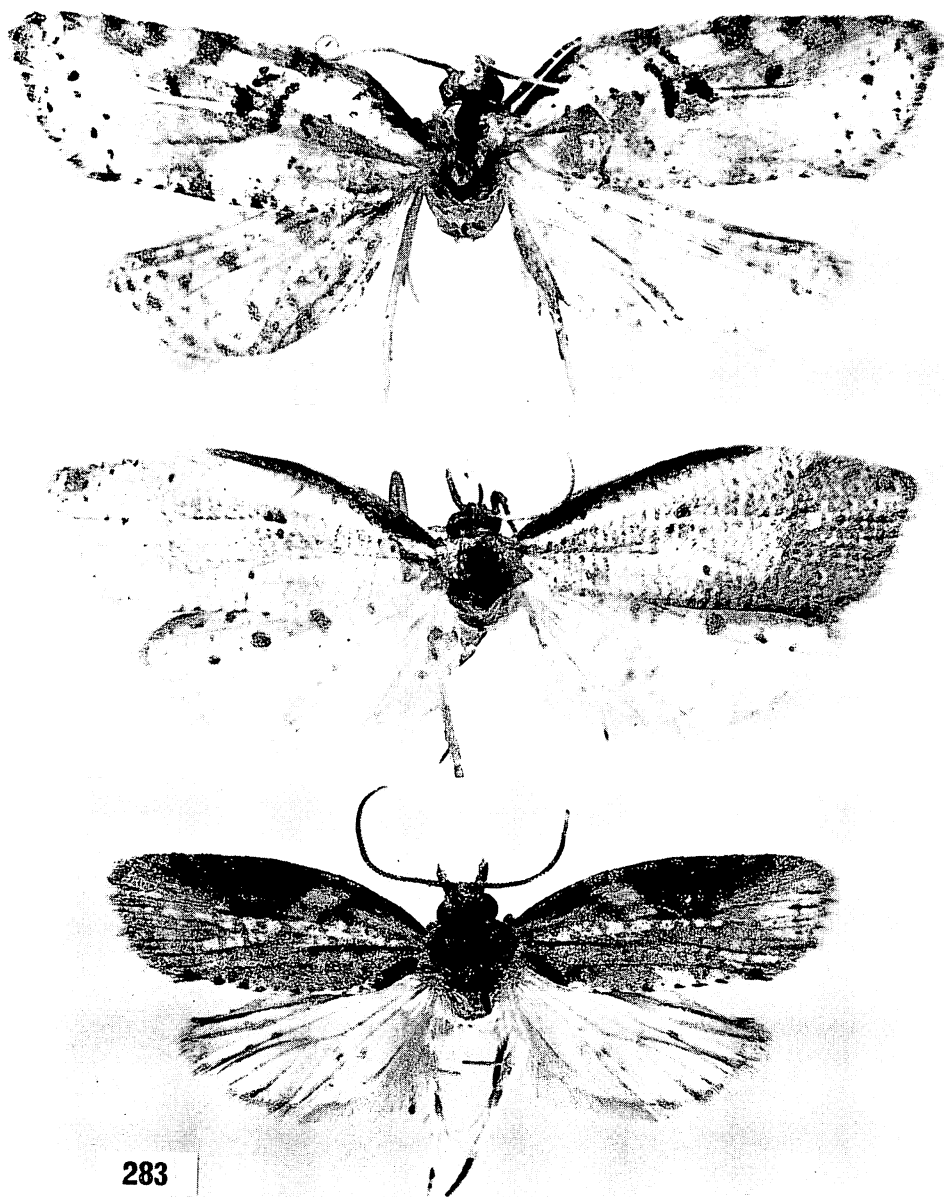


Figure 283—*Pararrhaptica*. Top, *perkinsiana* Walsingham, holotype male (abdomen lost); Haleakala, 5,000 feet, Maui; expanse 20 mm. Middle, *punctiferana* (Walsingham), holotype male (BM slide 1966); Haleakala, 5,000 feet, Maui; expanse 25 mm. Bottom, *pycnomias* (Meyrick), holotype male (Busck slide 209); forewing 9 mm.



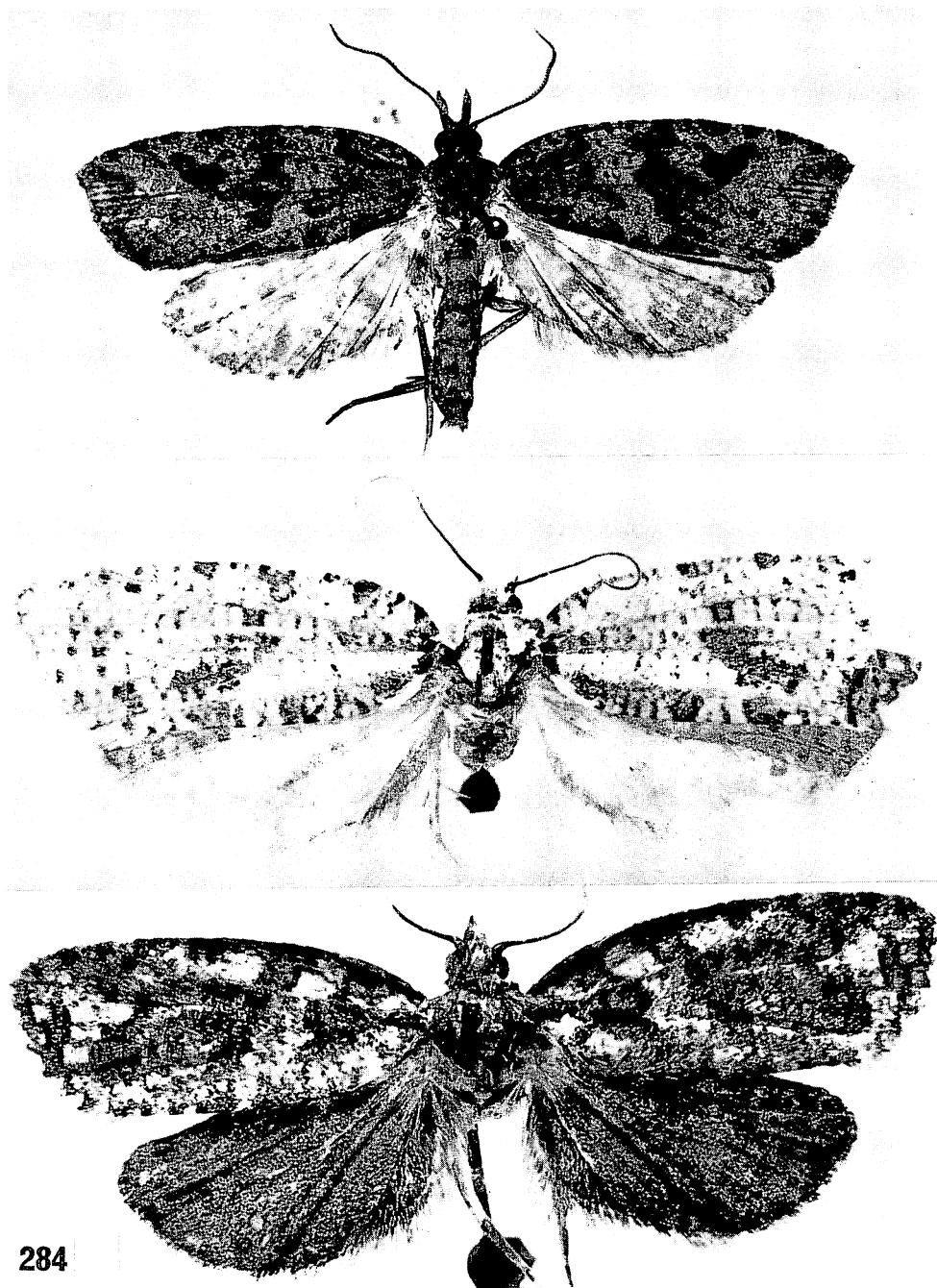
**284**

Figure 284—*Pararrhaptica*. Top, *sublichenoides* (Swezey), holotype; Kilauea, Hawaii; forewing 14.5 mm. Middle, *subnescens* (Walsingham), holotype female (BM slide 1906); Molokai; left forewing 14.5 mm. Bottom, *trochilidana* (Walsingham), holotype male (BM slide 1912); Molokai, about 4,000 feet; forewing 10 mm.

**Pararrhaptica falerniana** (Walsingham), **new combination** (fig. 279, moth).*Tortrix* (?) *falerniana* Walsingham, 1907*b*:701, pl. 11, fig. 22.*Eulia falerniana* (Walsingham) Meyrick, 1913*b*:38.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.

This moth is known only from the holotype which lacks its abdomen.

**Pararrhaptica fuscocinerea** (Swezey), **new combination** (figs. 279, moth; 288, male genitalia).*Archips fuscocinereous* Swezey, 1913*e*:237, misspelling in list.*Archips fuscocinereus* Swezey, 1913*f*:275.

Endemic. Hawaii (type locality: Kilanea).

Hostplant: unknown.

This species is known only from the male type in Bishop Museum.

**Pararrhaptica fuscoviridis** (Walsingham), **new combination** (figs. 275, head, wing venation; 279, moth; 287, male genitalia).*Archips fuscoviridis* Walsingham, 1907*b*:693, pl. 11, fig. 12.*Eulia fuscoviridis* (Walsingham) Meyrick, 1913*b*:38; 1928*c*:96.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

This moth was described from two specimens: the male holotype from Lanai and a female paratype from Oahu. In Walsingham's text, the sexes of the specimens have been reversed, because the Lanai holotype is a male, not a female as stated by Walsingham, and the Oahu specimen is a female (BM slide 1911). I do not believe that the female paratype (figs. 277*a*, ovipositor lobe; 281, moth; 293, female genitalia) from Oahu is the same species as the holotype from Lanai, and I have deleted Oahu from the locality records. The Oahu paratype resembles *leucostichas* (Meyrick), which is also from Oahu, but there are differences which appear to indicate that the paratype is yet another species. The lack of adequate material renders impossible the solution of the problems involving this complex at this time. This species and *trochilidana* are closely allied, and their male genitalia are distinct from the other members of the genus (see the illustrations).

**Pararrhaptica leopardella** (Walsingham), **new combination** (figs. 280, moth; 287, male genitalia).*Archips leopardella* Walsingham, 1907*b*:692, pl. 11, fig. 9.*Tortrix leopardella* (Walsingham) Meyrick, 1913*b*:31.*Eulia leopardellus* (Walsingham) Meyrick, 1928*c*:96.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This moth is known only from the male holotype.

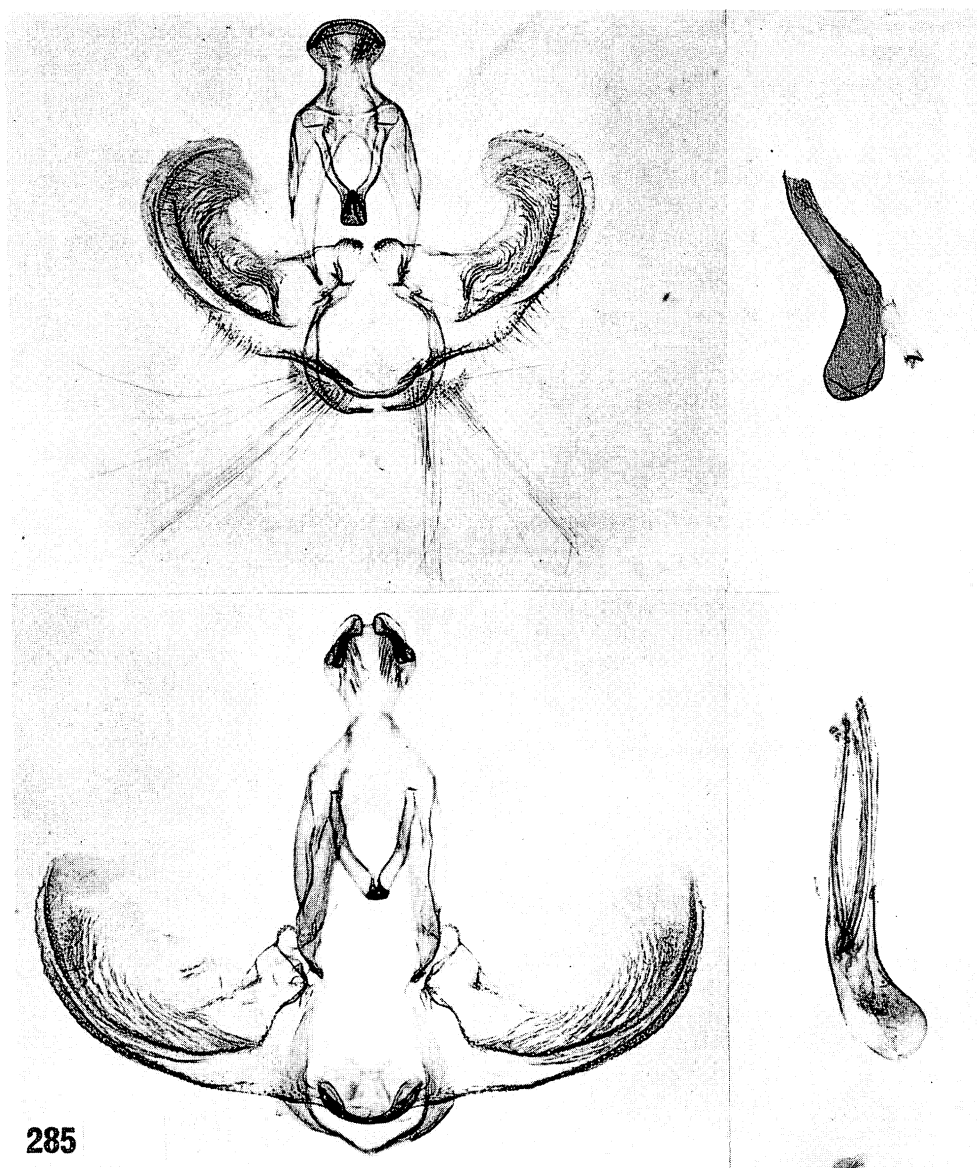
**285**

Figure 285—Male genitalia of *Pararrhaptica*. Top, *capucina* (Walsingham) (BM slide 1897); northwest Koolau Mts., Oahu. Bottom, *dermatopa* (Meyrick) (BM slide 3982); Olympus, Oahu; note the long cornuti in the aedeagus.

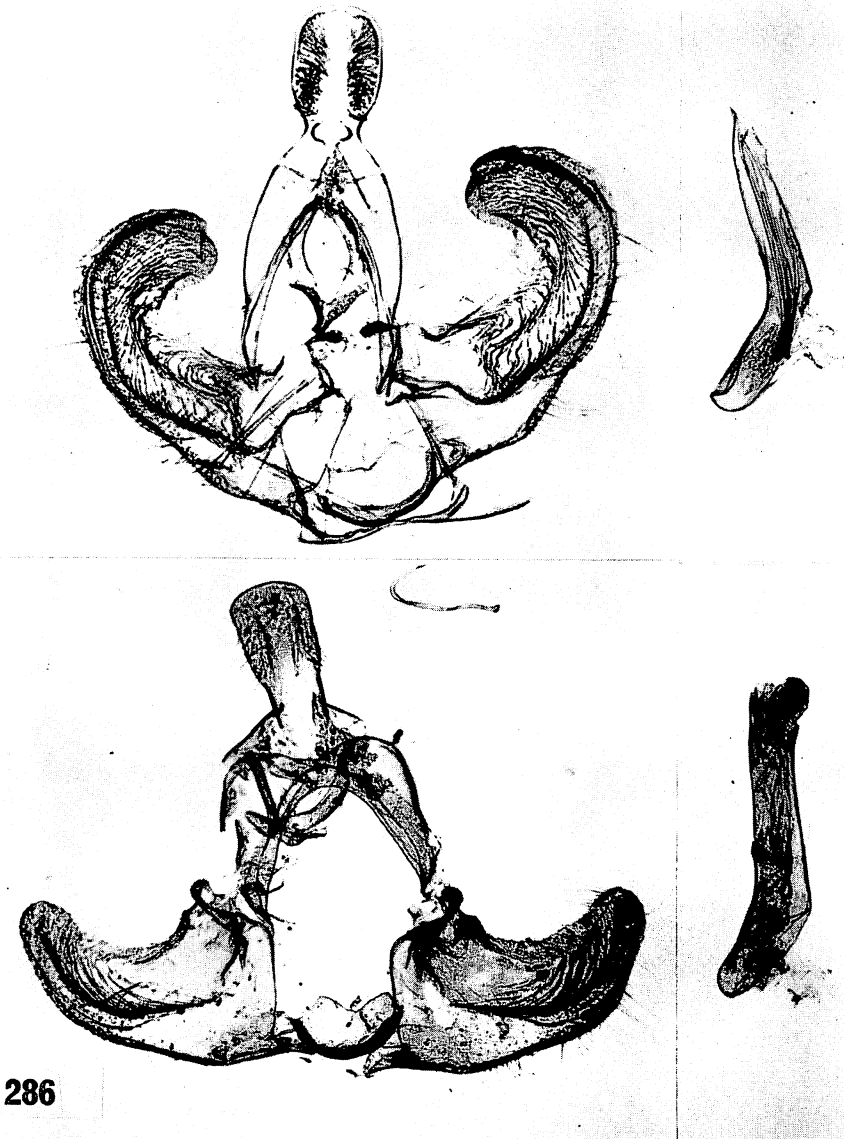
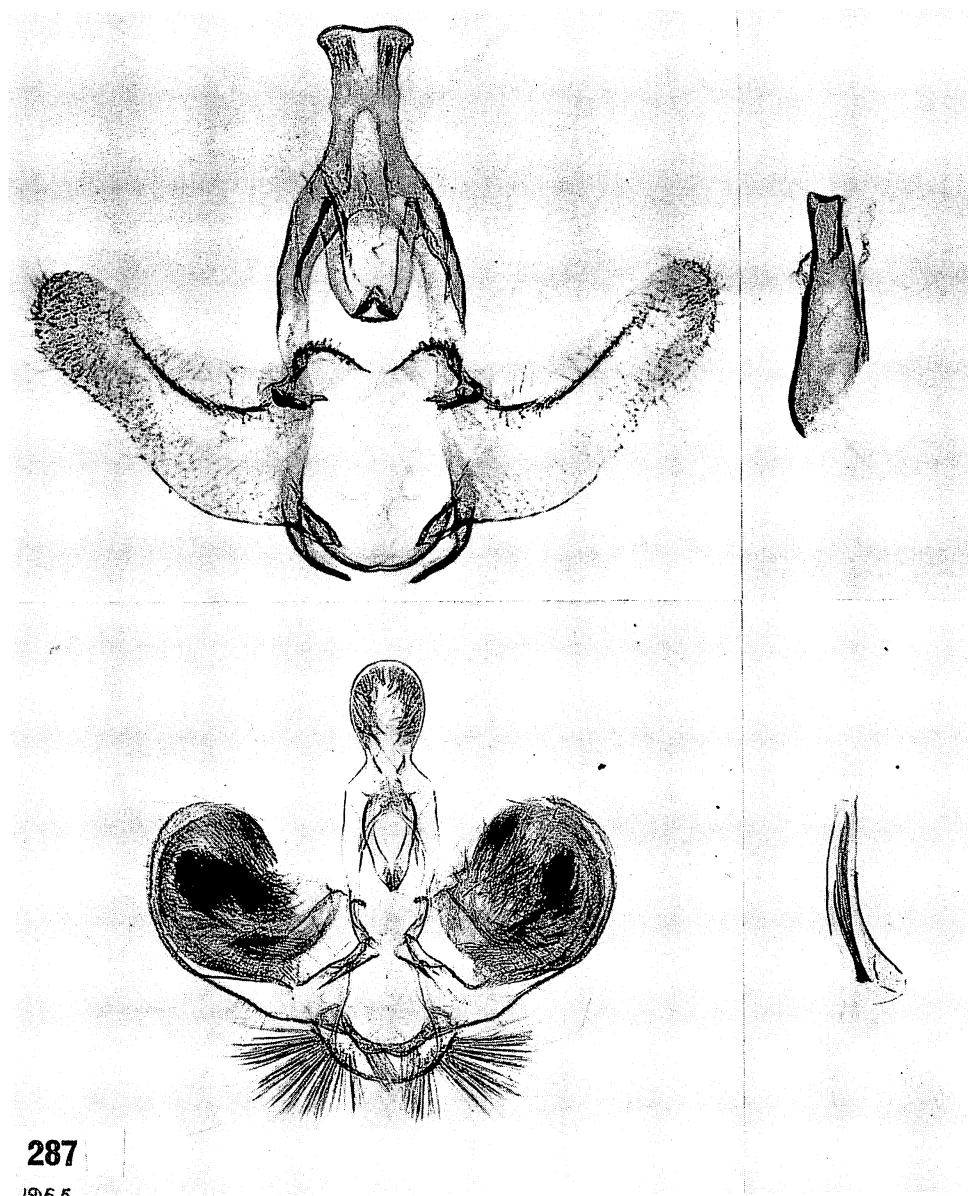


Figure 286—Male genitalia of *Pararrhaptica*. Top, *chlorippa* (Meyrick), holotype (slide Z-IX-5-61-G); Mt. Olympus, Oahu. Bottom, *lysimachiae* (Swezey), holotype (slide Z-IX-5-61-E); Kalalau Trail, Kauai.



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Figure 287—Male genitalia of *Pararrhaptica*. Top, *fuscoviridis* (Walsingham), holotype (BM slide 1910); Lanai, 2,000 feet. This is an unusual species which appears to differ from all other known species of *Pararrhaptica* except *trochilidana*, which see. Bottom, *leopardella* (Walsingham), holotype (BM slide 1965); Kaholuamano, 4,000 feet Kauai.

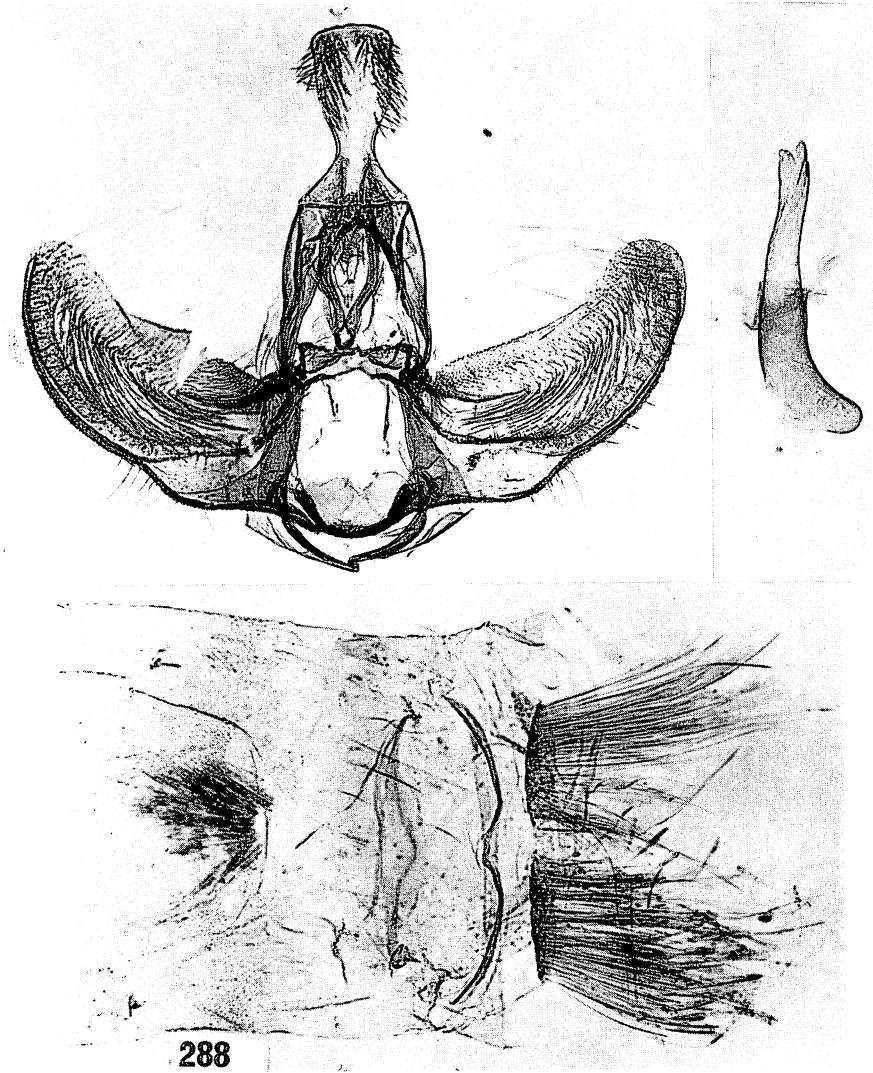
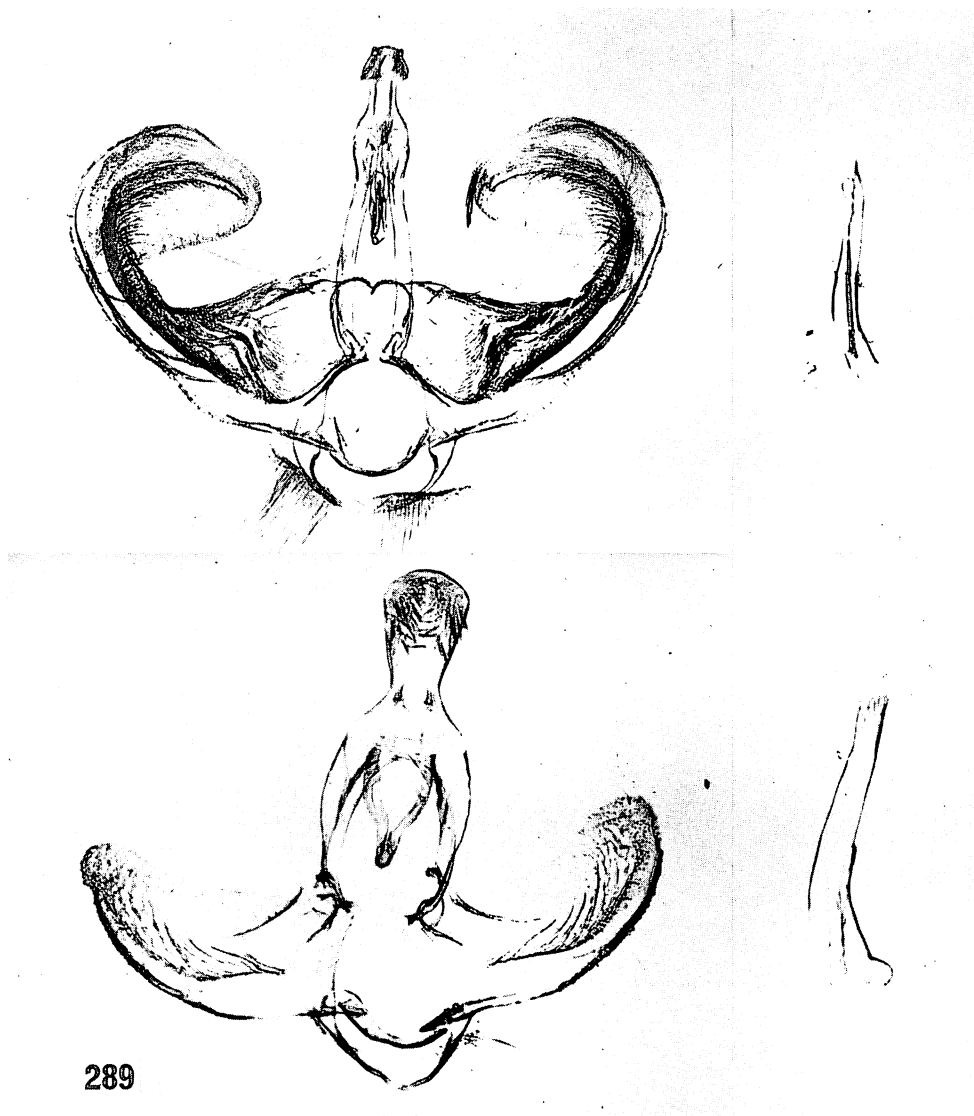


Figure 288—Male genitalia and abdominal apex of *Pararrhaptica fuscocinerea* (Swezey); Kilauea, Hawaii (slide Z-IX-3-61-1).



289

Figure 289—Male genitalia of *Pararrhaptica*. Top, *longiplicata* (Walsingham), holotype (BM slide 1968); Haleakala, 5,000 feet, Maui. The uncus terminates in two conical points; note the approximate arms of the gnathus. Bottom, *punctiferana* (Walsingham), holotype (BM slide 1966); Haleakala, 5,000 feet, Maui.

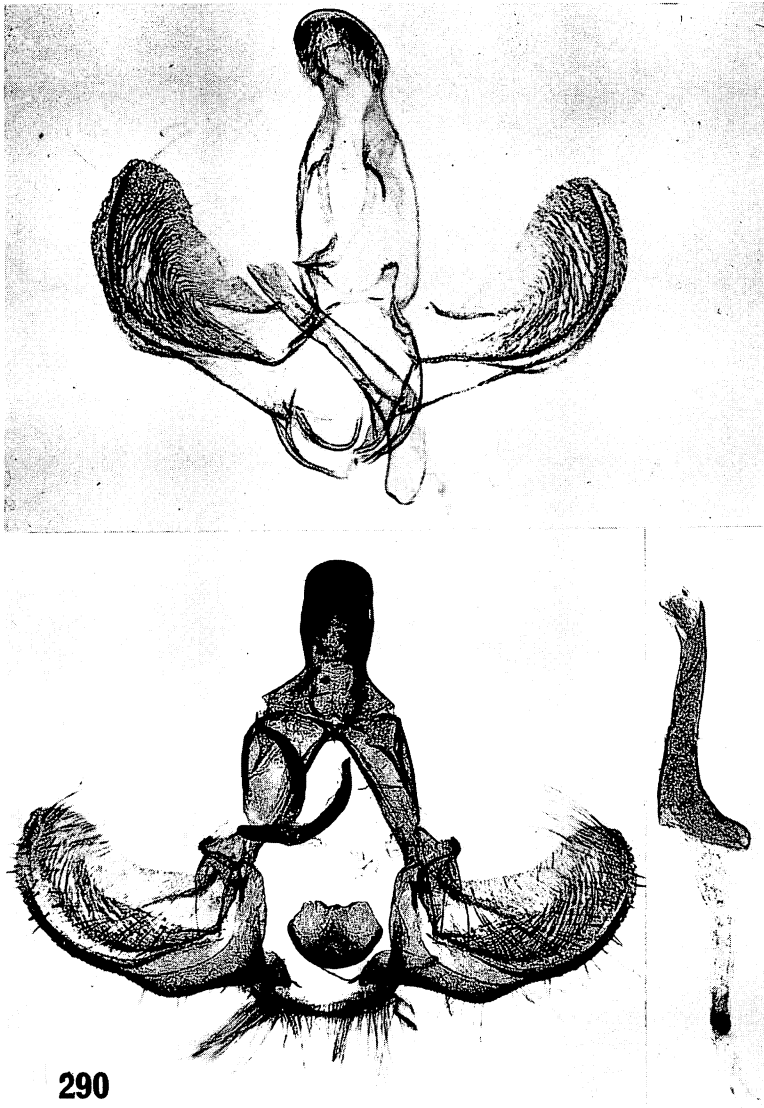
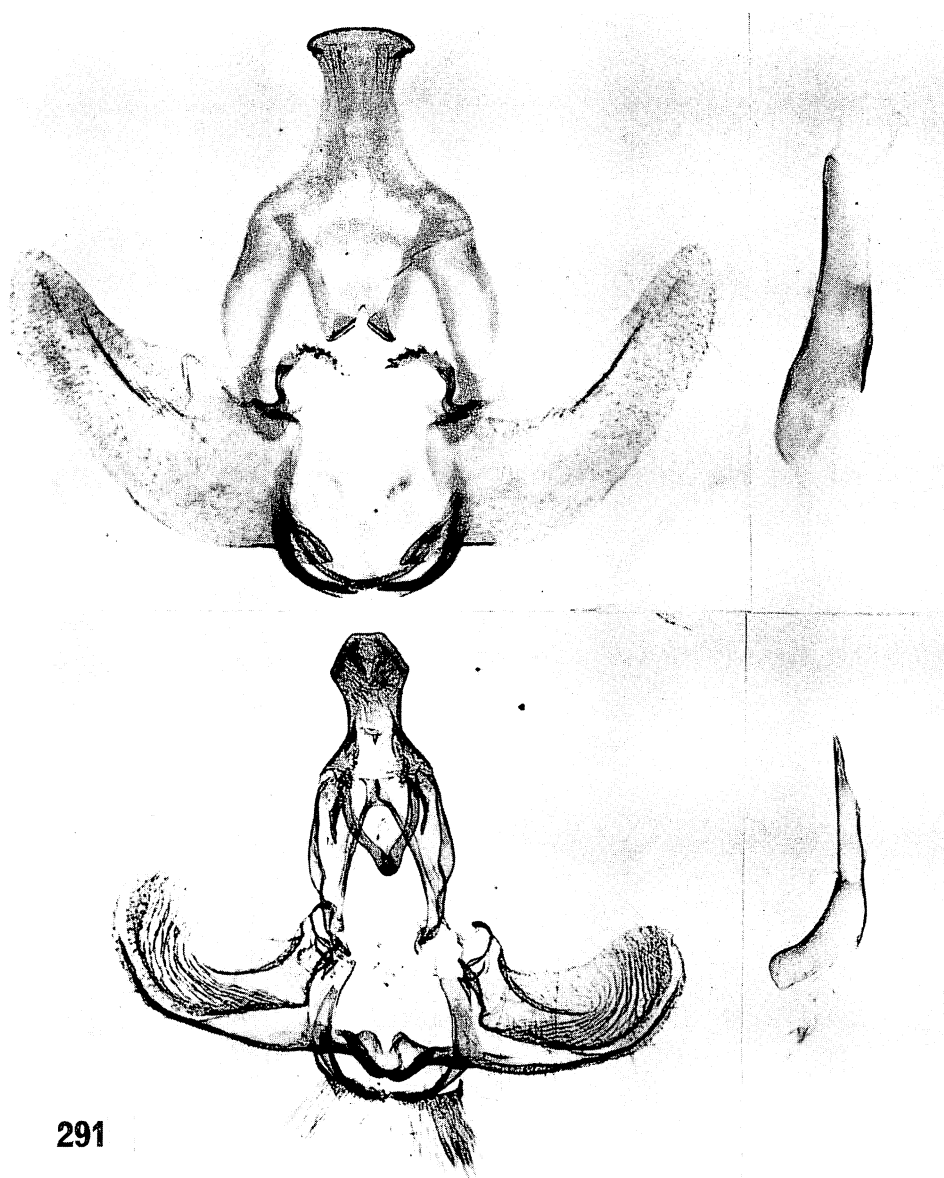


Figure 290—Male genitalia of *Pararrhaptica*. Top, *pynomias* (Meyrick), paralectotype (BM slide 3851); Wailupe, Oahu. Bottom, *subsenescens* (Walsingham), determined by Dr. Swezey (Slide Z-VI-18-61); Kilauea, Hawaii.





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Figure 291—Male genitalia of *Pararrhaptica*. Top, *trochilidana* (Walsingham), holotype (BM slide 1912); Molokai, about 4,000 feet. Compare the similar, but not identical, genitalia of *fuscoviridis* in figure 287. Bottom, *sublichenoides* (Swezey); Kilauea, Hawaii (slide JDB 6).

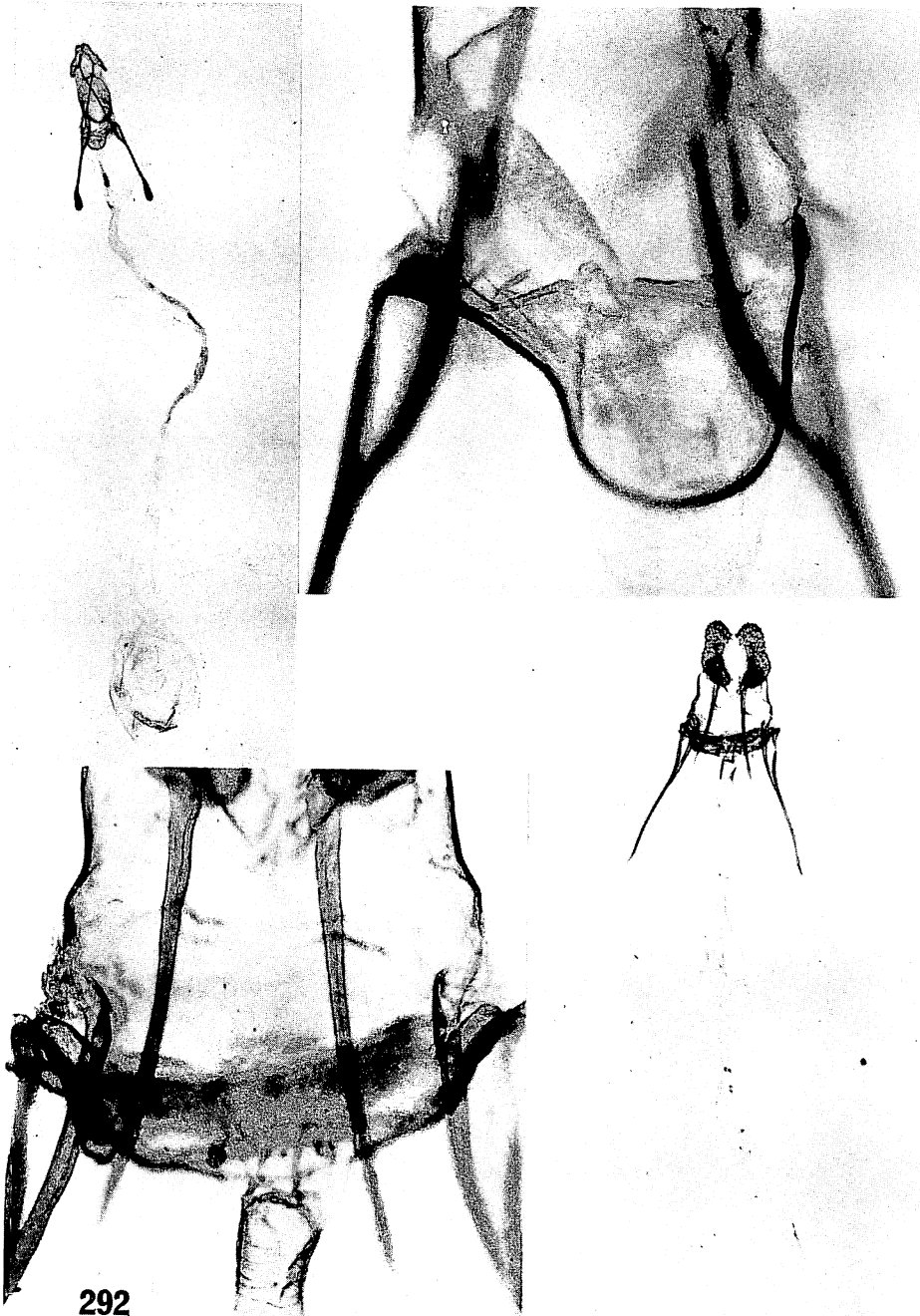


Figure 292—Female genitalia of *Pararrhaptica*. Top, *capucina* (Walsingham), holotype (BM slide 1896); Molokai, 4,000 feet. The figure of the whole genitalia has been reversed in the print. Bottom, *lichenoides* (Walsingham), holotype (BM slide 1907); Kilauea, Hawaii.

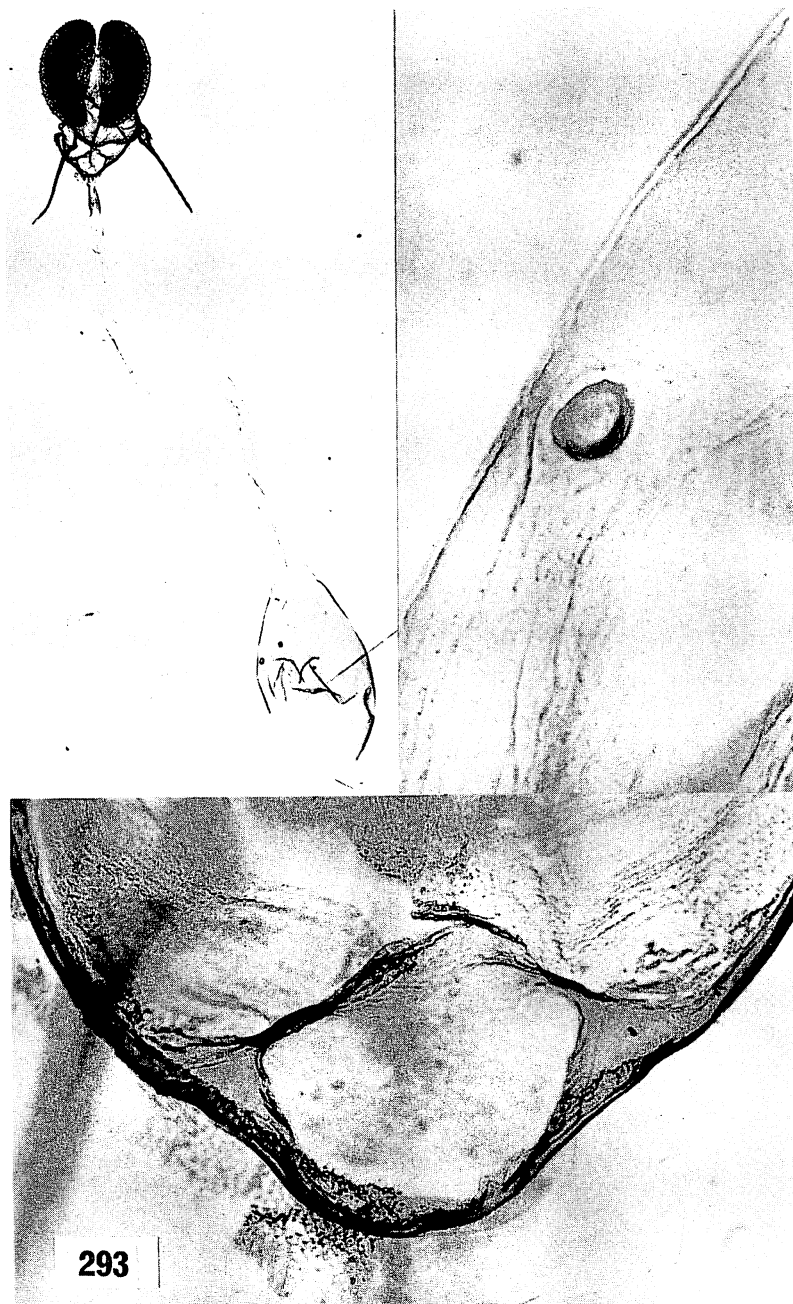
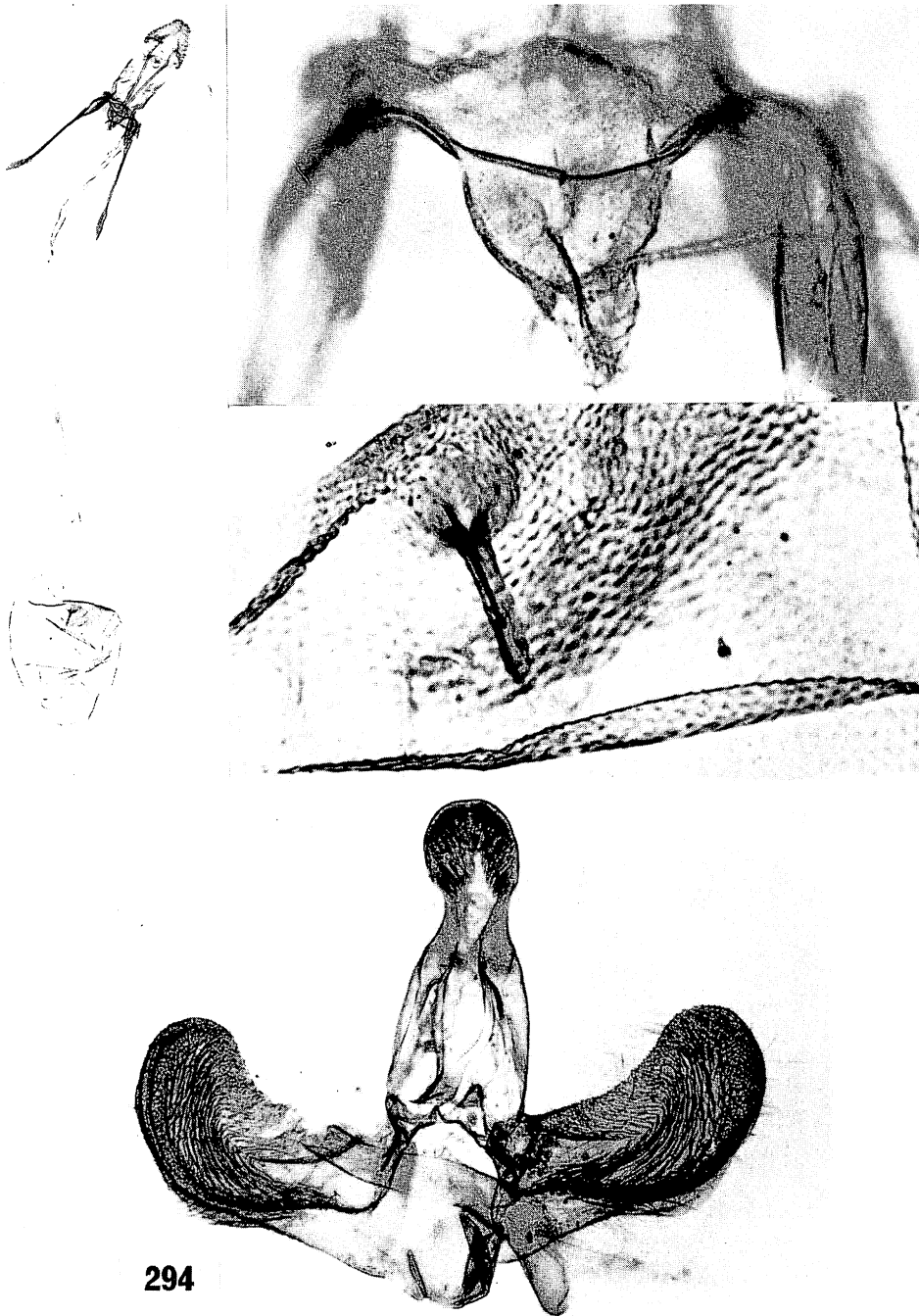


Figure 293—Female genitalia of a *Pararrhaptica* species confused as a paratype of *fuscoviridis* by Walsingham; northwest Koolau Mts., Oahu (BM slide 1911). See figure 281 for an illustration of the moth, and see the discussion under *fuscoviridis* in the text. What appears to be a second signum to the right of the signum in the top left figure is a piece of debris—the true signum is enlarged at upper right.



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Figure 294—*Pararrhaptica* genitalia. Top three figures, female genitalia of a specimen of *longiplicata* (Walsingham) from the northwest Koolau Mts., Oahu (BM slide 1969); note the strong, elongate signum as enlarged. Bottom, male genitalia of a specimen of *notocosma* (Meyrick) from Mt. Olympus, Oahu (BM slide 3850).

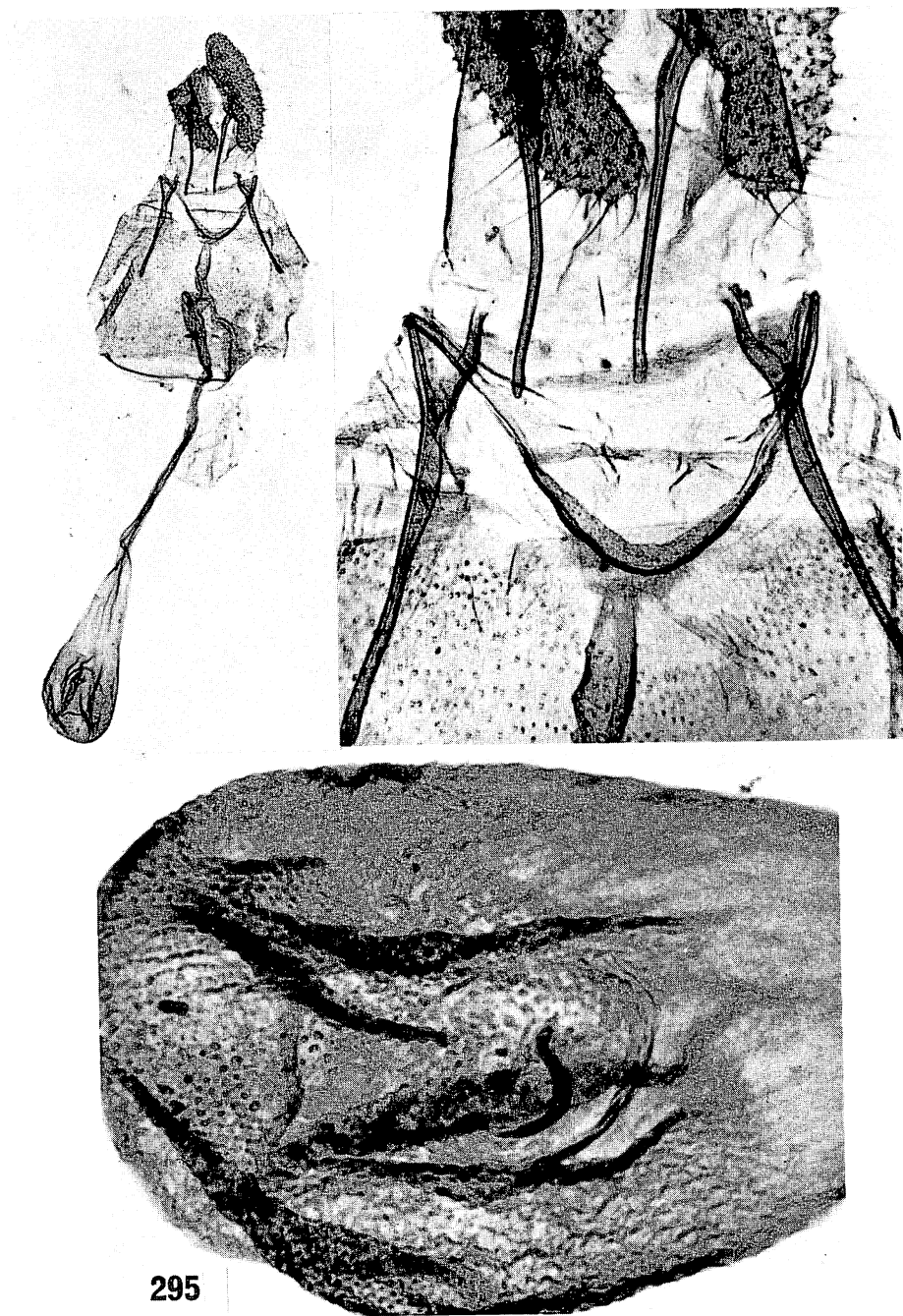


Figure 295—Female genitalia of *Pararrhaptica lysimachiana* (Swezey), holotype (slide Z-IX-5-61-H); Hapapa, Waianae Mts., Oahu. The signum is the crescent-shaped dark object near the middle of the bottom figure (the photographic negative was printed from the wrong side, and the print is thus reversed).

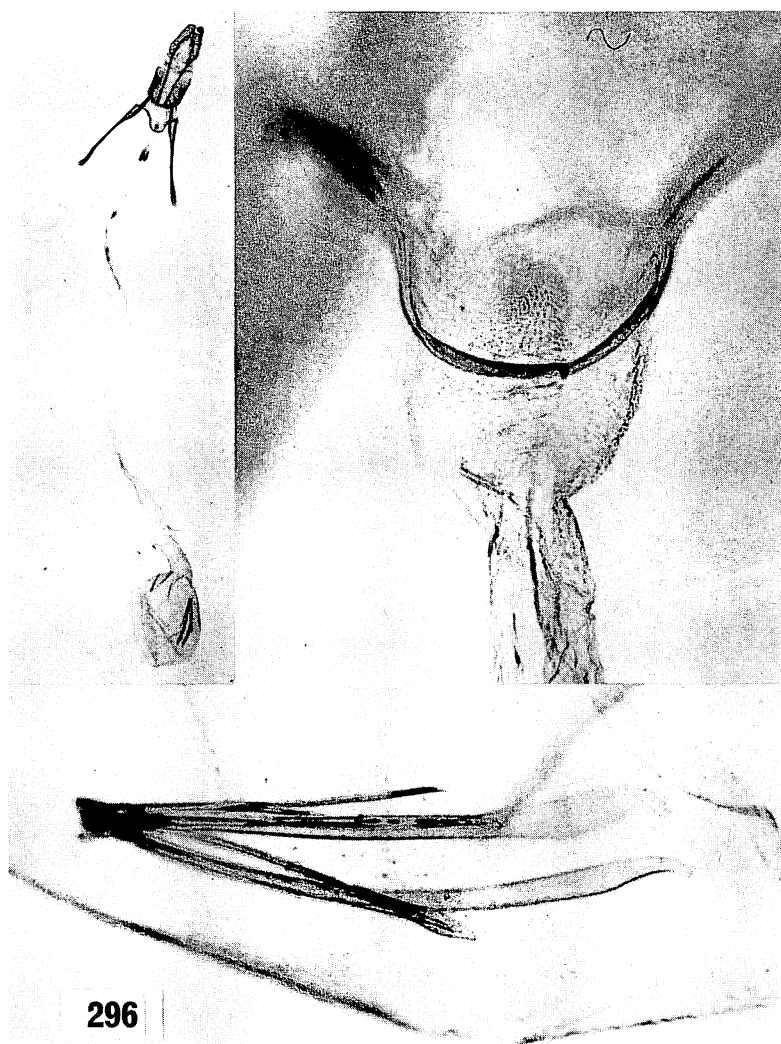


Figure 296—Female genitalia of *Pararrhaptica perkinsiana* Walsingham, paratype (BM slide 1948); Olinda, 4,000 feet, Maui. The print of the photograph of the whole genitalia has been reversed. At the bottom is an enlarged view of the cluster of deciduous cornuti transferred from the male during copulation.



Figure 297—Female genitalia of *Pararrhaptica*. Top, *punctiferana* (Walsingham), paratype (BM slide 1967); Molokai, about 4,000 feet. Bottom, *leucostichas* (Meyrick), lectotype (BM slide 9542 Clarke); Honolulu, Oahu; ex *Myrsine* shoots.



Figure 298—Female genitalia of *Pararrhaptica sublichenoides* (Swezey); Kilauea, Hawaii (slide Z-IX-5-61-1). The photographic negative was reversed when the print for the bottom figure was made.



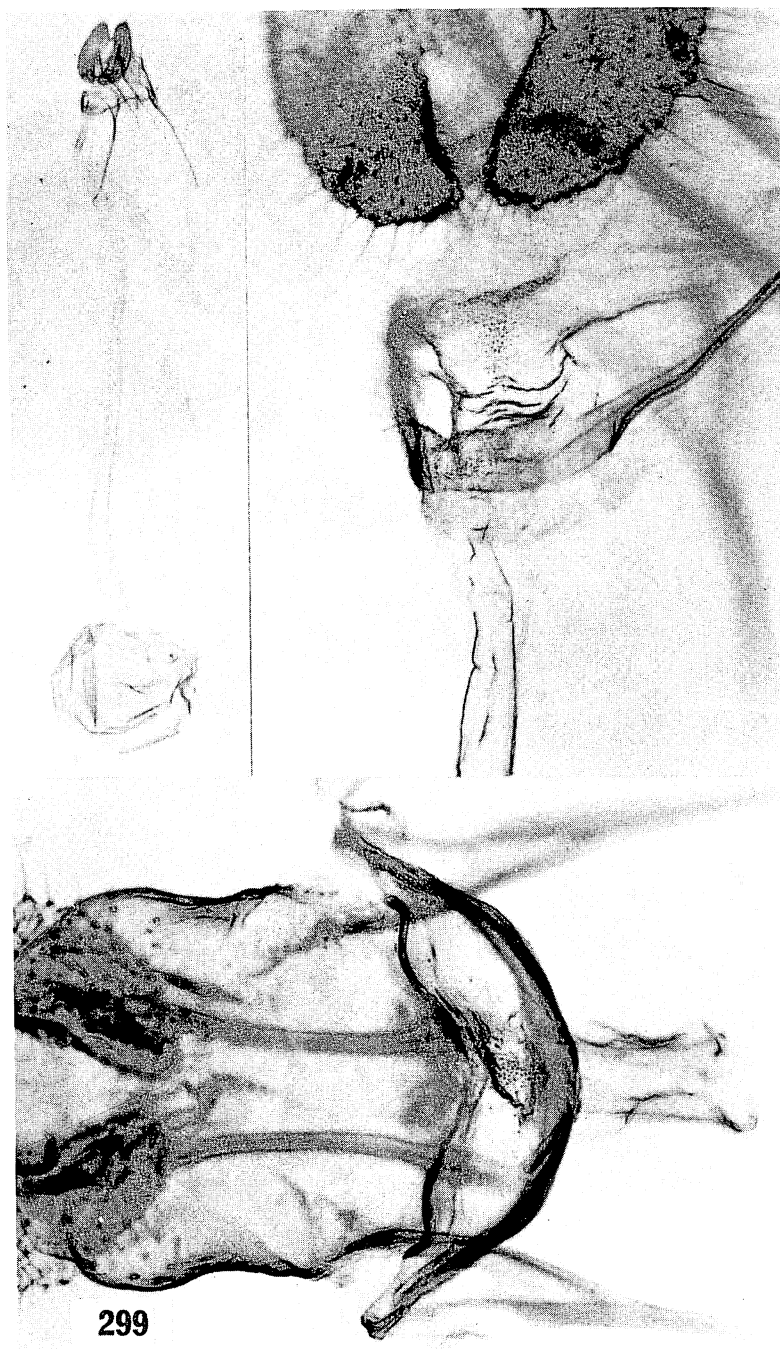


Figure 299—Female genitalia of *Pararrhaptica*. Top, *subsenescens* (Walsingham), holotype (BM slide 1906); Molokai. Bottom, *trochilidana* (Walsingham), holotype (BM slide 1913). The delicate, weakly stained bursa was not photographed; there is no signum.

**Pararrhaptica leucostichas** (Meyrick), **new combination** (figs. 277*c*, ovipositor lobes; 280, moth; 297, female genitalia).

*Eulia leucostichas* Meyrick, 1932:258.

Endemic. Oahu (type locality: Honolulu).

Hostplant: *Myrsine* (= *Suttonia*).

This species was described from two specimens reared from the shoots of the hostplant by Perkins in June, 1906. Although the label states that the locality of these specimens is "Honolulu", it is probable that the true locality is the mountains behind Honolulu. The lectotype female (BM slide 9542, Clarke) and a paralectotype (abdomen lost) are in the British Museum.

**Pararrhaptica lichenoides** (Walsingham), **new combination** (figs. 277*d*, ovipositor lobes; 280, moth; 292, female genitalia).

*Archips* (?) *lichenoides* Walsingham, 1907*b*:694, pl. 11, fig. 13.

*Eulia lichenoides* (Walsingham) Meyrick, 1913*b*:38; 1928*c*:96.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the female holotype is known. Swezey's note of 1913*e*:237 applies to *sublichenoides*.

**Pararrhaptica longiplicata** (Walsingham), **new combination** (figs. 276, wing venation; 277*i*, ovipositor lobes; 282, moth; 289, male genitalia; 294, female genitalia).

*Archips longiplicatus* Walsingham, 1907*b*:691, 736, pl. 11, fig. 8.

*Tortrix longiplicata* (Walsingham) Meyrick, 1913*b*:31.

*Eulia longiplicata* (Walsingham) Meyrick, 1928*c*:96.

Endemic. Kauai?, Oahu?, Maui (type locality: Haleakala, 5,000 feet), Lanai?, Hawaii?

Hostplant: *Myrsine* (= *Suttonia*).

Parasite: *Sierola capuana* Fullaway.

I question all of the localities except that of Maui, because there is a mixture of species under this name. Walsingham's notes concerning the supposed variability of the species are based upon more than one species. Walsingham's paratype 25065 (a male from Oahu), for example, is not the same species as the holotype, as can be ascertained by examining the genitalia.

The hostplant and parasite data require confirmation.

**Pararrhaptica lysimachiae** (Swezey), **new combination** (figs. 281, moth; 286, male genitalia).

*Eulia lysimachiae* Swezey, 1933*b*:302.

Endemic. Kauai (type locality: Kalalau Trail, about 3,800 feet).

Hostplants: *Lysimachia glutinosa*, *Lysimachia hillebrandi venosa*. The larvae have been found on the leaves.

**Pararrhaptica lysimachiana** (Swezey), **new combination** (figs. 282, moth; 295, female genitalia).

*Tortrix lysimachiana* Swezey, 1946:626.

Endemic. Oahu (type locality: Puu Hapapa, Waianae Mountains).

Hostplant: *Lysimachia rotundifolia*.

This moth is known only from the female holotype which was reared from a caterpillar found on the leaves of the hostplant.

It has been confusing that, although Dr. Swezey described this species in *Tortrix*, he placed the allied *lysimachiae* in *Eulia*.

**Pararrhaptica notocosma** (Meyrick), **new combination** (figs. 282, moth; 294, male genitalia).

*Eulia notocosma* Meyrick, 1928c:97.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Myrsine lessertiana*.

I believe that there has been confusion regarding the hostplant of this species, because Meyrick had two males bred from *Myrsine* (= *Suttonia*) and one female supposedly bred from *Astelia varatroides* before him when he described the moth. Swezey (1954:138) states that one specimen had been reared from *Astelia*, and presumably he was referring to the one recorded by Meyrick. Meyrick said that the specimens he had were "unquestionably sexes of the same species", but because *Astelia* is a lily and *Myrsine* is a myrsinaceous tree, I believe that either two species are involved or that there has been an error in recording the hostplant of the specimen supposedly reared from *Astelia*.

**Pararrhaptica perkinsiana** Walsingham (figs. 273, head, wing venation; 277f, ovipositor lobe; 283, moth; 296, female genitalia).

*Pararrhaptica perkinsiana* Walsingham, 1907b:689, pl. 11, fig. 6.

*Tortrix perkinsiana* (Walsingham) Meyrick, 1913b:31.

Endemic. Molokai, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

The male holotype has lost its abdomen, and no other male has been seen by me. This is particularly unfortunate, because *perkinsiana* is the type-species of *Pararrhaptica*.

**Pararrhaptica punctiferana** (Walsingham), **new combination** (figs. 277g, ovipositor lobe; 283, moth; 289, male genitalia; 297, female genitalia).

*Archips punctiferanus* Walsingham, 1907b:692, pl. 11, fig. 10.

*Tortrix punctiferana* (Walsingham) Meyrick, 1913b:31.

*Eulia punctiferana* (Walsingham) Meyrick, 1928c:96.

Endemic. Molokai?, Maui (type locality: Haleakala, 5,000 feet), Hawaii?

Hostplant: unknown.

This moth was described from one male from Maui, and Walsingham had a single specimen from Molokai which he thought might be the female. It is possible that it represents a different species. I have questioned the Hawaii record also, because it is based upon material determined as this species (probably from literature only) by Dr. Swezey from specimens collected at light at Kilauea by Giffard. It is possible that three species are involved in these records.

**Pararrhaptica pycnomias** (Meyrick), **new combination** (figs. 283, moth; 290, male genitalia).

*Eulia pycnomias* Meyrick, 1928c:97.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Myrsine* (= *Suttonia lessertiana*).

This species was described from two males, and I have not seen the female.

**Pararrhaptica sublichenoides** (Swezey), **new combination** (figs. 284, moth; 291, male genitalia; 298, female genitalia).

*Archips sublichenoides* Swezey, 1913f:276.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Dr. Swezey's notes of 1913f:237 apply to this species instead of to *lichenoides*.

**Pararrhaptica subnescens** (Walsingham), **new combination** (figs. 277b; ovipositor lobe; 284, moth; 290, male genitalia; 299, female genitalia).

*Archips* (?) *subnescens* Walsingham, 1907b:695, pl. 11, fig. 14.

*Eulia subnescens* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Molokai (type locality: no specific locality is on the label, but the type was collected by Perkins "5-VIII-1893"), Hawaii?

Hostplant: unknown.

This species was described from one female. I have questioned the Hawaii record which is by Dr. Swezey from specimens collected at light at Kilauea by Giffard, because the specimens have not been compared with the holotype.

**Pararrhaptica trochilidana** (Walsingham), **new combination** (figs. 277e, ovipositor lobe; 284, moth; 291, male genitalia; 299, female genitalia).

*Archips trochilidanus* Walsingham, 1904b:693, pl. 11, fig. 11.

*Eulia trochilidana* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Molokai (type locality: 3,500 feet).

Hostplant: unknown.

This moth is close to *fuscoviridis* and shares the unusual kind of male genitalia of that species. It has very dark fuscous hindwings.

Genus **PARAPHASIS** Walsingham

*Paraphasis* Walsingham, 1907b:730. Type-species: *Paraphasis perkinsi* Walsingham, monotypic.

This endemic genus was assigned to the wrong family by Walsingham. He placed it in the Tineidae, but an examination of the accompanying illustrations will demonstrate that it belongs in the Tortricidae. It was described from one male specimen, and nothing has been recorded concerning it since it was described.

Although the male genitalia indicate that the type-species belongs to the Tortricinae, as defined in this text, the vestiture of the sides of the metascutum differs from all other Hawaiian Tortricinae and agrees with the Hawaiian Olethreutinae. The vestiture distinctly consists of elongated squamae and not hairs on the metascutum. Also, the lack of maculation on the undersides of the hindwings renders it more confusing in the Island fauna. It is unfortunate that only one damaged specimen is known to have been collected.

The wing venation is "loose" and peculiar. Vein 2 in the forewing terminates on the posterior wing margin ("dorsum") instead of on the termen as it does in all other Hawaiian tortricids; this is a highly peculiar character. In the hindwing, vein 6 is basally well separated from 7, as illustrated, and this is another peculiarity. The male antennae (figure 220) are conspicuously bipectinate; in Hawaii *Paraphasis* shares this character only with *Panaphelix*, although it is not allied to that genus.

*Paraphasis* is a strange moth, and I have been unable to determine its affinities.

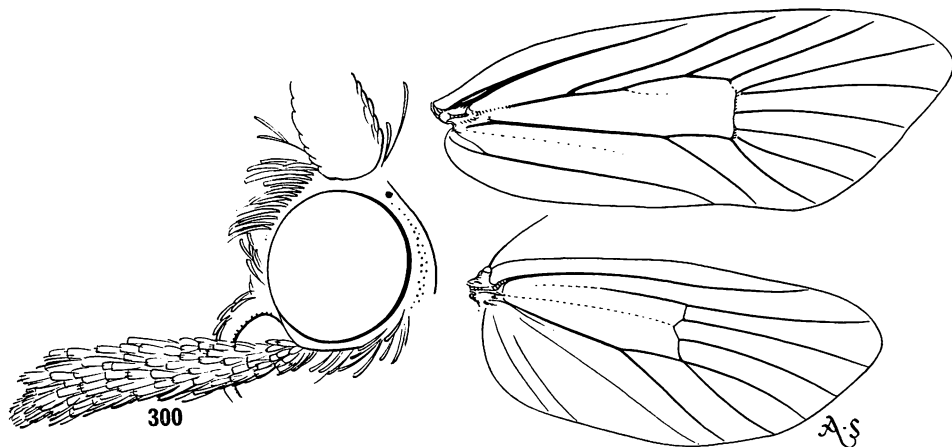


Figure 300—Head and wing venation of *Paraphasis perkinsi* Walsingham, holotype male (BM slide 1860); Kauai, 3,000 to 4,000 feet. Note the strange "open" venation and the unusual course of vein 2 which runs to the hind margin in the forewing instead of to the termen. The head is abraded and shriveled and not in good condition. A fold in the collapsed, abraded occiput largely conceals the small left ocellus. The labial palpus is displaced downward from its normal attitude; it should be more ascending. Although this is a tortricid, it was wrongly placed in the Tineidae when it was originally described.

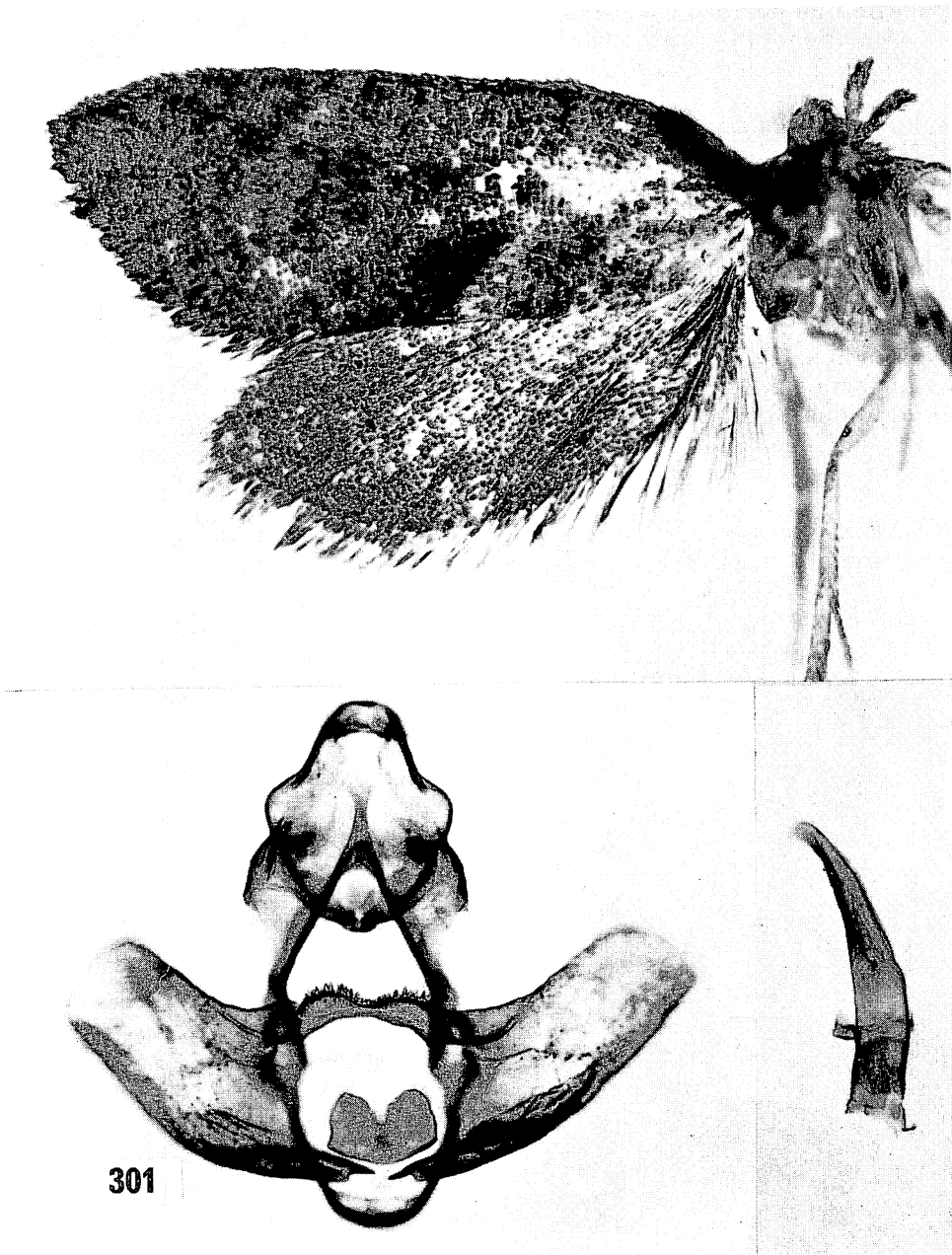


Figure 301—*Paraphasis perkinsi* Walsingham, holotype male and its genitalia (BM slide 1860); Kauai, 3,000 to 4,000 feet; forewing 6.5 mm. The dark macula near the middle of the posterior margin of the forewing is a mixture of mostly orange and brown scales, and there is a scattering of orange scales over most of the wing. The large pale subbasal area is an abrasion.

**Paraphasis perkinsi** Walsingham (figs. 220, male antenna; 300, head, wing venation; 301, moth, male genitalia).

*Paraphasis perkinsi* Walsingham, 1907b:730.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The unique male holotype is partly abraded, especially on the head and thorax, and the head is partly crushed and has been glued to the thorax. It is, therefore, impossible to ascertain the true nature of certain characters. The ocelli are small and difficult to see because of the deformed integument. The holotype bears the Walsingham label "*Entlechia perkinsi* Wlsm."

This is one of the very few species of Hawaiian Microlepidoptera which Walsingham did not illustrate in *Fauna Hawaiiensis*.

Further details concerning this highly unusual moth must await the capture of additional specimens.

#### Genus **PANAPHELIX** Walsingham

*Panaphelix* Walsingham, 1907b:695. Type-species: *Panaphelix marmorata* Walsingham, by original designation.

This is a group of large tortricids (about 20 to nearly 40 mm. in expanse). The genus appears to be endemic. Meyrick (1922a:495) described a *Panaphelix allomorpha* from Reunion Island (east of Madagascar), but the specimen does

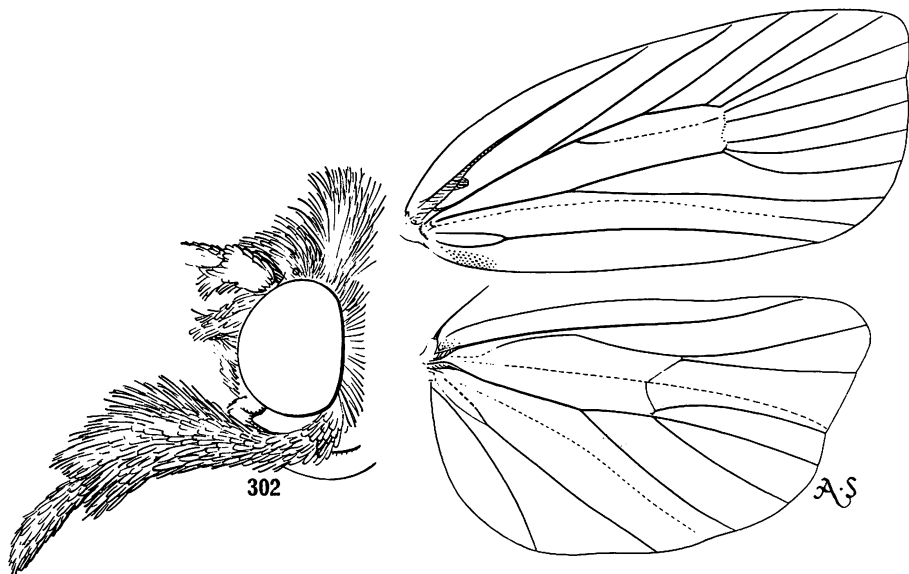


Figure 302—*Panaphelix marmorata* Walsingham. Head of the allotype female; the labial palpi are generally similar to those of *Mantua* (see figure 307). Wings of the male holotype (BM slide 9596 Clarke).

not belong to *Panaphelix*. I have examined the type in the Paris Museum. Diakonoff (1957b:254) placed *allomorpha* in *Borboniella*. In the Hawaiian fauna, *Panaphelix* appears closest to *Mantua*. It somewhat resembles the complex of genera which includes *Pandemis* Hübner, 1825; *Parapandemis* Obraztsov, 1954; and *Borboniella* Diakonoff, 1957b, and associates, as well as some *Archips*. I do not, however, know to what *Panaphelix* is most closely allied or whence it has come, but it may be a development from Holarctic *Archips*.

The males are easily recognized by their strongly bipectinate antennae (see figure 220) together with their large size. The only other genus in Hawaii which contains a male whose antennae are bipectinate is *Paraphasis*, but the only known male of that genus is only 14 mm. in expanse, and *Paraphasis* is otherwise very different. The broad valvae of the male *Panaphelix* genitalia are distinctive in the Hawaiian fauna. There are conspicuous pairs of pits on abdominal tergites 2 and 3 which are noteworthy (see the details under *asteliana*, below). Freeman (1958:85) figures similar pits on the Holarctic *Archippus*, and he reports that pits may be present or absent on species of *Archips*. Also in Hawaii, *Amorbia* has a single pit. The pupae of *Panaphelix* and *Amorbia* also bear dorsal foveae as shown in figures 302-A, *e* and 327.

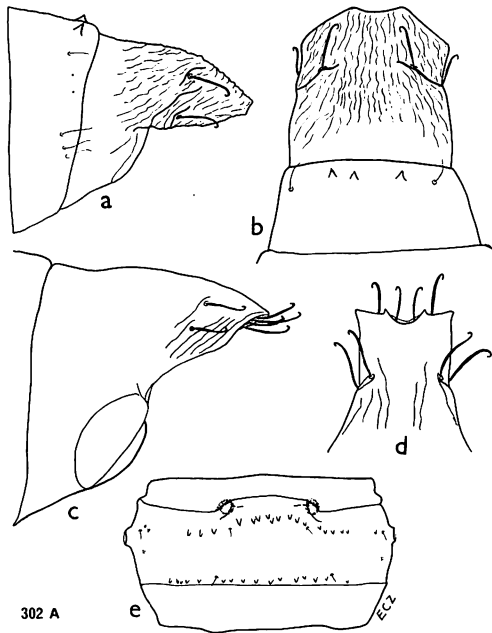


Figure 302-A—Details of tortricid pupae. *a, b*, lateral and dorsal aspects of the cauda of *Bradleyella thoracina* (Walsingham)?, as determined by Swezey; Mt. Tantalus, Oahu, ex *Perottetia*; length, 9.25 mm. *c, d*, lateral and dorsal aspects of the cauda of *Panaphelix asteliana* Swezey; Mt. Kaala, Oahu; length 13.5 mm. *e*, dorsal aspect of sixth abdominal segment of *asteliana* to show the two conspicuous foveae which occur on tergites two to seven inclusive.



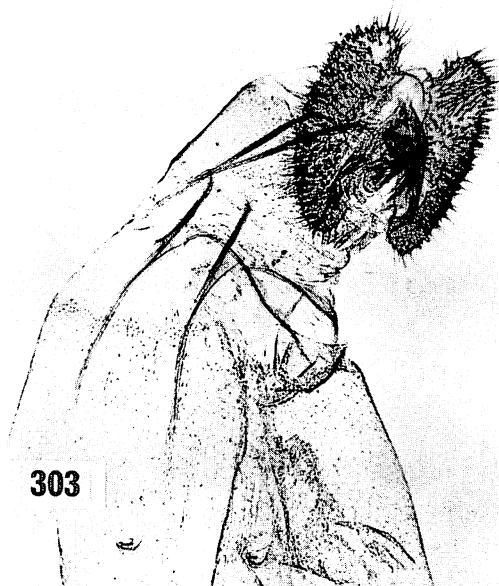
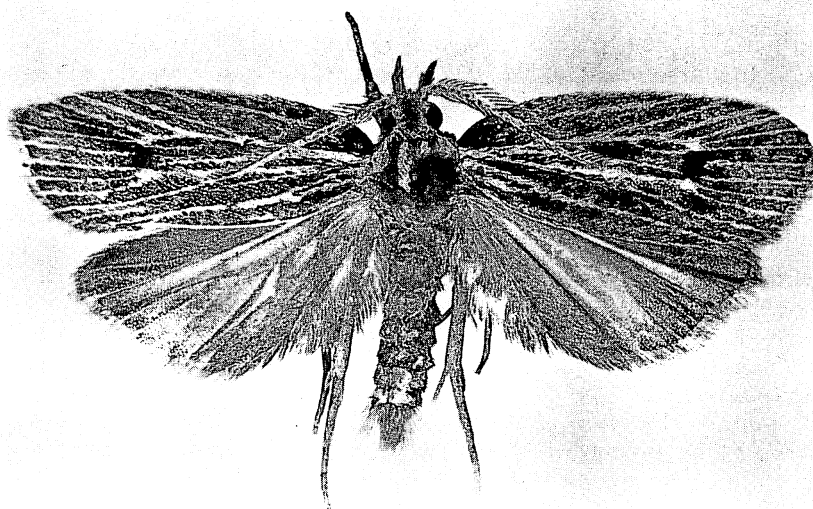


Figure 303—*Panaphelix asteliana* Swezey. Top, male holotype; Mt. Kaala, Oahu; forewing 11 mm. Bottom, part of the female genitalia of a paratype (Busck slide 149); Oahu; ex *Astelia*.

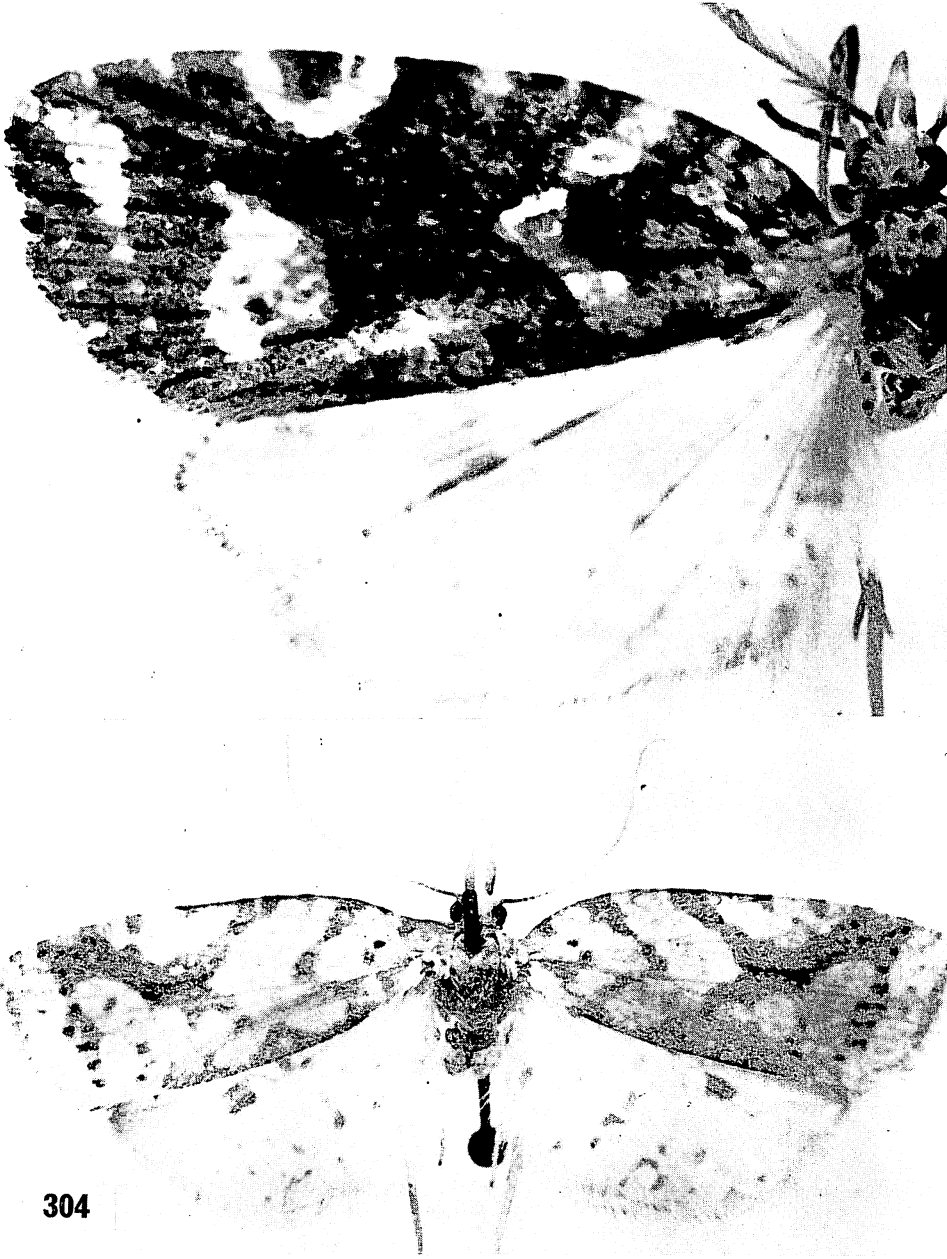


Figure 304—*Panaphelix marmorata* Walsingham. Top, holotype male (BM slide 9596 Clarke); Haleakala, 6,000 feet, Maui; forewing 16 mm. Bottom, allotype female (BM slide 9597 Clarke); Haleakala, 5,000 feet, Maui; expanse 30 mm.

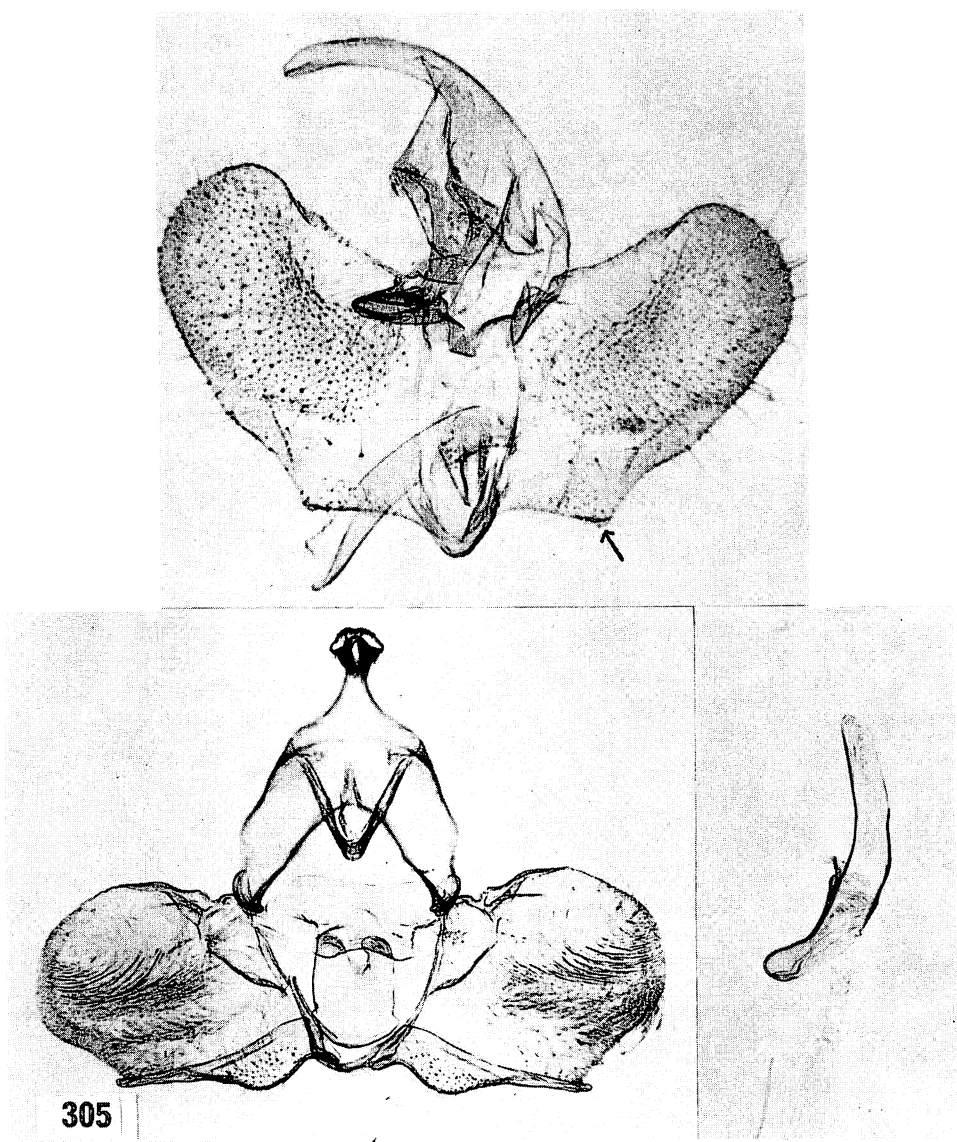


Figure 305—Male genitalia of *Panaphelix*. Top, *asteliana* Swezey, paratype (Busck slide 148); Oahu; ex *Astelia*. The sacculus sclerotization is almost obsolete, but its apex remains as a small sclerotized flange as noted by the arrow. Bottom, *marmorata* Walsingham, holotype (BM slide 9596 Clarke); Haleakala, 6,000 feet, Maui. Note the sclerotization of the sacculus; compare figure 306.

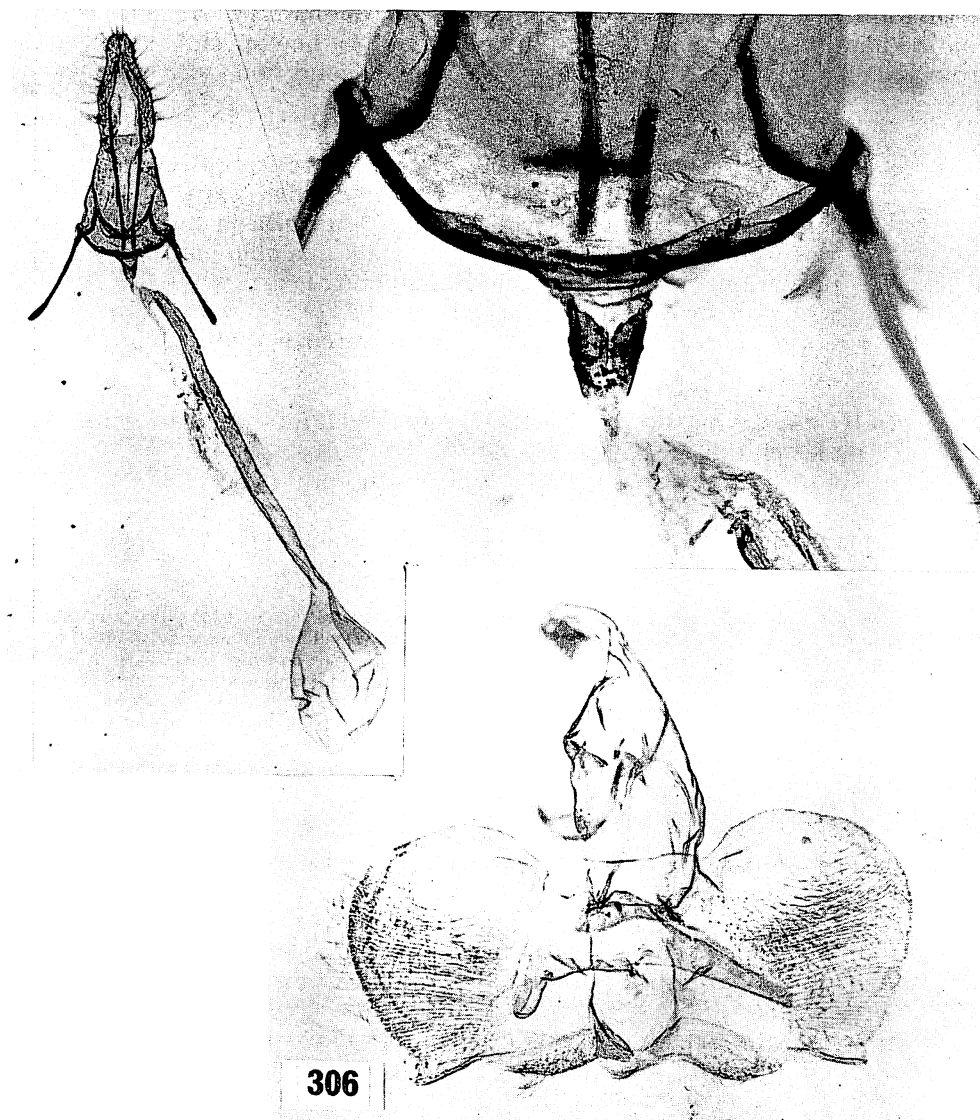


Figure 306—*Panaphelix marmorata* Walsingham. Top, genitalia of a female paratype (BM slide 9597); Haleakala, 6,000 feet, Maui. Bottom, genitalia of a male paratype (Busck slide 80 in the Bishop Museum; Walsingham specimen 28128); compare figure 305.

In addition to the two species listed here, Walsingham (1907b:697) stated that he had a single female of what appeared to be a new species of the genus from Kilauea, Hawaii; this specimen was in poor condition.

#### KEY TO THE SPECIES OF PANAPHELIX

1. Pattern of forewing mostly a series of pale lines on a brown background (veins pale-scaled); hindwings rather shiny brown; figure 303.....**asteliana** Swezey.
2. Forewings boldly marked with large pale maculae on a brown and orange background; hindwings nearly white with pale brownish maculae; figure 304.....**marmorata** Walsingham.

**Panaphelix asteliana** Swezey (figs. 302, pupa; 303, moth, female genitalia; 305, male genitalia).

*Panaphelix asteliana* Swezey, 1932:202, pl. 13, fig. 8.

Endemic. Oahu (type locality: Mt. Kaala, about 3,200 feet).

Hostplant: *Astelia veratroides*.

The larva is greenish with some fuscous marks on head and cervical shield. It feeds beneath web on apical part of the *Astelia* leaf. The leaf is partially eaten on a transverse line on lower side about 6 inches to a foot from the apex. The apical portion then bends down and is the part on which the larva feeds, eating off the under surface and leaving the extreme apical portion rolled and spun together for a retreat which eventually becomes filled with the frass.

The pupa is brown, about 15 mm. in length. The wing and leg sheaths reach the apex of the 3rd abdominal segment; the abdominal segments have two dorsal transverse rows of short spines; near the base of each abdominal segment 1 to 7 is a pair of circular dorsal pits wide apart; cremaster somewhat extended, bluntly conical with 8 hooked bristles, 4 on apical margin and 2 on each side. (Swezey, 1932:202.)

There is a pair of conspicuous pits on the second and third abdominal tergites of the moth (compare these with the pits found on the pupa as described by Swezey in the quotation above).

The color pattern of the forewings, which consists principally of a brown background on which the ochreous-scaled veins stand out as pale lines, is so different from the type-species that the two appear to be widely separated forms.

At first sight, the valvae of the male genitalia may appear to differ from *marmorata* more than they really do. This is because the sacculus is well-developed on *marmorata* but it is much reduced on *asteliana* on which species only its apical part is developed as a sclerotized flange.

**Panaphelix marmorata** Walsingham (figs. 220, male antenna; 302, head, wing venation; 304, moths; 305, 306, male, female genitalia).

*Panaphelix marmorata* Walsingham, 1907b:696, pl. 11, fig. 15 (male). Diakonoff, 1957b:243, pl. 8, figs. 24–25, male genitalia.

*Panaphelix chrysochroa* Walsingham, 1907b:697, pl. 11, fig. 16 (female).

Endemic. Maui (type locality: Haleakala, 6,000 feet, male; 5,000 feet, female).

Hostplant: unknown.

It is not certain that the sexes are correctly associated under this name in collections, and, as the illustrations demonstrate, the holotype male and allotype female appear to be of different species. Walsingham (1907b:697) said that he had at first described the female "as distinct under the name *chrysochroa*, and should it be proved to represent a constant form or variation, or to belong to another closely allied species, this name may be applied to it."

This species may contain the largest individuals of any of the genera of Hawaiian Tortricidae; specimens have been seen which range from 32 to 37 mm. in expanse. Other large Hawaiian tortricids with wing expanses exceeding 30 mm. are *Mantua fulvosericæ*, *Pararrhaptica lichenoides*, and *P. subsenescens*.

### Genus **MANTUA** Zimmerman, **new genus**

Head, as illustrated; roughly scaled between and behind antennae, with closely appressed scales on front, those on lower half smoothest. Labial palpi, as illustrated, comparatively slender, ascending-parallel, second segment mostly smooth-scaled, especially along ventral edge, and dorsal expansion at most moderate; third segment conspicuous, longitudinal, subcylindrical, and exposed for most of its length. Ocellus strongly protuberant, as far from antennal fossa as the diameter of its dark base and closer to eye than the diameter of its lens. Chaetosema strong. Antenna extending to about middle of costa of forewing; ventral cilia on males conspicuous, numerous, and long (longer over most of the length of the antenna than the breadths of the antennal segments and, in the type-species, nearly twice as long as the basal segments are wide). Proboscis evidently shorter than the palpi.

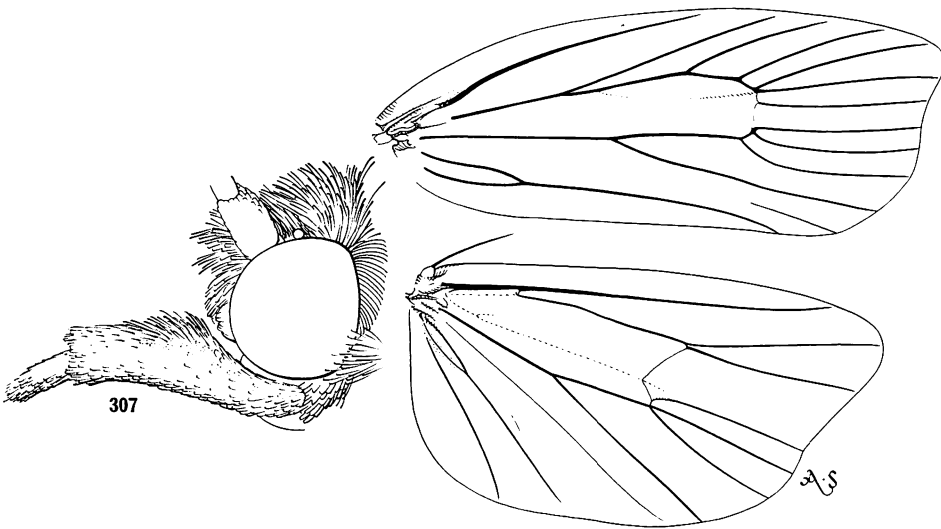


Figure 307—Head and wing venation of *Mantua fulvosericæ* (Walsingham), holotype male (BM slide 1894).

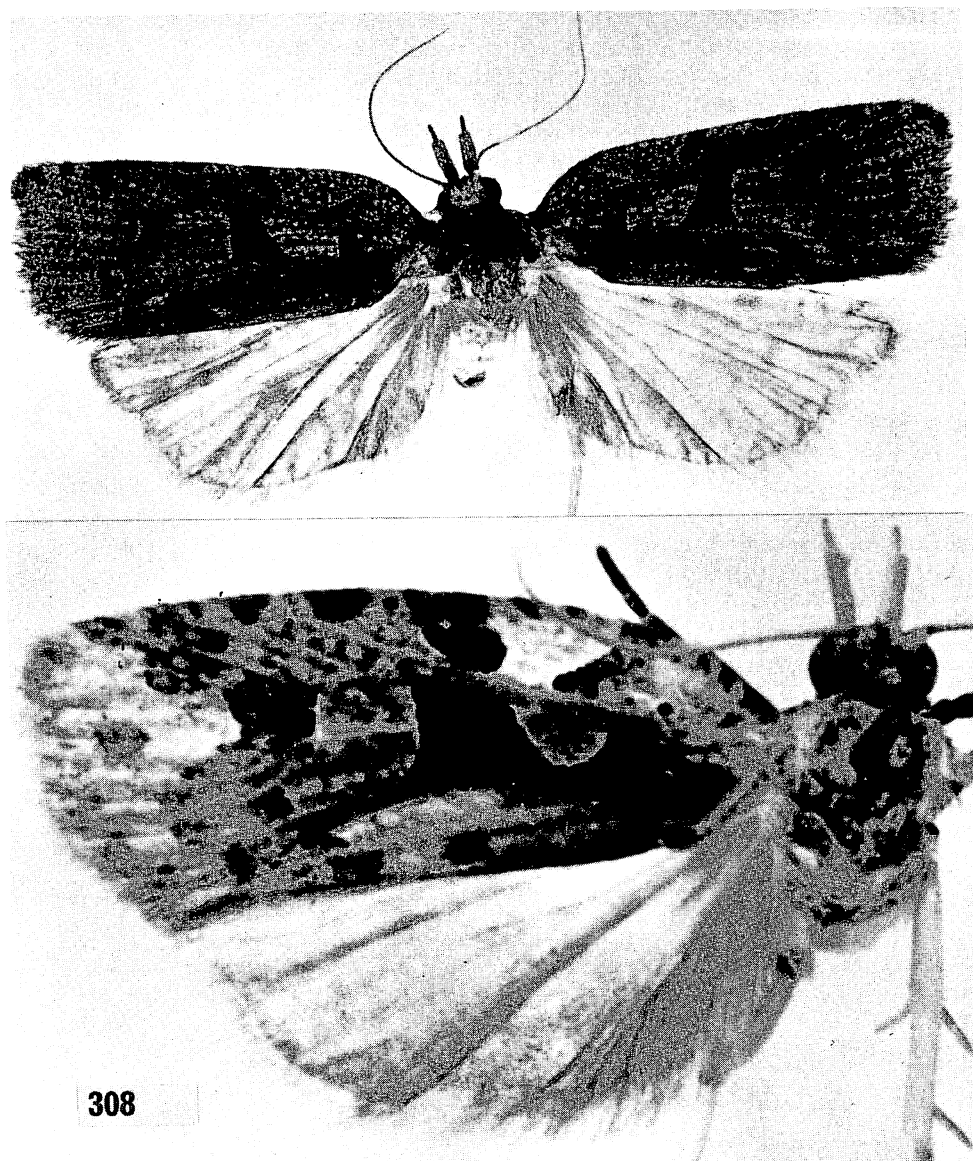


Figure 308 *Mantua fulvosericæ* (Walsingham). Top, allotype female (BM slide 1895); Kauai, 3,000 to 4,000 feet; expanse 34 mm. Bottom, holotype male (BM slide 1894); Molokai, 3,500 feet; forewing 12 mm.



Figure 309—*Mantua fulvosericea* (Walsingham). Top, genitalia of the holotype male (BM slide 1894); Molokai, 3,500 feet. Bottom, female genitalia of allotype (BM slide 1895); Kauai, 3,000 to 4,000 feet; the photographic print of the whole genitalia has been reversed.



Thorax smooth, without a crest; metanotum with broad, smooth scales at middle (metascutellum), but with long, fine, hairlike vestiture on each side of the metascutum. Legs without unusual characters; tibial spurs long, inner spurs longer, and those of middle legs much longer than outer spurs and a little longer than the distance from base of spur to base of inner side of tibia; inner, submedial spurs of hind tibiae reaching over base of apical spurs; hind tarsus a little shorter than hind tibia, ventral surfaces with numerous spines protruding from the vestiture.

Abdomen lacking subbasal dorsal pits.

Wings with shape and venation as in figure 307, hindwings with a strong hair-tuft arising from near base of vein 1b and another from the axil between wing and thorax (in both sexes); no specialized hairs along posterior margin of cell; undersides of hindwings strongly maculate.

Genitalia of male and female as in figure 309. Uncus very strong, broadly expanded distad; socii moderate setose plates; gnathus fused medially into a sharp hook; transtilla without denticles; sacculus long, slender, bladelike, lying entirely along ventral margin of valva, extending well beyond middle of valva and with free apex. Ductus bursae lacking cestum (sclerotized longitudinal band). Bursa copulatrix lacking a signum.

Type-species: *Dipterina fulvosericæ* Walsingham.

This group outwardly appears to resemble *Panaphelix*, and it has similar wing venation and palpi; but the genitalia are distinctive, as the illustrations demonstrate, and the abdomen lacks the subbasal dorsal pits of *Panaphelix*. The antennae of the male are long-hairy beneath, but the male antennae of *Panaphelix* are strongly, peculiarly bipectinate (see figure 220). *Mantua* is proposed for one endemic Hawaiian species which was originally assigned incorrectly to *Dipterina* by Meyrick, 1881b (type-species: *imbriferana* Meyrick of New Zealand; see also Dugdale, 1966: 749 and figures). I have been unable to determine the extra-Hawaiian relationships of *Mantua*.

*Mantua* is derived from the name of Virgil's birthplace. Its gender is to be taken as feminine.

***Mantua fulvosericæ*** (Walsingham), **new combination** (figs. 307, head, wing venation; 308, moths; 309, male, female genitalia).

*Dipterina fulvosericæ* Walsingham, 1907a: 697, pl. 11, figs. 17, 18.

*Cnephassia fulvosericæ* (Walsingham) Meyrick, 1913b: 46.

Endemic. Kauai (type locality of female allotype: 3,000 to 4,000 feet), Oahu, Molokai (type locality of male holotype: 3,500 feet), Lanai.

Hostplant: *Xylosma hawaiiense*, the caterpillars spin the leaves together.

This moth is widely distributed in the islands, but few specimens have been captured. I can recall having collected only one female (at Kokee, Kauai in June, 1937). It is a large moth with a wing expanse of 28 to 36 mm. The male holotype is so different in appearance from the female allotype that one wonders if they represent the same species. Much remains to be learned about this extraordinary moth. I have examined only one male during this study, but I have seen several females.

Genus **BRADLEYELLA** Zimmerman, **new genus**

Head as illustrated; with appressed, smooth scales on front but roughly scaled between and behind the antennae. Labial palpi as illustrated, ascending, second segment with scaling expanded dorsad and ventrad, thus making the segment subtriangular in shape; third segment exposed, subcylindrical, and continuing the medial longitudinal axis of the second segment. Ocelli moderate, well separated from the antennal fossa and separated from eye margin by about the diameter of the ocellar lens. Chaetosemata moderate. Antennae not reaching middle of costa of forewing; male antennae short-furry beneath, the cilia not strong and not as long as the breadths of the segments; rather similar, but narrower, in female. Proboscis moderate.

Thorax smooth, without a crest; metanotum with hairlike scales on each side; metascutellum with smooth, broad scales. Legs without unusual characters; inner spurs on middle legs much longer than outer spurs; inner submedial spur on metatibia capable of overlapping bases of terminal spurs; metatarsi a little shorter than metatibia and the several spines on the ventral surfaces of the segments with only their tips exposed through the scaling.

Wings with shape and venation as illustrated; hindwings with a strong hair-tuft from the base of vein 1b and with another tuft in the axil between the base of the wing and the thorax in both sexes; undersides of hindwings maculate distad only, not conspicuously maculate on discs or basad.

Genitalia as illustrated; uncus and gnathus well-developed, the arms of the latter joined at apices to form a median hooklike process; socii reduced;

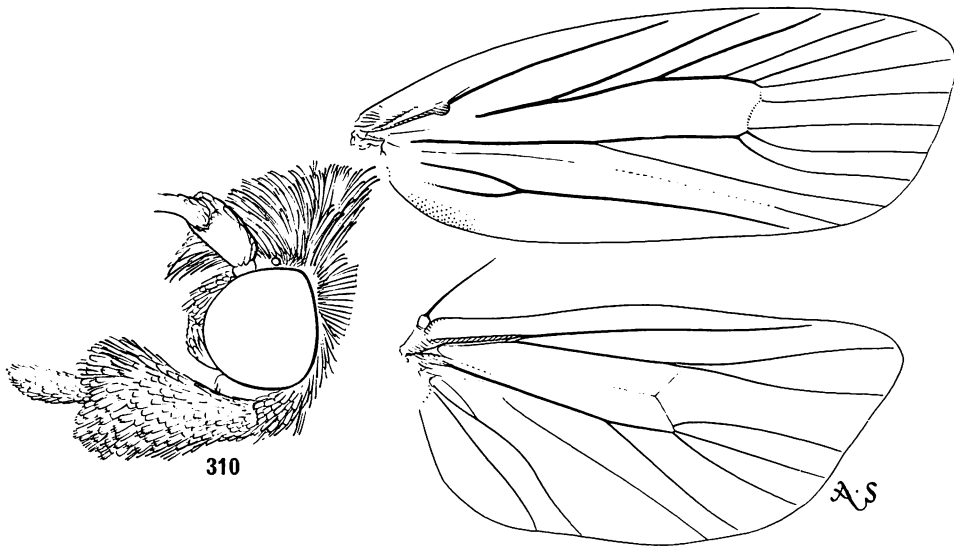


Figure 310—*Bradleyella chlorocalla* (Walsingham). Head of the female holotype. Wings of a male paratype (BM slide 1904). Both specimens are from Olaa, 2,000 feet, Hawaii. This is the type-species of *Bradleyella*.

transtilla simple, unarmed; female lacking a signum in the bursa copulatrix and without a sclerotized band (cestum) in ductus bursae; male with an extraordinary development of very large, curved spines on each side of the apex of the eighth abdominal segment.

Type-species: *Tortrix chlorocalla* Walsingham.

*Bradleyella* is erected for a group of poorly known species heretofore "dumped" into *Tortrix* and *Eulia*. The males bear highly unusual spines at the apices of the abdomens (see the illustrations), and this character alone will separate them from all other genera in Hawaii. Spines similar to these have been seen by me in only one other species, *Tortrix endopyra* Meyrick from Africa (but it is not a *Tortrix*). The character is a parallel development only, and it does not indicate any relationship (see Clarke, 1958:239, fig. 1c for an illustration of the African species). I am unable at this time to say to what genus *Bradleyella* is allied or whence it might have come. It has certain features which recall *Pararrhaptica*, but the genitalia differ.

It is with a deep feeling of gratitude and obligation that I dedicate this unusual genus to my friend, Dr. J. D. Bradley, formerly British Museum (Natural History) and now Commonwealth Institute of Entomology, who has contributed so much toward this volume and who has given generously of his aid over the entire period of years during which I have been working on the Hawaiian Lepidoptera. Without his able assistance this volume could not have been done as it has been done.

Only five species of *Bradleyella* have been described, but numerous species may await discovery and description.

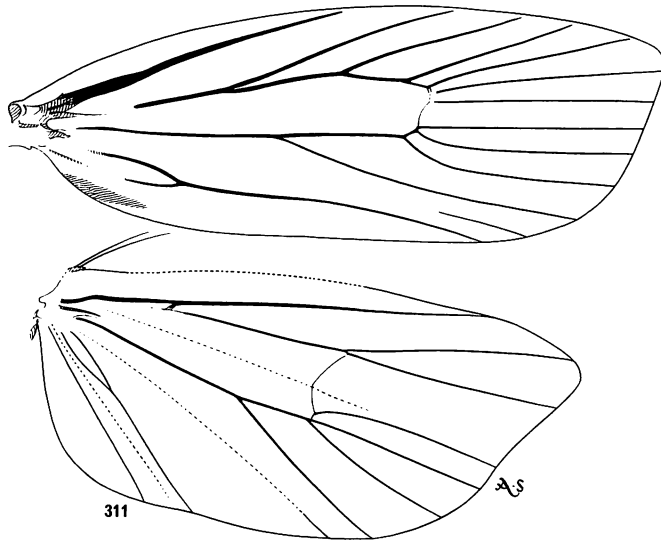


Figure 311—*Bradleyella metallurgica* (Walsingham). Wing venation of a female paratype (BM slide 1902b); Lanai, 2,000 feet.

We know little about the distribution and habits of *Bradleyella*. Representatives of the genus have been found from Kauai to Hawaii, but, strangely, no specimens have yet been recorded from the large, high, central island of Maui where several species must occur. Recorded by type locality only, there is one species from Kauai, one from Oahu, one from Molokai and two from Hawaii. The Kauai species (*thoracina*) has been recorded from the adjacent island of Oahu, and *metallurgica* has been recorded from Oahu, Molokai (type locality), Lanai and Hawaii, but there appears to be confusion in the records.

The known hostplants of *Bradleyella* are *Perrottetia* (Celastraceae), *Phyllanthus* (Euphorbiaceae), and *Xylosma* (Flacourtiaceae).

***Bradleyella chlorocalla*** (Walsingham), **new combination** (figs. 310, head, wing venation; 313, moth; 315, male genitalia; 319, female genitalia).  
*Tortrix chlorocalla* Walsingham, 1907b:699, pl. 11, fig. 19.  
*Eulia chlorocalla* (Walsingham) Meyrick, 1913b:38.

Endemic. Hawaii (type locality: Olaa).

Hostplant: unknown.

***Bradleyella metallurgica*** (Walsingham), **new combination** (figs. 310–312, wing venation; 313, moth; 316, male genitalia; 320, female genitalia).  
*Tortrix metallurgica* Walsingham, 1907b:699, pl. 11, figs. 20.  
*Eulia metallurgica* (Walsingham) Meyrick, 1913b:38.

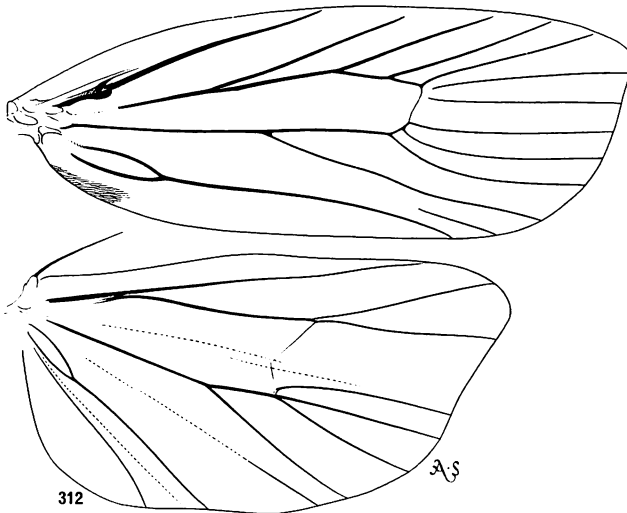


Figure 312—*Bradleyella thoracina* (Walsingham). Wing venation of a male paratype (BM slide 1900); Kaholuamano, 4,000 feet, Kauai.

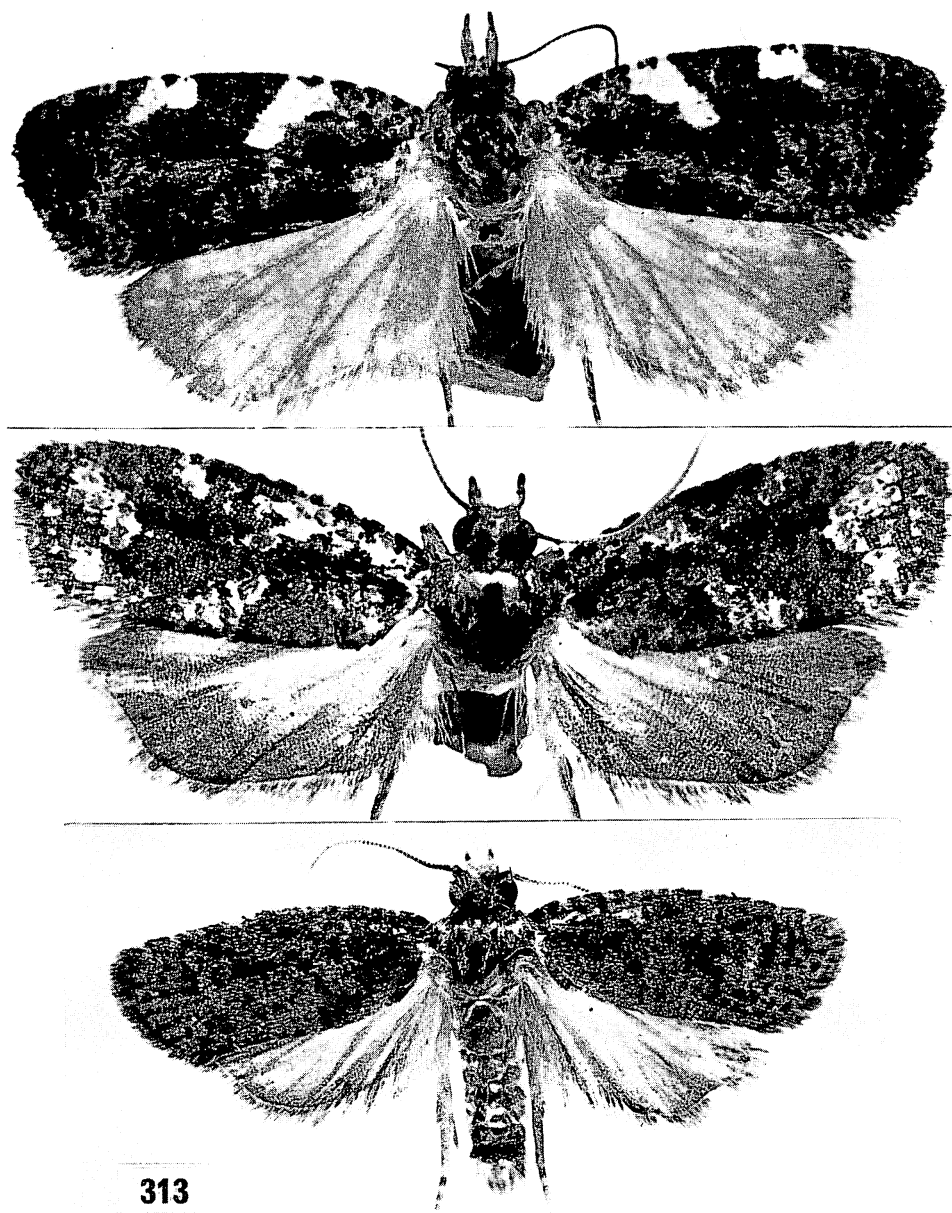


Figure 313—*Bradleyella*. Top, *chlorocalla* (Walsingham), holotype female (BM slide 1903); Olaa, Hawaii; expanse 20 mm. Middle, *metallurgica* (Walsingham), holotype male (BM slide 1901); Molokai, 3,000 feet; expanse 14 mm. Bottom, *phyllanthana* (Swezey), holotype male; Malamalama, Oahu; forewing 6 mm.

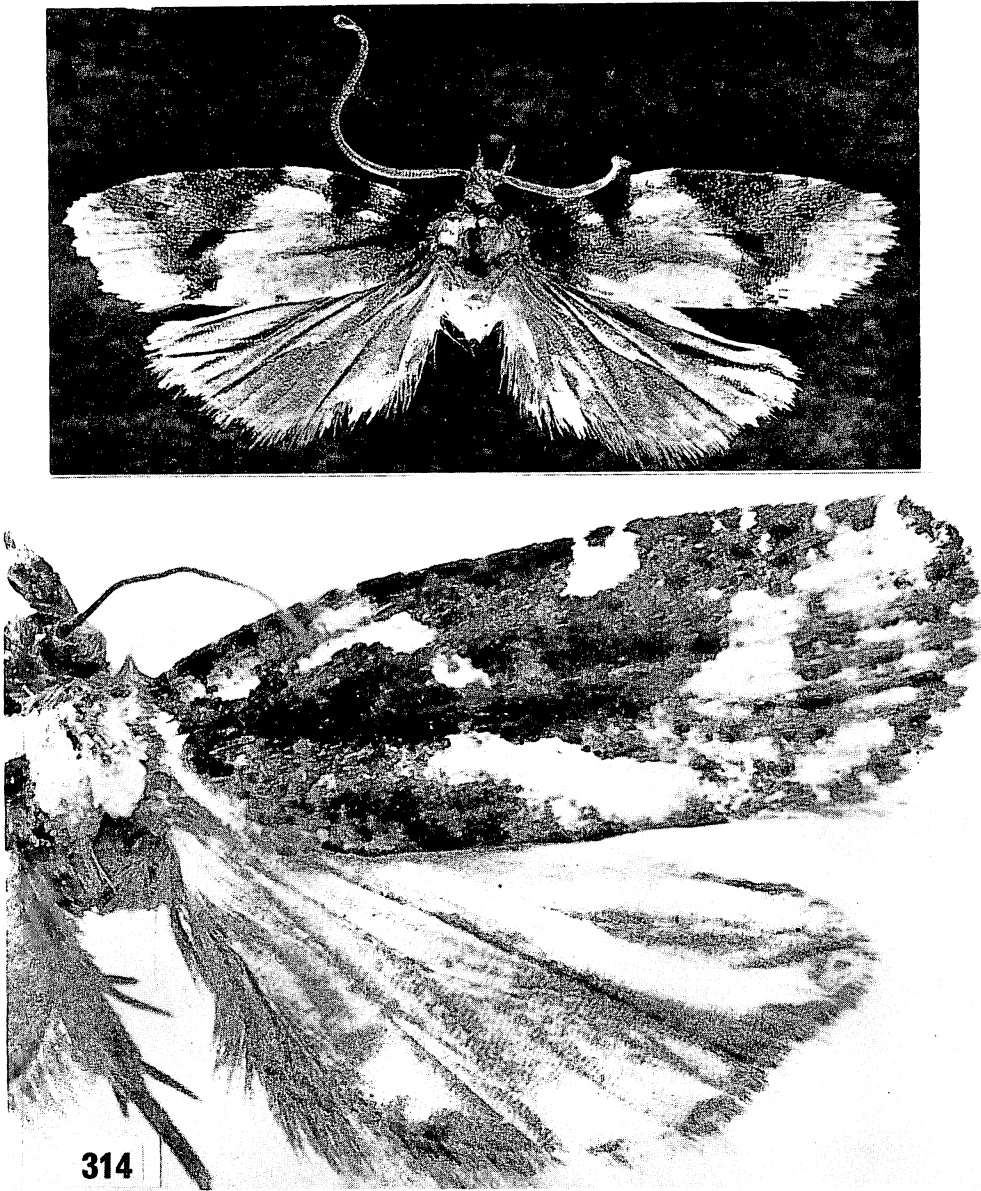


Figure 314—*Bradleyella*. Top, *semicinerea* (Swezey), holotype male; Kilauea, Hawaii (abdomen lost); forewing 9 mm. Bottom, *thoracina* (Walsingham), holotype female (BM slide 1899); Kauai, 3,000 to 4,000 feet; forewing 11 mm.

Endemic. Oahu?, Molokai (type locality: 3,000 feet), Lanai?, Hawaii?

Hostplants: *Phyllanthus*?, *Xylosma*?

Parasites: *Horogenes blackburni* (Cameron)?, *Trathala flavo-orbitalis* (Cameron)?

This species was described from the male holotype from Molokai and a female from Lanai. I am not positive that the female from Lanai is the same species. In 1954:228, Dr. Swezey recorded the species from Oahu ("This moth was once reared from *Xylosma* leaves on Mt. Tantalus, Oahu. It occurs on other trees also."), but I have not studied his material from *Xylosma*, and I am not sure that his determination is correct. In 1910e:142, he recorded it from *Phyllanthus*, without mentioning a locality, but he did not list *Phyllanthus* in his 1954 book on Hawaiian forest entomology. Is it possible that he formerly confused with *metallurgica* that which he later described as *phyllanthana*? *Phyllanthus* (Euphorbiaceae) and *Xylosma* (Flacourtiaceae) are in widely different plant families, and these hostplant records and the parasite records require confirmation. Dr. Swezey also determined specimens from Honakaa, Hawaii, as *metallurgica*, and the identity of those specimens also requires verification.

**Bradleyella phyllanthana** (Swezey), **new combination** (figs. 313, moth; 317, male genitalia; 320, female genitalia).

*Tortrix phyllanthana* Swezey, 1940b:462.

Endemic. Oahu (type locality: Malamalama Ridge).

Hostplant: *Phyllanthus sandwicensis*.

The green larvae were found by Dr. Swezey between spun-together leaves. Is it possible that this is the species which Swezey had previously confused with *metallurgica* when he recorded *metallurgica* from Oahu?

**Bradleyella semicinereana** (Swezey), **new combination** (fig. 314, moth).

*Tortrix semicinereana* Swezey, 1913f:276.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

This moth was described from one specimen (abdomen lost) taken at a light in 1912 and not recorded since.

**Bradleyella thoracina** (Walsingham), **new combination** (figs. 302-A, pupa; 312, wing venation; 314, moth; 318, 321, male genitalia; 319, 321, female genitalia).

*Tortrix thoracina* Walsingham, 1907b:700, pl. 11, fig. 21.

*Eulia thoracina* (Walsingham) Meyrick, 1913b:38.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Oahu.

Hostplant: *Perrottetia*.

Parasite: *Horogenes blackburni* (Cameron).

This moth was described from one female and a questionably associated female from Kauai. Dr. Swezey is responsible for the Oahu record and for the hostplant and parasite records, and I have not verified his determinations.

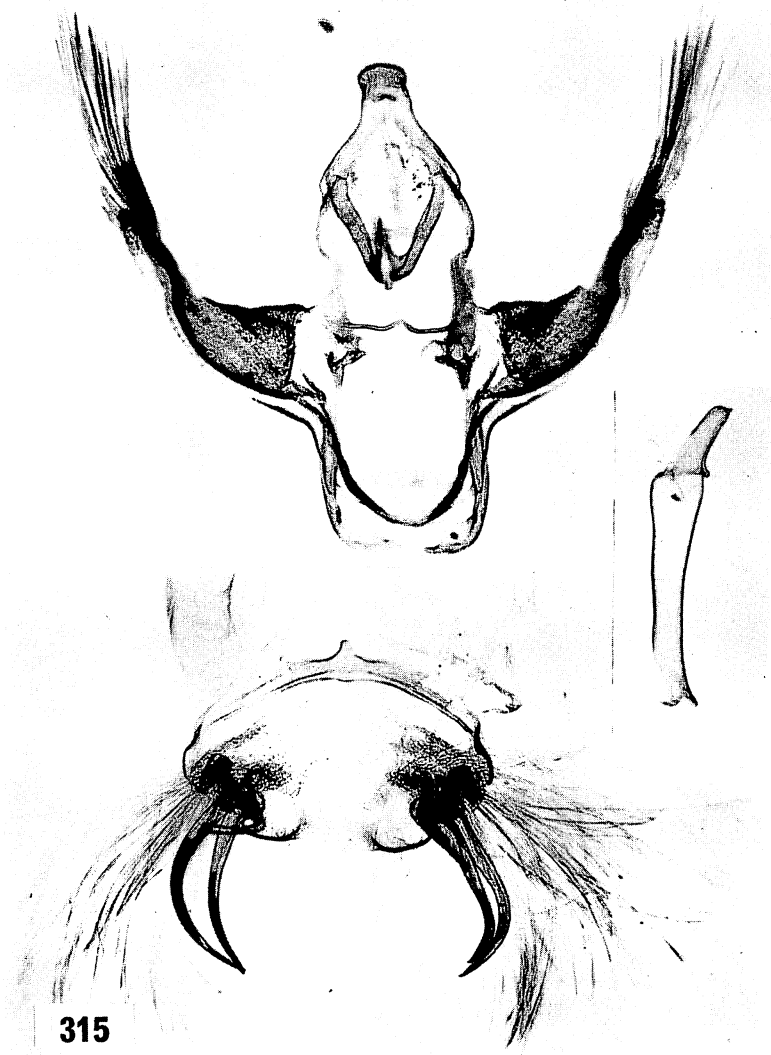


Figure 315—Male genitalia and apex of abdomen of *Bradleyella chlorocalla* (Walsingham), paratype (BM slide 1904); Olaa, 2,000 feet, Hawaii. The figure of the aedeagus is upside down.



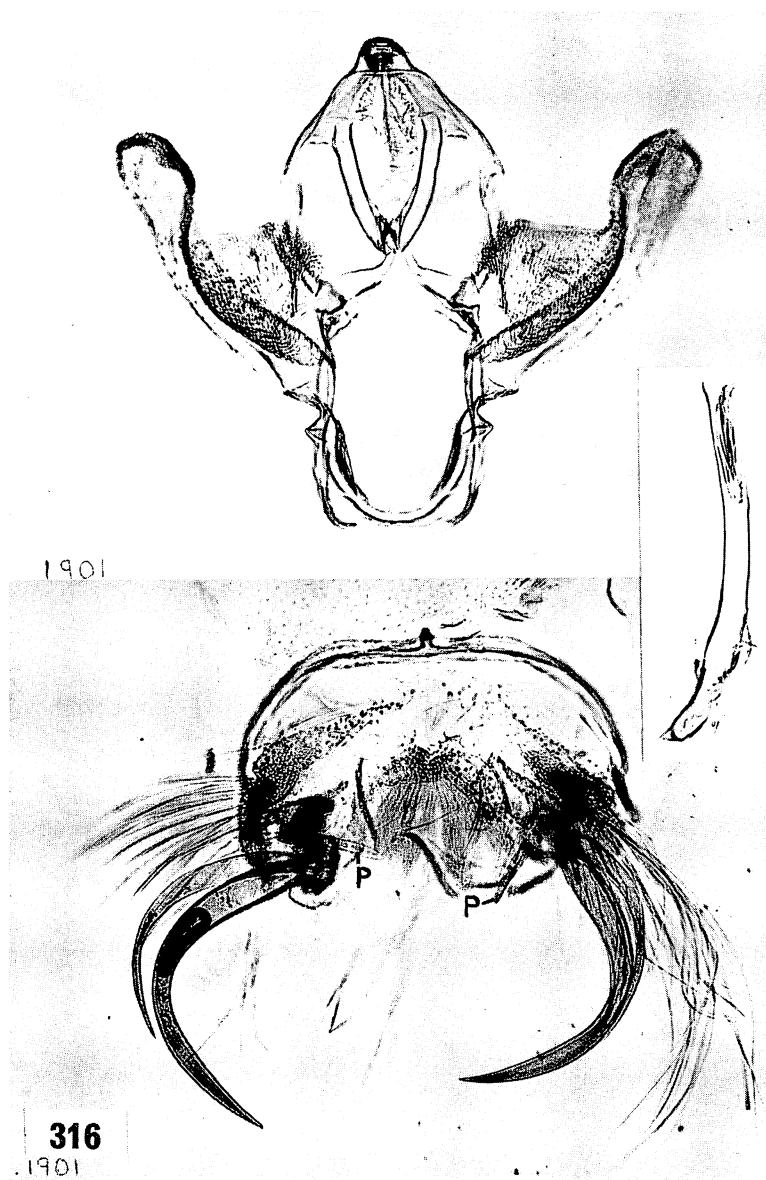


Figure 316—Male genitalia of *Bradleyella metallurgica* (Walsingham), holotype (BM slide 1901); Molokai, 3,000 feet. The dissection is mounted in a cavity slide. The aedeagus is viewed from the side. The uncus is U-shaped in dorsal view. Note the greatly reduced ectal caudal abdominal processes (marked "p").

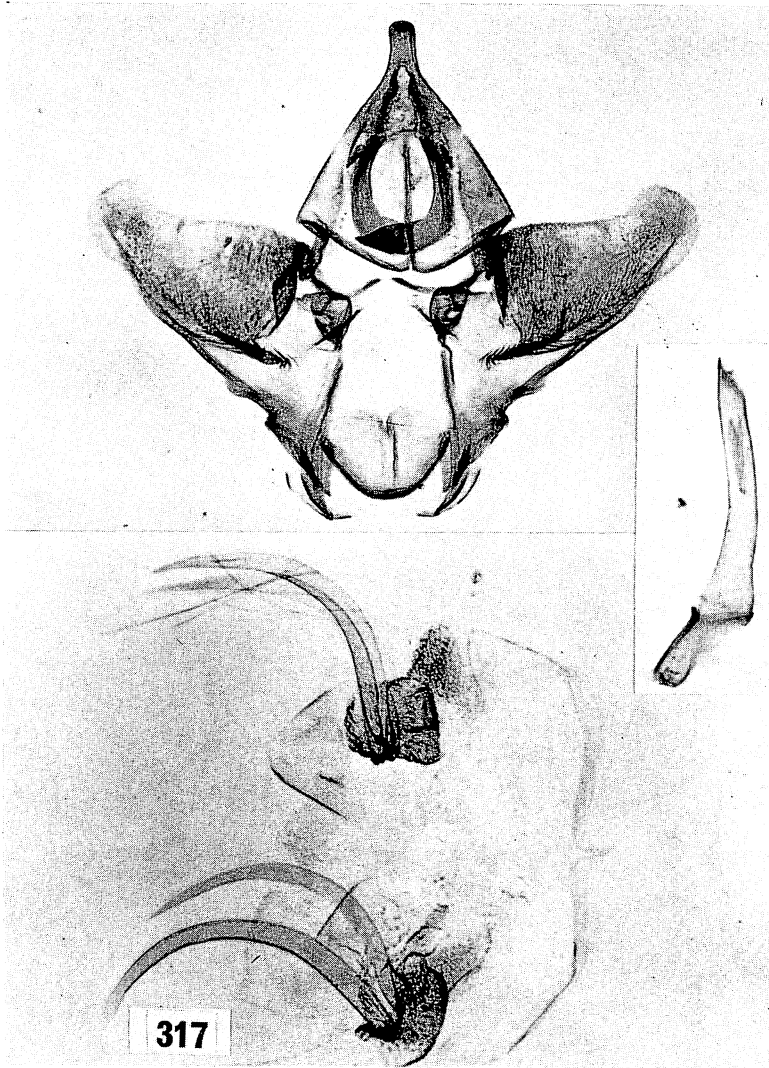


Figure 317—Male genitalia of *Bradleyella phyllanthana* (Swezey), paratype (slide JDB 3); Malamalama, Oahu. The aedeagus is seen in lateral aspect. There appear to be only two abdominal hooks on each side.

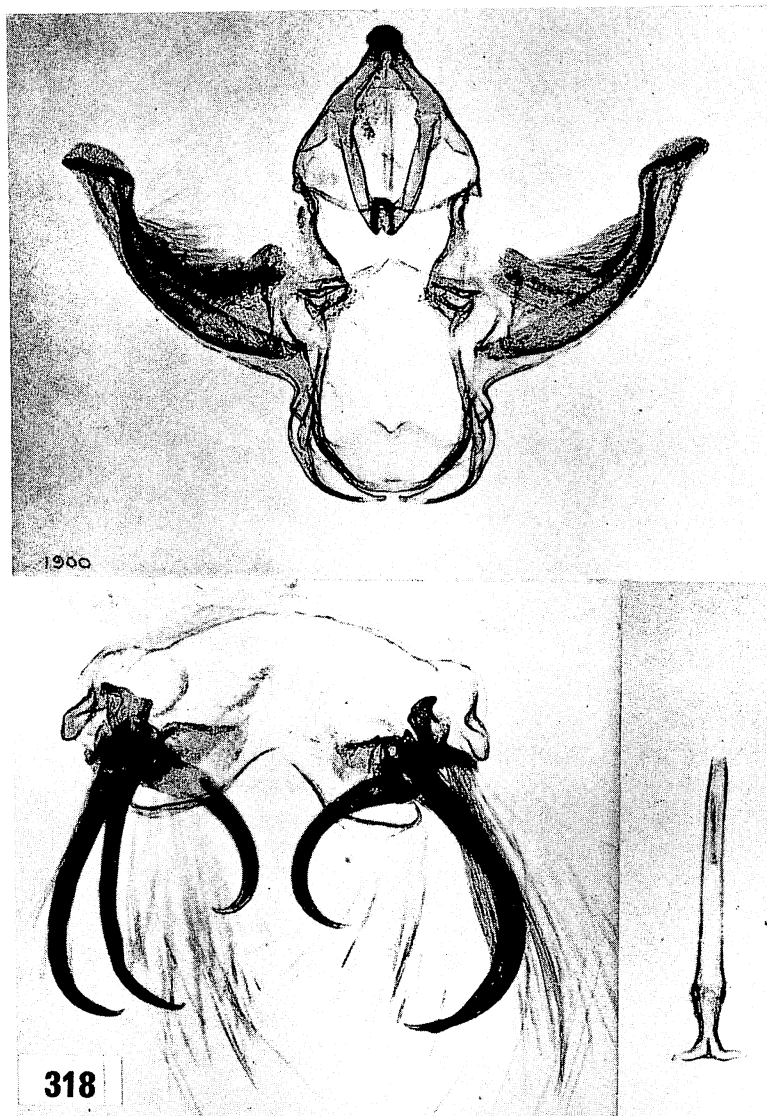


Figure 318—Male genitalia of *Bradleyella thoracina* (Walsingham), paratype (BM slide 1900); Kaho-luamano, 4,000 feet, Kauai. The aedeagus is viewed from beneath (it later rotated in the mounting medium and may now present a different side when viewed on the slide). There are three abdominal hooks on each side, but one of those on the right side is concealed.

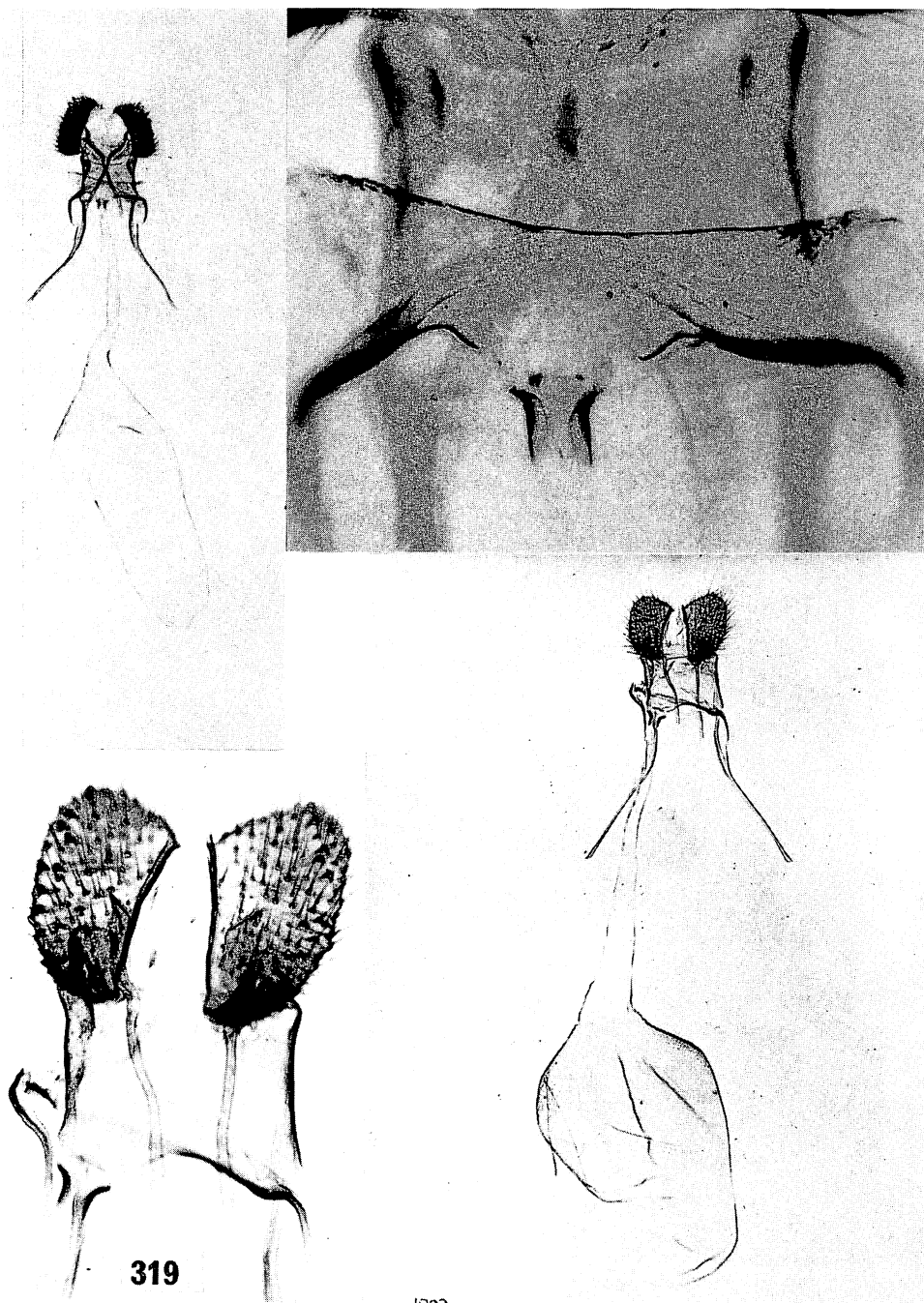


Figure 319—Female genitalia of *Bradleyella*. Top, *chlorocalla* (Walsingham), holotype (BM slide 1903); Oloa, 2,000 feet, Hawaii. Bottom, *thoracina* (Walsingham), holotype (BM slide 1899); Kauai, 3,000 to 4,000 feet. Compare figure 321.

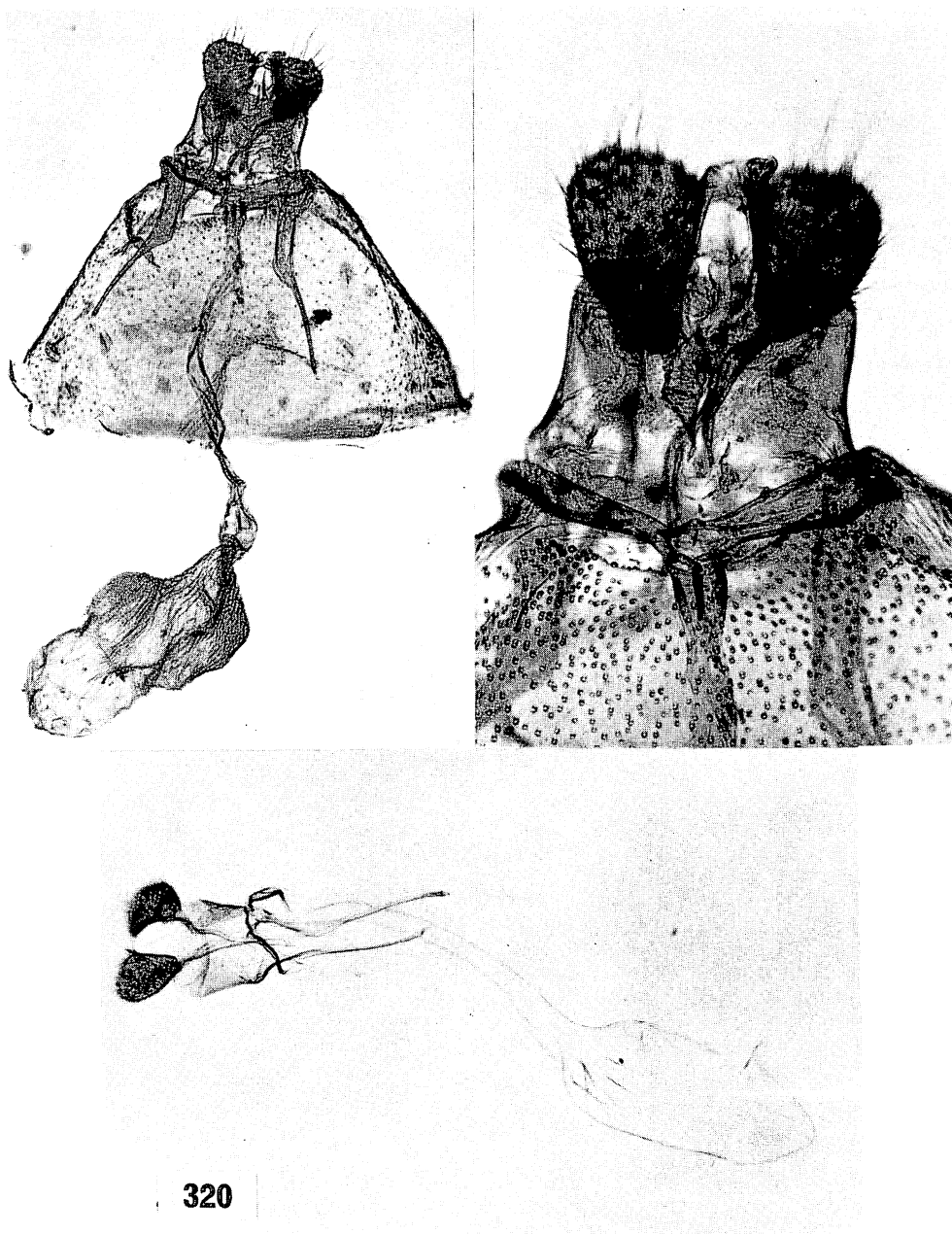


Figure 320—Female genitalia of *Bradleyella*. Top, *phyllanthana* (Swezey), paratype (slide Z-IX-5-61-F); Malamalama, Oahu. Bottom, *metallurgica* (Walsingham), paratype (BM slide 1902); Lanai.



Figure 321—*Bradleyella thoracina* (Walsingham). Top, female genitalia (Busck slide 215). Bottom, male genitalia (Busck slide 214); one left and two right hooks have been broken away; note the expanded base of the aedeagus. Both specimens are from Kaholuamano, Kauai, and both were determined by Dr. Swezey.

Genus **AMORBIA** Clemens

*Amorbia* Clemens, 1860b:352. Type-species: *Amorbia humerosana* Clemens. Meyrick, 1913b:56, redescription. MacKay, 1962:87, larvae.

This genus is easily recognized in the Hawaiian fauna, because it is the only genus of Tortricidae now known in Hawaii that lacks ocelli. The male genitalia are quite similar to those of *Sparganothis*. In the forewing, veins 7 and 8 are stalked in the female but coincident in the male. Thus, the female has 12 veins in the forewings, but the male has only 11 veins. The only other genera of Tortricidae in Hawaii that have vein 7 branching from 8 are *Eccoptyocera* and *Spheterista*. There are 25 or more species of *Amorbia* in America, and one of these was introduced accidentally to Hawaii where it has become a pest species.

*Amorbia* belongs to the group called Sparganothinae or Sparganothidinae (Obraztsov, 1945a:22; 1954:149) or Sparganothini (MacKay, 1962:7, 72; Powell, 1964:66). The group is confined mostly to America with the greatest proliferation in the Neotropical zone. It is poorly understood. MacKay (1962:29) said "There is difficulty in defining the tribes Archipsini and Sparganothini on larval characters." I do not believe that there are subfamily differences between the Tortricinae and the *Sparganothis* group and would not give the latter more than tribal rank. The vestiture of the posterior margin of

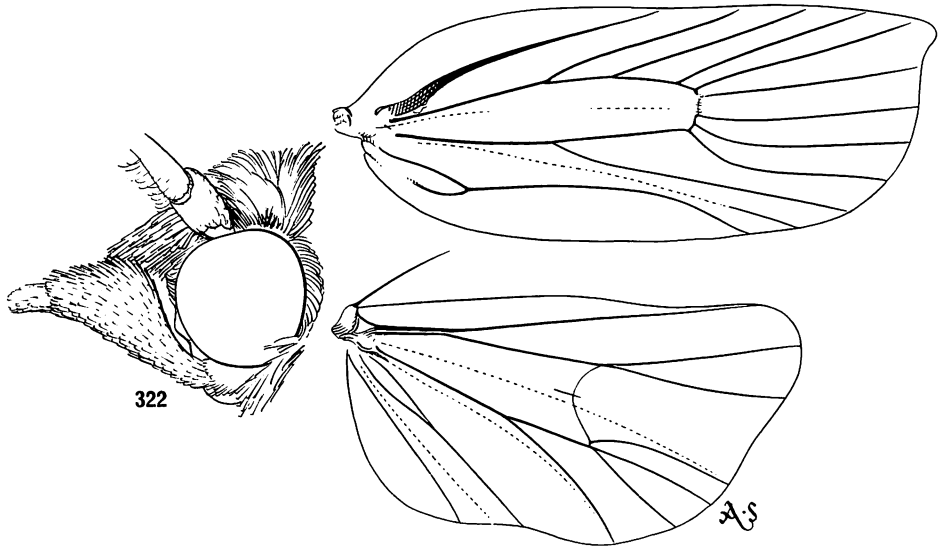


Figure 322—Head and wing venation of a male *Amorbia emigratella* Busck (BM slide 3846); Hawaiian specimens. Note carefully: in the male, veins 7 and 8 in the forewing are fused (hence there are only 11 veins in the forewing of the male), but in the female both veins 7 and 8 are present and stalked (hence there are 12 veins in the female). There are no ocelli in this genus.

the cell in the hindwing is certainly not similar to that of the Olethreutinae, as one might conclude from some statements in the literature. The fact that the arms of the gnathus are free and not fused apically has been given undue weight; the genitalia are otherwise quite similar to typical Archipsini.

**Amorbia emigratella** Busck (figs. 322, head, wing venation; 323, moth, male genitalia; 324, moth; 325, female genitalia; 326, larva; 327, pupa). *Amorbia emigratella* Busck, 1910a(1909):201. Fullaway, 1911:23–27, fig. 8, moth, larva, pupa. Meyrick, 1913b:56. MacKay, 1962:88, fig. 83, larva.

The Mexican leaf-roller.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Although this species was described from Hawaii (Mt. Tantalus and Makiki in Honolulu), it is known to be a native of Mexico and Central America. It was first discovered in Hawaii at Honolulu in 1902 by Dr. Perkins who found it to be common on orange trees. In 1909, Dr. Swezey wrote to August Busck (Busck, 1910a[1909]:202) that "This tortricid is quite a pest in the Hawaiian Islands. The larvae are leaf-rollers on many kinds of plants, shrubs, and fruit-trees, often so numerous as to defoliate the trees and sometimes attacking the fruit as well. It is an introduced species here which has been present for several years."

Hostplants: *Acacia koaia*, *Arachis hypogaea* (peanut), *Brassaia*, *Brassica oleracea* (broccoli), *Carica papaya* (papaya), *Cassia leschenaltiana*, *Citrus sinensis* (orange), *Dodonaea viscosa*, *Dracaena*, *Gardenia*, *Gliricidia sepium*, *Gossypium* species (cotton), *Ipomoea batatas* (sweetpotato), *Lycopersicon esculentum* (tomato), *Macadamia*, Orchidaceae, *Passiflora*, *Persea americana* (avocado), *Phais*, *Phaseolus* species (garden beans), *Pipturus*, *Psidium guajava* (guava), *Rosa*, *Rubus* species (blackberry), *Rubus hawaiiensis*, *Solanum melongena* (eggplant), *Solanum tuberosum* (potato), *Sophora*, *Theobroma cacao* (cocoa), *Ulex europaeus* (gorse), *Wikstroemia foetida*, *Zea mays* (maize corn), and other plants.

Parasites: *Bracon omiodivorum* (Terry), *Brachymeria obscurata* (Walker), *Echthromorpha agrestoria fuscator* (Fabricius), *Ephialtes hawaiiensis* (Cameron), *Trichogramma minutum* Riley.

Predators: *Iridomyrmex humilis* Mayr (Argentine ant), *Odynerus rudolphi* Perkins, *Pachodynerus nasidens* (Latreille), *Pheidole megacephala* (Fabricius) (all the foregoing are Hymenoptera), *Xiphidiopsis lita* Hebard (Orthoptera).

The often-abundant larvae of this moth attack many kinds of plants. They roll the edges of the leaves (especially young growth) or web together the leaves. Their activities frequently disfigure, injure, or defoliate many ornamental and crop plants as well as other plants including native species in the mountain forests. The eggs are deposited in coated-over masses on the leaves of the hostplant. The larvae, which are green with a conspicuous black line on each side of the pronotum "sometimes eat the young fruits of the orange and [avocado], if a leaf lies near or in contact" (Swezey, 1912a:166). The damage done by the larvae is similar to that done by *Epiphyas*, which see, and they may occur side by side.



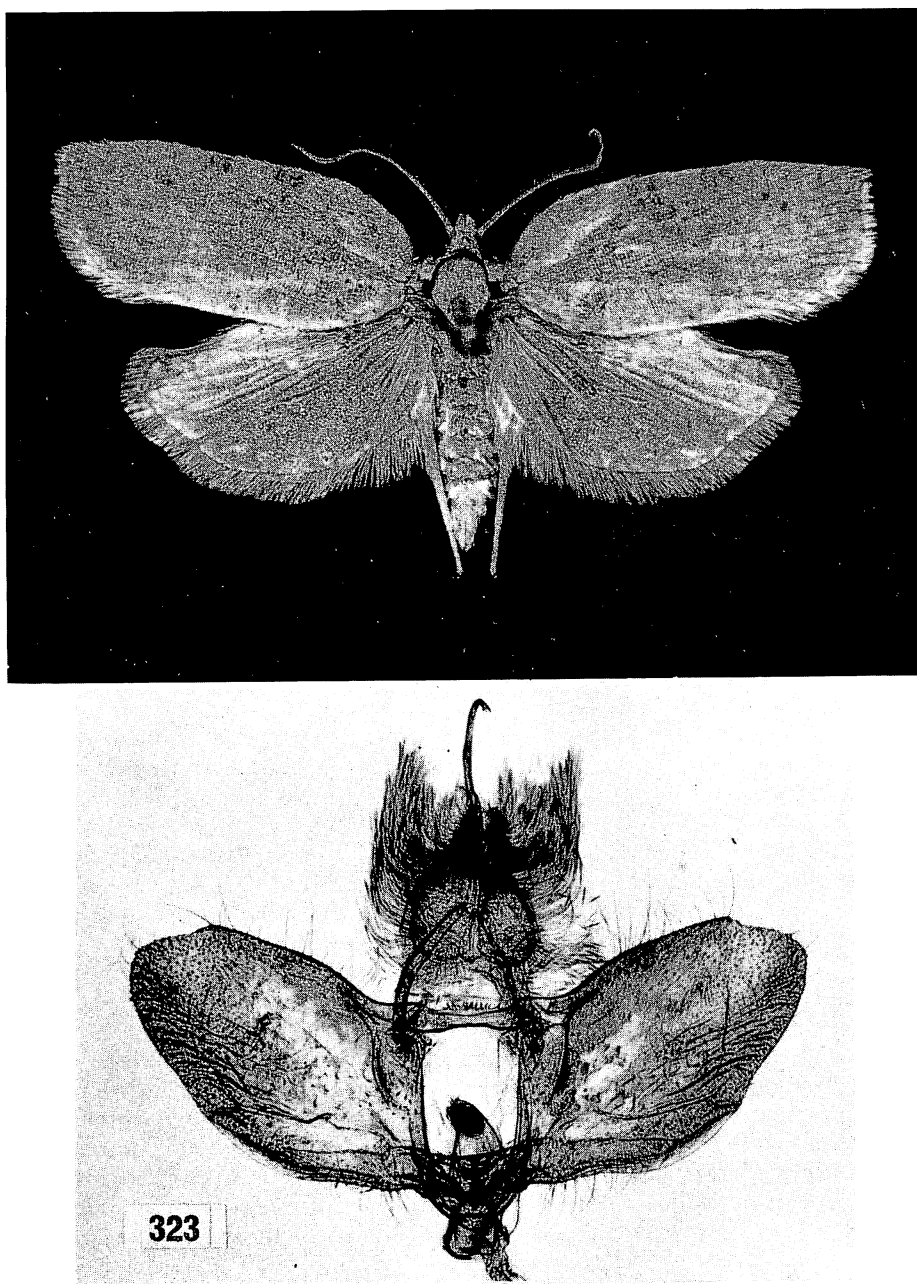


Figure 323—*Amorbia emigratella* Busck. Top, an Hawaiian male, forewing 10 mm. The antennae of the male have conspicuously long hairs beneath. The dark spot at the base of the second abdominal tergum is a conspicuous fovea (present in both sexes). This is of assistance in separating this species from rather similar species in Hawaii, such as *Epiphyas postvittana*. Bottom, male genitalia of another Hawaiian specimen (BM slide 3846); the dark mass in the apex of the aedeagus is a fascicle of setae.

Fullaway (1911: 23–27) figured the adult, larva, and pupa, and the following details are mostly abstracted and augmented from his account. The moth increased very rapidly after first being discovered in Hawaii, as do many introduced insects which are not checked by parasites or other factors, and its great range of food plants makes it an unusually destructive form. The larvae are often so numerous as to defoliate trees, and they also attack the fruits of some trees. The young larvae feed beneath coarse web. When attacking fruits, they commence to bore inside, but they soon desist and work on the surface beneath a web or they fasten the fruit to the nearest object such as another fruit or a leaf. They destroy the blossoms of papaya and prevent the setting of fruit. The eggs are laid in clusters of from about 65 to 120, although sometimes only a few eggs are deposited in a cluster, these usually being deposited on the upper surface of a leaf or sometimes on other objects. The cluster of eggs has a greenish color and has a whitish protective covering which extends beyond

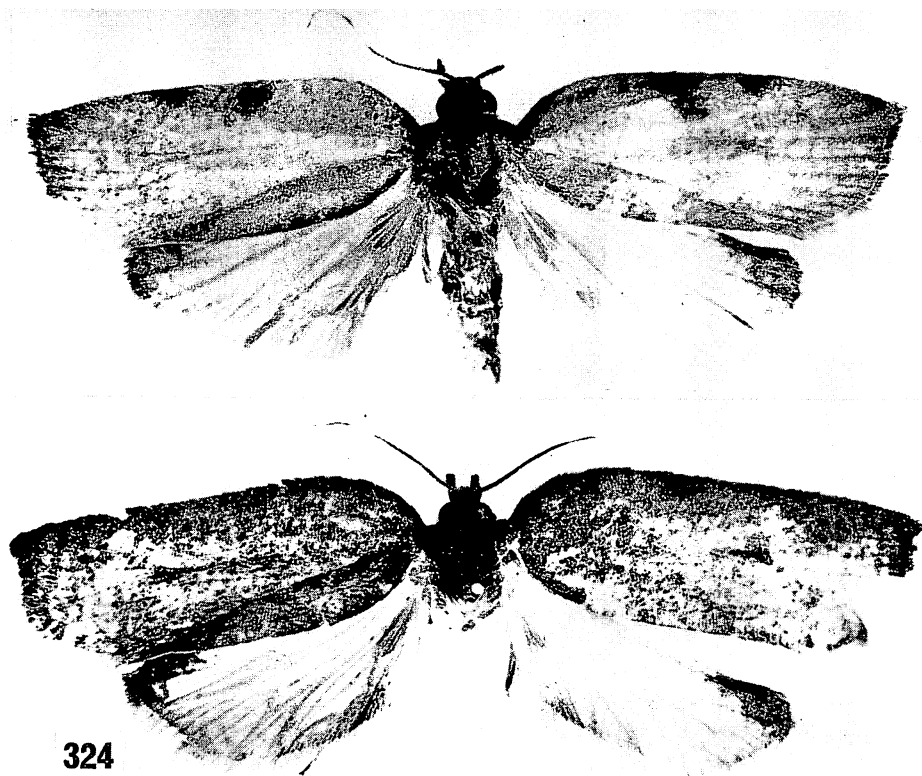


Figure 324—*Amorbia emigratella* Busck, two females from Kokee, Kauai. Top, expanse 23 mm. Bottom, expanse 25 mm. The color pattern of the forewing is subject to much variation. This is a very common and widespread moth in the gardens, fields, and forests of Hawaii. It may be confused on occasion with *Epiphyas postvittana*, which see.



Figure 325—*Amorbia emigratella* Busck. Female genitalia of an Hawaiian specimen (BM slide 3753).

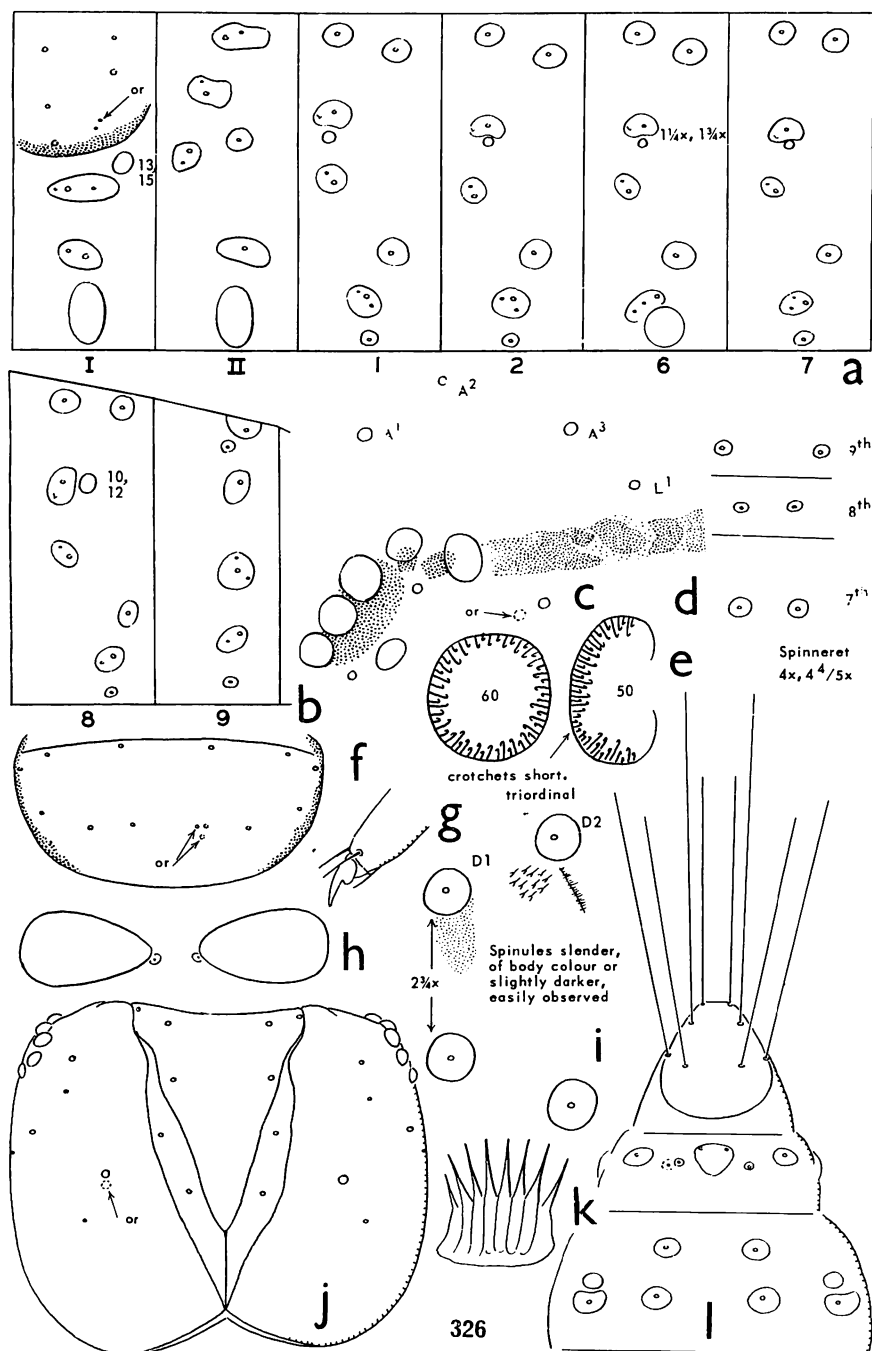


Figure 326—Details of the larva of *Amorbia emigratella* Busck. a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; b, the same of abdominal segments 8 and 9; c, ocellar area of the left side of the head; d, the VI setae along the midline of abdominal sternites 7, 8, and 9; e, crochets of a mid-abdominal and an anal proleg; f, prothoracic shield; g, lateral aspect of a thoracic leg tarsus; h, metacoxae and the associated VI setae; i, dorsal setae and dermal spinules of an anterior abdominal tergum; j, frontal aspect of head; k, anal fork; l, dorsal aspect of abdominal segments 8, 9, and 10. (Plate loaned by Margaret MacKay.)

the edge of the egg mass. The eggs are flat, elliptical, about 1 mm. long, slightly iridescent, finely reticulated, and are deposited in a slightly imbricated manner. The egg stage occupies about 10 days.

Fullaway found the larval period to be 28 to 35 days in Honolulu, and he described the pupa as follows (pp. 24–26): “Pupation takes place within the folded leaf. Pupa 9 to 12 mm., dark brown on dorsum shading into golden-brown on venter; wing-cases luteous, extending beyond middle of fourth

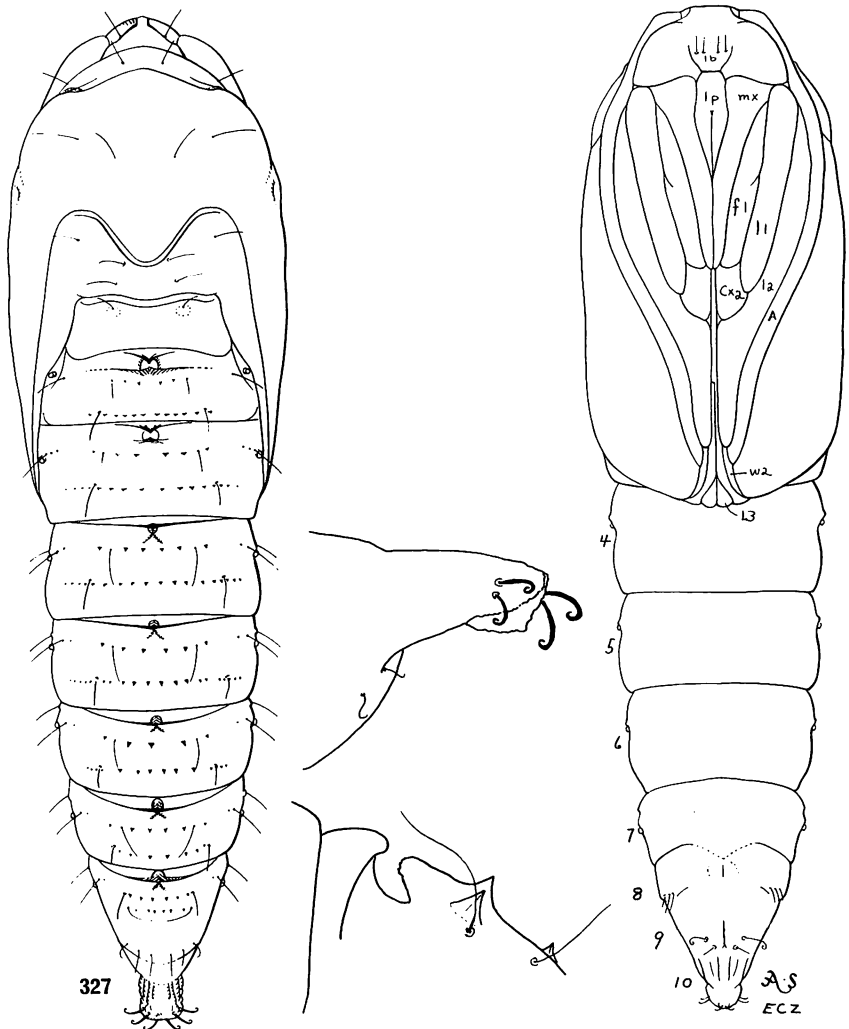


Figure 327—Pupa of *Amorbia emigratella* Busck; Olinda, Maui; ex gorse; length 11.5 mm. A sketch of the cauda in left lateral aspect and an outline of the eighth abdominal tergite in left lateral aspect to show the subbasal fossa are inserted. A, antenna; Cx2, mesocoxa; fl, profemora; lb, labrum; lp, labial palpus; l1, l2, l3, legs; mx, galea of maxilla (proboscis); W2, hindwing. Ventral setae mostly omitted.

abdominal segment; spiracular openings small, reddish-brown; on dorsum of abdominal segments 2 to 8 two transverse rows of minute blunt spines, near anterior and posterior margins, becoming smaller outwardly from median line and disappearing before the spiracles; posterior row a trifle more extensive than the anterior; in front of anterior row on median line of dorsum of segments 2 to 7 [8] a pit, partially covered by narrow blackish lip extending from posterior margin of preceding segment [This statement is in error; the sclerotizations arise from the same segment as each pit, and there is also a sclerotization caudad of each pit.]; on segment 9 a few scattered hairs; cremaster moderately pointed with eight short recurved spines. The pupal stage covers 10 days."

Margaret MacKay (1962:88, fig. 83) has given a modern description of the larva, as follows: "Last-instar larva about 25 mm. . . . Head brownish yellow, with dark ocellar area and a narrow band of dark pigment extending posteriorly from ocellus 1 parallel to the dark bar of pigment beneath it, which extends anteriorly from the postgenal juncture; the latter not always distinct. Thoracic shield yellowish, bordered laterally with a narrow band of dark pigment as illustrated. Thoracic legs yellowish or brownish. Remainder of body pale. Pinacula of body colour, moderately large, the dorsal and subdorsal ones on the mesothorax, and to a lesser extent on the metathorax, elongated posteriorly as illustrated; setae long, unusually so on anal shield. Spinules slender, of body colour or slightly darker, easily observed."

This common, widespread, variable moth may on occasion be confused with *Epiphyas postvittana*; it often is attracted to light in company with that species, and the larvae of the two species may sometimes be found in close association on the same hostplant. There are three easily seen external characters that will serve to distinguish the imagos of the *Amorbia* from the *Epiphyas*. *Amorbia* has at the base of the second abdominal tergite a conspicuous median fovea, but *Epiphyas* has no such structure. *Amorbia* lacks ocelli, but ocelli are present on *Epiphyas*. *Amorbia* has the discs of the undersides of the hindwings immaculate, but on *Epiphyas* the undersides of the hindwings are conspicuously multimagulate overall.

Because the larvae and pupae of *Amorbia emigratella* and *Epiphyas postvittana* may often be taken together on the same hostplant, and the observer may be confused by them, one should make certain of the identity of the specimens he observes. They are easily distinguished, as follows:

## KEY TO THE LARVAE AND PUPAE OF AMORBIA EMIGRATELLA AND EPIPHYAS POSTVITTANA

### I. LARVAE

1. Sternum of the 9th abdominal segment with the V1 setae (the two setae that occur one on either side of the middle), about twice as distant from each other as are the V1 setae of sternite 8; (the three L setae of the 9th abdominal segment form a more or less distinct triangle with L1 obviously cephalad of a line drawn from L2 to L3; side of head with seta A2 much closer to A1 than to

A3, and a line drawn between setae O3 and O2 and extended dorsad passes far caudad of A2 and nearer A3 than A2; these characters may vary); at each side of the pronotal shield there is a conspicuous dark vitta

..... **Amorbia emigratella** Busck.

2. Ninth abdominal sternum with the V1 setae slightly less distant from each other than are the V1 setae of the 8th sternum, or subequally separated; (the three L setae of the 9th abdominal segment form a nearly straight (but oblique) line with L1 only slightly out of line; side of head with seta A2 more nearly equidistant from A1 and A3, and a line drawn between setae O3 and O2 and extended dorsad passes close to A2; these characters may vary); pronotal shield not bordered by a dark vitta ..... **Epiphyas postvittana** (Walker).

## II. PUPAE

1. Abdominal tergites 2 to 8 each with a conspicuous, unusual, subbasal pit bordered cephalad and caudad by heavy sclerotizations which form lips overhanging the pits and the sclerotizations are, at least in part, darkened or black ..... **Amorbia emigratella** Busck.
2. Dorsum of abdomen without any pits ..... **Epiphyas postvittana** (Walker).

Subfamily **OLETHREUTINAE** (Hübner) Walsingham

*Olethreutae* Hübner, 1825 (1816–1826):374.

*Olethreutinae*: Walsingham, 1895:500, 518, 1897*a*:56; 1897*b*:121.

*Olethreutidae*: Walsingham, 1913 (1909–1915):224.

*Penthinidi* Guenée, 1845*a*:151.

*Penthinidae*: Anonymous, 1858:63.

*Spilonotidi* Guenée, 1845*a*:154.

*Grapholithidae* Meyrick, 1881*b*:413.

*Trichophoridae* Walsingham, 1895:517.

*Epiblemidae* Meyrick, 1895:453.

*Eucosmidae* Meyrick, 1907*b*:731.

Heinrich, 1923, 1926, revision of North American fauna.

Diakonoff, 1853:88–89, key to New Guinea genera.

Obraztsov, 1954–1967, review of Palaearctic fauna.

My conclusions regarding the status of the Olethreutinae, and the characteristics which serve to distinguish the group in Hawaii are outlined in the key on p. 402 above and in the notes preceding and following the key. As stated there, Margaret MacKay could not find characters in the larvae to define the Olethreutinae as a subfamily separate from the Tortricinae. The male genitalia are representative, as noted in the quotations above from Heinrich and Clarke, and as an examination of my illustrations will demonstrate.

For an extensively illustrated report on the larvae of many of the North American species, see MacKay, 1959.

**KEY TO THE GENERA OF OLETHREUTINAE IN HAWAII**

1. Forewing with only 11 veins, vein 7 stalked with 8;  
hindwing with only 7 veins, vein 5 obsolete; venation  
as in figure 328.....**Eccoptocera.**
- Forewing with 12 veins, veins 7 and 8 free from origins;  
hindwings with all eight veins developed .....2
- 2(1). Hindwing with veins 3 and 4 forking at apex of cell, as  
in figures 344, 354, 368.....3
- Hindwings with veins 3 and 4 fused for a distance  
beyond cell and then forking, as in figures 371,  
403, 417 .....6
- 3(2). Forewing with veins 3 to 7 tending to condense on  
termen, thus the distance between apices of veins 3  
and 7 measured along termen is not greater (usually  
distinctly less) than the distance between these veins  
measured at the point of greatest arcuation of vein 7,  
as in figure 421 .....**Episimus.**
- Forewing with veins 3 and 7 all diverging to termen,  
thus the distance between the apices of veins 3 and 7  
along termen is much greater than the distance  
between these veins measured at the point of greatest  
arcuation of vein 7, as in figures 344, 354, 368 .....4



- 4(3). Labial palpi widely expanded by vestiture and terminal segment normally hidden by the shaggy scaling, as in figure 344 ..... **Bactra.**  
 Labial palpi narrower, terminal segment exposed, as in figures 354, 368.....5
- 5(4). Undersides of hindwings strongly maculate with many conspicuous dark spots ..... **Cryptophlebia.**  
 Undersides of hindwings not maculate. . **Macraesthetica.**
- 6(2). Forewings with veins 3, 4, and 5 obviously more widely separated at termen than at origin on cell, venation and head as in figures 371, 399 .....7  
 Forewings with veins 3, 4, and sometimes 5 about as close together on termen as at origin, as in figures 403, 417 .....8
- 7(6). Hindwings with vein 8 reaching costa at a point far beyond apex of cell and at a point about opposite middle of vein 7, or farther distad; males without a dorsal costal fold or flap on forewing, but most species with a pocket extending from the undersides of the hindwing of the male as illustrated in figures 371-375; antennae of male not "notched" above near base ..... **Cydia.**  
 Hindwings with vein 8 reaching costa at a point moderately beyond apex of cell and at a point about opposite the basal one-fourth or less of vein 7; male with a conspicuous dorsal costal fold or flap and without a pocket on the underside of hindwing, as in figure 399; male antenna strongly "notched" on dorsal edge at a point about equal to the diameter of an eye beyond base ..... **Strepsicrates.**
- 8(6). *Crocidosema* and *Epinotia*. I have been unable to find reliable external characters to separate both sexes of these two genera which are maintained by various authors on the basis of genital characters. However, the male of our *Epinotia* has a well-developed costal fold, and the chorda is absent; the pecten on the hindwing is weak; the hair-tuft in the posterior axil of the hindwing next to the metathorax (do not confuse hairs on wing membrane) is strongly developed and consists of long, conspicuous, specialized, basally thickened hairs obviously different from those adjacent on the wing membrane, and these hairs have long, somewhat expanded apical

sections (easily broken off). On the males of our *Crocidosema*, however, there is no costal fold, the chorda is present, the hindwing pecten is conspicuous to large and heavy, the hair-tuft in the hindwing axil is inconspicuous and the hairs it bears are not specialized as on *Epinotia*, but are similar to the hairs on the wing membrane between veins 1a and the inner wing margin. Heinrich, in his monograph of the North American olethreutids, separated the two groups on characters of the male genital valvae, but he did not (could not?) give characters for separating the females. To separate the species in Hawaii by the use of the male genitalia, we may use the following summary:

- a. Valva with about the apical one-half (cucullus) directed subhorizontally, ectal side of valva with a distinct, submedian, subhorizontal “rib” which may or may not bear one to three long, usually strongly differentiated, conspicuous setae directed ventrad from near its apex (figure 407) . . . . . **Crocidosema.**
- b. Valva with apical one-half or more curved upward and without a “rib” on ectal surface and without any such long spinelike setae (figure 407) . . . . . **Epinotia.**

Genus **ECCOPTOCERA** Walsingham

*Eccoptocera* Walsingham, 1907b:673. Type-species: *Steganoptycha foetorivorans* Butler, by original designation and monotypy.

The loss of a vein in both fore- and hindwings (the wings thus have only 11 and seven veins instead of the normal 12 and eight) will distinguish this endemic genus from all other tortricids in Hawaii. The forking of veins 7 and 8 in the forewing is shared in the Hawaiian tortricids only with *Spheterista* and the female of *Amorbia*. The male has a strong costal fold on the forewing and a narrow vannal fold on the hindwing. Walsingham (1907b:673) stressed the fact that the dorsal side of the male antenna has an “excised notch above beyond the basal joint”. The only other tortricid genus in Hawaii whose male antennae are “notched” is *Strepsicrates*, but its “notch” is about the length of an eye beyond the basal segment.

Much of what Walsingham said about the possible relationships of *Eccoptocera* is meaningless. The genus appears quite similar to the Indo-Pacific *Hermenias* Meyrick, 1911c:225, but *Hermenias* has all wing veins present. *Hermenias* is close to the large and widespread genus *Spilonota* Stephens, 1829 (type-species: *Tortrix ocellana* Denis and Schiffermüller from Europe). Typical *Spilonota* lacks

an uncus, but *Eccoptocera* has the uncus developed. *Spilonota* supposedly ranges across Eurasia to Japan, and from India to Africa and out through the Pacific to New Zealand and through Fiji and Samoa to southeastern Polynesia. Australia has the largest number of recorded species. Many of the species assigned to *Spilonota* may not belong to it, however. *Spilonota ocellana* (Denis and Schiffmüller), the well-known European pest of apples and some other fruits, has been introduced accidentally to North America.

*Eccoptocera* has remained monotypic in the literature since its description, and considerable confusion exists regarding it. It includes a swarm of closely similar species, and the group appears to be in the process of "flowering". A second described species is added here by the transfer of a species from "*Epagoge*" where it was erroneously placed by its author. I have examined a number of new species, some of which are illustrated here. Much work remains to be done on *Eccoptocera* for we have hardly begun to study the group.

Species of *Eccoptocera* are, at times, commonly attracted to light, and I found them to be the most abundant tortricids caught in my light trap at Kokee, Kauai in July, 1937.

In addition to the more obvious differences in the color and pattern of the forewings, the legs are variously marked. The genitalia of both sexes reveal characters useful in species differentiation, as the illustrations demonstrate. The females display distinct differences in the ostium and the bursa copulatrix. Some of the differences in the male genitalia are obscured in microscope slide-mounted specimens, and it may be best in the future to preserve the prepared genitalia in tubes of glycerin instead of mounting them on microscope

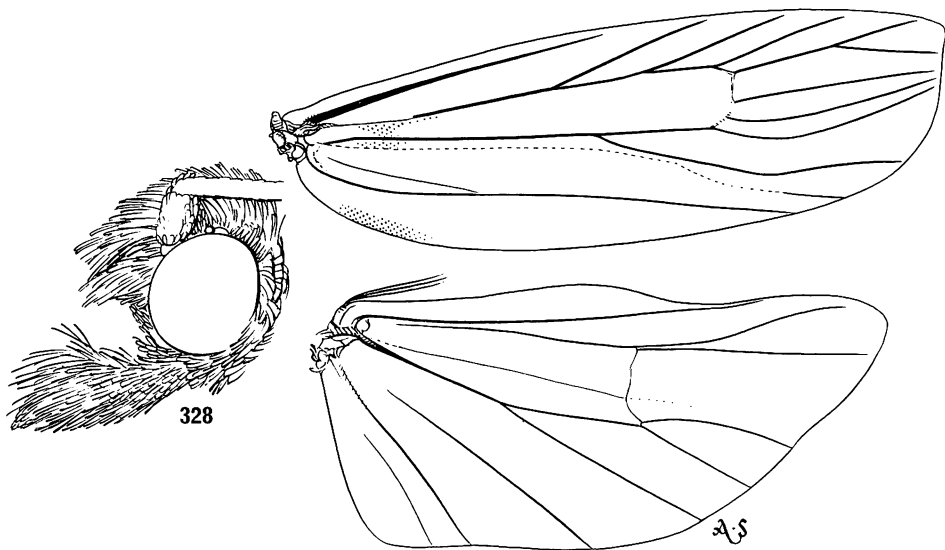


Figure 328—*Eccoptocera foetorivorans* (Butler). Left, head of the male allotype; Waialua, Oahu. Right, wing venation of the female holotype, Oahu (BM slide 1871). See also figure 329.

slides. The shapes of the apices of the valvae and the dorsal, caudal, and lateral views of the uncus often not only cannot be clearly shown in slide mounts but may, in fact, be distorted or obscured. I discovered this fact after most of the dissections for these studies had been made. The aedeagus contains a large cluster of deciduous spines which may be lost in mated specimens, a characteristic which may be confusing to one unfamiliar with it.

For an illustration of some details of the pupa, see figure 417-A *a-c*.

See color plate 2, figure 6.

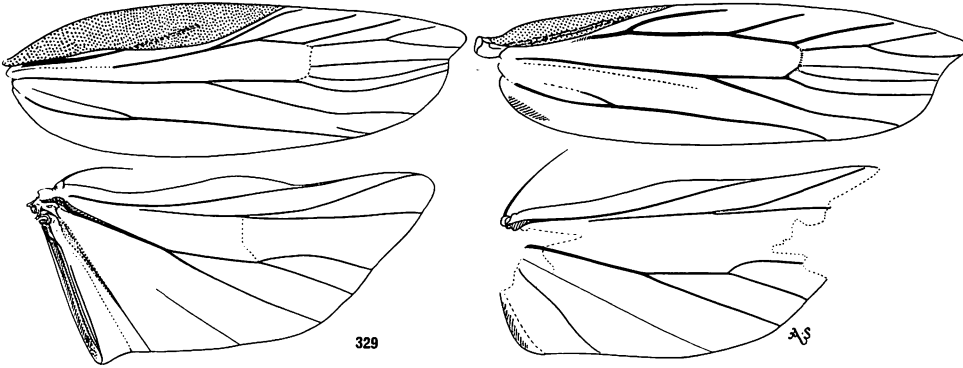


Figure 329—Wing venations of *Eccoptocera*. Left, *foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu (genitalia on same slide). Right, *osteomelesana* (Swezey), Wailupe Valley, Oahu (slide Z-VI-27-61-A); the crossvein at cell apex is obsolete. Note the different positions of veins 10 and 11 in the forewings in relation to the origin of vein 2.

***Eccoptocera foetorivorans*** (Butler) (figs. 328, head, female wing venation; 329, male wing venation; 330, antennal base; 331*a-c*, 332*a-c*, male genitalia; 333, moths; 340, female genitalia).

*Steganoptycha foetorivorans* Butler, 1881:394.

*Eccoptocera foetorivorans* (Butler) Walsingham, 1907*b*:674, 735, pl. 10, figs. 12, 13, 14.

Endemic. Kauai?, Oahu (type locality: "Mountains of Oahu"; the holotype bears the Blackburn code data "Hawaiian Islands 81.7 66"), Molokai?, Maui?, Lanai?, Hawaii?

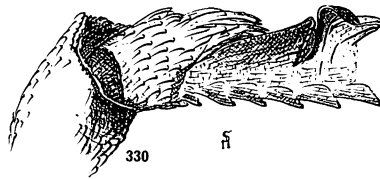


Figure 330—Basal parts of the male antenna of *Eccoptocera foetorivorans* (Butler); northwest Koolau Mts., Oahu.

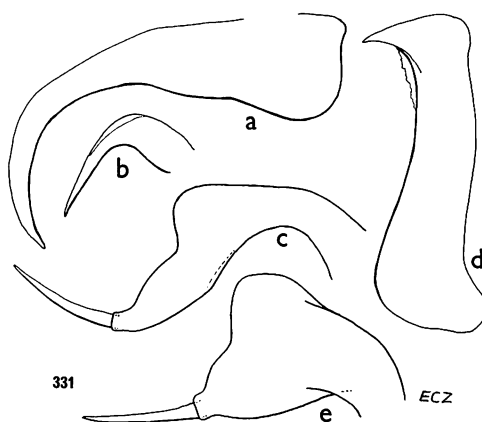


Figure 331—Details of the male genitalia of *Eccoptocera* drawn in glycerin and all to the same scale. *a, b, c, foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu: *a*, lateral aspect of aedeagus with a different view of its apex at *b*; *c*, ectal aspect of the apical part of the right valva. *d, e*, new greyish species 2; mountains near Honolulu, 2,000 feet (BM slide 14278): *d*, lateral aspect of aedeagus of a mated male which has lost the deciduous cornuti; *e*, ectal aspect of the distal part of the right valva. See figure 332 for other drawings of these specimens.

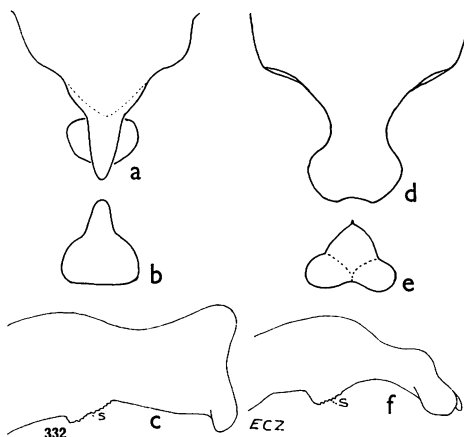


Figure 332—Details of *Eccoptocera* male genitalia. *a, b, foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu: *a*, dorsal aspect of tegumen and uncus; *b*, caudal aspect of apex of uncus; *c*, lateral aspect of part of tegumen, socius ("S"), and uncus of another specimen of *foetorivorans* from the northwest Koolau Mts., Oahu (BM slide 14284). *d, e*, new grey species 2: *d*, dorsal aspect of tegumen and uncus; *e*, caudal aspect of apex of uncus; *f*, lateral aspect of part of the tegumen, socius, and uncus (*d* and *e*, from a specimen from mountains near Honolulu, 2,000 feet, BM slide 14278; *f*, from a specimen from the northwest Koolau Mts., Oahu, BM slide 14286). All specimens drawn to the same scale from specimens in glycerin as are other sketches in figure 331, which see. Allowance should be made for some variation in shape according to the position from which the objects are viewed as well as some individual variation.

Hostplants: *Cheirodendron*, *Metrosideros* (preferred host), *Psidium guajava* (guava), *Syzygium sandwicensis*. These hostplant records may apply to several species of *Eccoptocera*, and the true host range of *foetorivorans* remains to be determined.

Parasite: *Pristomerus hawaiiensis* Perkins.

Predator: *Odynerus* species.

The larvae feed amongst webbed-together leaves. Blackburn, who first collected the species, wrote in his field notes (as quoted by Butler, 1881:395) "Occasionally taken by beating; also bred from a larva spinning together leaves of a tree unknown to me by name. The tree in question superficially resembles box; but the leaves are somewhat larger, and have a strong, rather unpleasant scent."

Walsingham, who had 70 specimens of *Eccoptocera* before him when he prepared the *Fauna Hawaiiensis* monograph, said that "this is a most variable species, but . . . I cannot regard any of the numerous forms included in Mr Perkins' various consignments as entitled to special distinction." After more detailed study, I have found that several species have been confused under the one name *foetorivorans*. I have not had an opportunity to make a detailed study of specimens from all of the islands from which the genus has been reported, but I have found that some of the specimens collected on islands other than Oahu are new species. Moreover, more species than *foetorivorans* occur on Oahu. I have, therefore, questioned all locality records other than Oahu pending confirmation that the species occurs on the other islands. It may be that *foetorivorans* does range over several of the islands, but its distribution remains to be determined. Several species occur on some islands. Perkins said (1913:clxvii) "The single species of *Eccoptocera* is one of the commonest of Hawaiian moths and is extremely variable. It is especially attached to *Metrosiderus* [*sic*], and its caterpillars are much sought after by the wasps of the genus *Odynerus*. There is no reason to doubt its endemicity." Perkins, as other authors, confused several species under one name.

I have designated as allotype male a specimen in the British Museum bearing the label data "Waialua Oahu Hawaiian Is. V. 1901 Perkins 29192", and the right wings and the genitalia are on slide BM 5198. I have illustrated its wing venation and the genitalia. Because the female holotype is not a good specimen and because it would not make a good photograph, I have not included an illustration of it as a whole moth. I have, instead, included a photograph of another specimen whose markings are closely similar to those of the holotype.

The pair mentioned by Walsingham (1907b:674) as having been taken "*in cop.*" are specimens of a pale form which has no bold markings, and they represent a new species. They are briefly described under "*Eccoptocera* new species 2."

**Eccoptocera osteomelesana** (Swezey), **new combination** (figs. 329, wing venation; 337, male genitalia; 341, moth, female genitalia).  
*Epagoge osteomelesana* Swezey, 1946:626.

Endemic. Oahu (type locality: Woodlawn, Manoa Valley, Honolulu).  
Hostplant: unknown.

This moth was described from an unique female, but J. W. Beardsley has caught a number of specimens in light traps in recent years. It is the smallest species of *Eccoptocera* I have seen.

**Eccoptocera new species 1** (fig. 334, moth).  
*Eccoptocera* species formerly confused with *foetorivorans*.

Endemic. Kauai (Kaholuamano).  
Hostplant: unknown.  
This is a greyish species.

**Eccoptocera new species 2** (figs. 331*d, e*, 332*d–f*, male genitalia; 334, moth; 318 male abdomen; 342–343, female genitalia).  
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia slides BM 5197, 14279, 14286; female genitalia, BM 14280.

Endemic. Oahu (Koolau Mts., near Honolulu, 2,000 feet).  
Hostplant: unknown.  
This is another greyish species.

**Eccoptocera new species 3** (figs. 334, moth; 342–343, female genitalia).  
*Eccoptocera* species formerly confused with *foetorivorans*. Female genitalia on slide BM 14285.

Endemic. Oahu (northwest Koolau Mts.).  
Hostplant: unknown.  
This is a boldly marked species.

**Eccoptocera new species 4** (figs. 335, moth; 337, male genitalia, abdomen).  
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide BM 14283.

Endemic. Maui (Haleakala, 5,000 feet).  
Hostplant: unknown.  
This is a dark colored species.

**Eccoptocera new species 5** (fig. 339, male genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide Z-I-16-65-C.

Endemic. Maui (Haleakala, 5,000 feet).

Hostplant: unknown.

This is a mostly dark maculate species with a partly pale posterior forewing margin.

**Eccoptocera new species 6** (figs. 335, moth; 342–343, female genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Female genitalia on slide BM 14282.

Endemic. Hawaii (Kona).

Hostplant: unknown.

This is a mostly dark species.

**Eccoptocera new species 7** (fig. 338, male genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide Z-I-16-65-A.

Endemic. Hawaii (Olaa).

Hostplant: unknown.

This is a mostly brownish species.

**Eccoptocera new species 8** (fig. 335, moth).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide BM 14281.

Endemic. Hawaii (Kilauea).

Hostplant: unknown.

This is a grey species.

**Eccoptocera new species 9** (fig. 339, male genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slides BM 1870, Z-I-16-65-B.

Endemic. Kauai (Kaholuamano).

Hostplant: unknown.

This is a boldly marked species rather similar to new species 3 from Oahu.



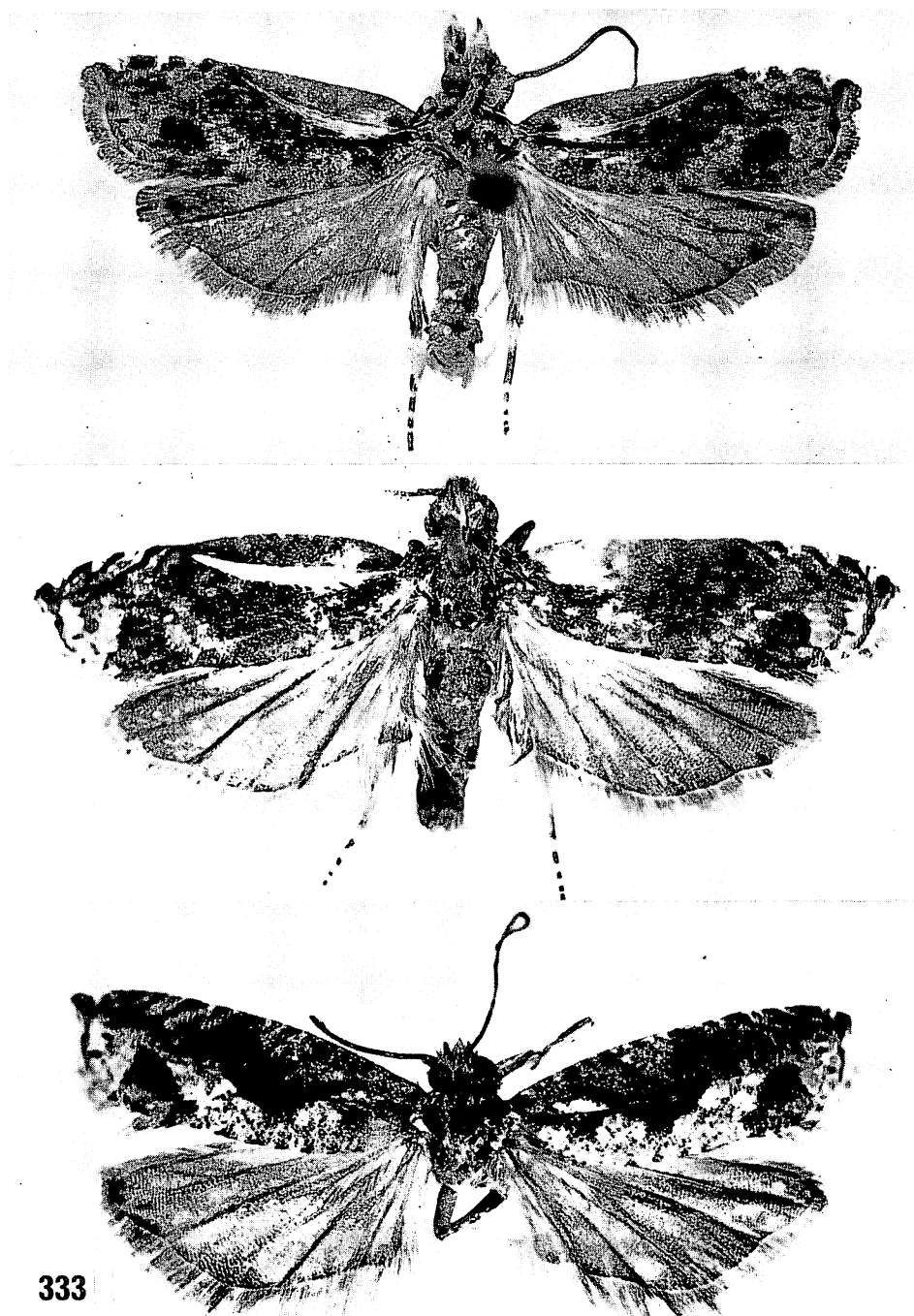


Figure 333—*Eccoptocera foetorivorans* (Butler). Top, male, Kukuiala Valley, Oahu; ex "ohia ha"; forewing 7 mm. Middle, another male of the same species; northeast Koolau Mts., Oahu; expanse 15 mm. (BM slide 14284); see the drawing of the uncus of this specimen. Bottom, a female closely similar to the holotype; northwest Koolau Mts., Oahu (Walsingham specimen 28930); abdomen lost. Note the strong costal folds on the forewings of the males.

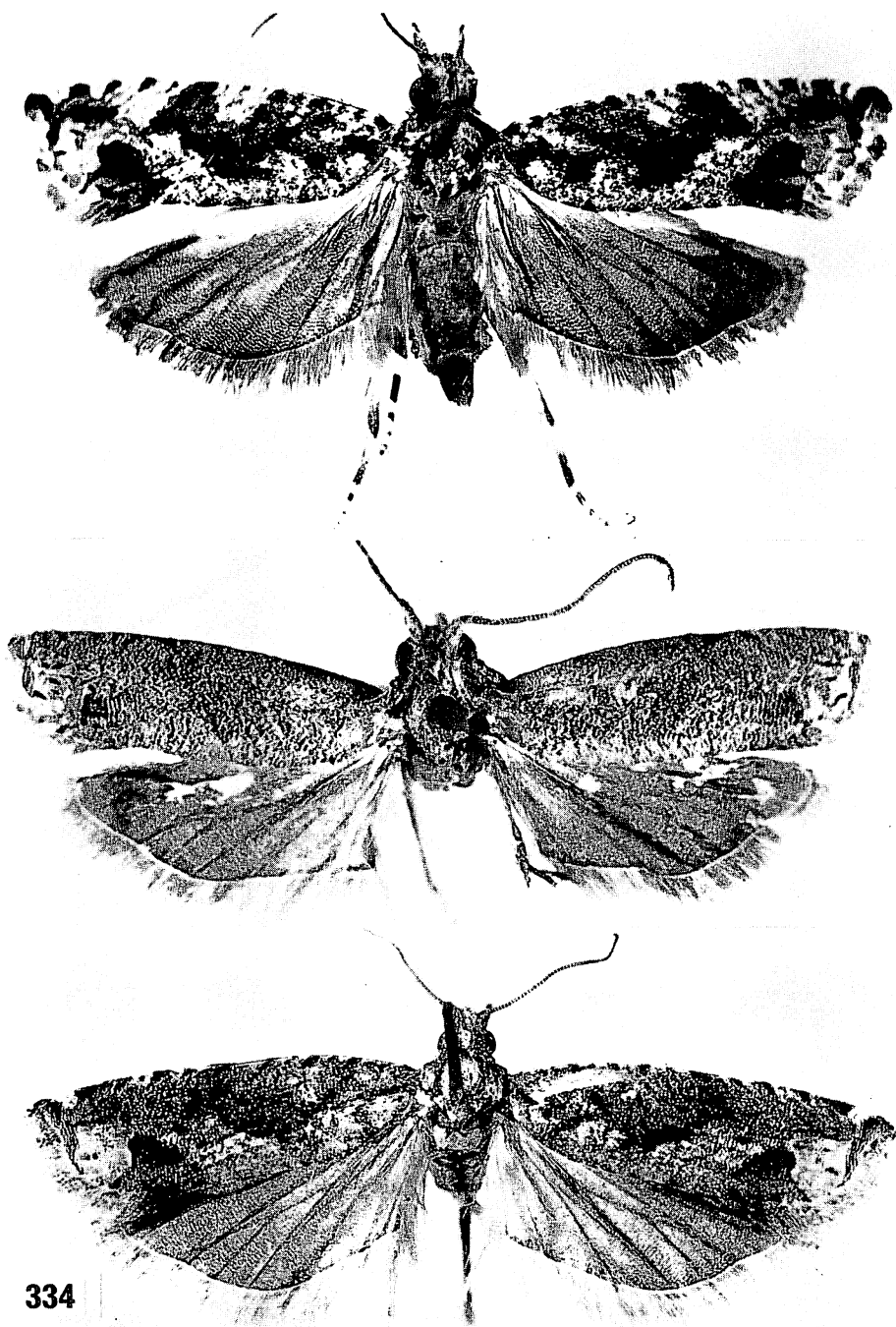


Figure 334—*Eccoptyocera*. Top, new species 3 (female genitalia figured here, BM slide 14285); northwest Koolau Mts., Oahu; expanse 17 mm. Middle, new species 2, male (BM slide 5197); northwest Koolau Mts., Oahu; expanse 13.5 mm. Bottom, new species 1, female (abdomen lost; Walsingham specimen 27732); Kaholuamano, Kauai; expanse 17 mm.

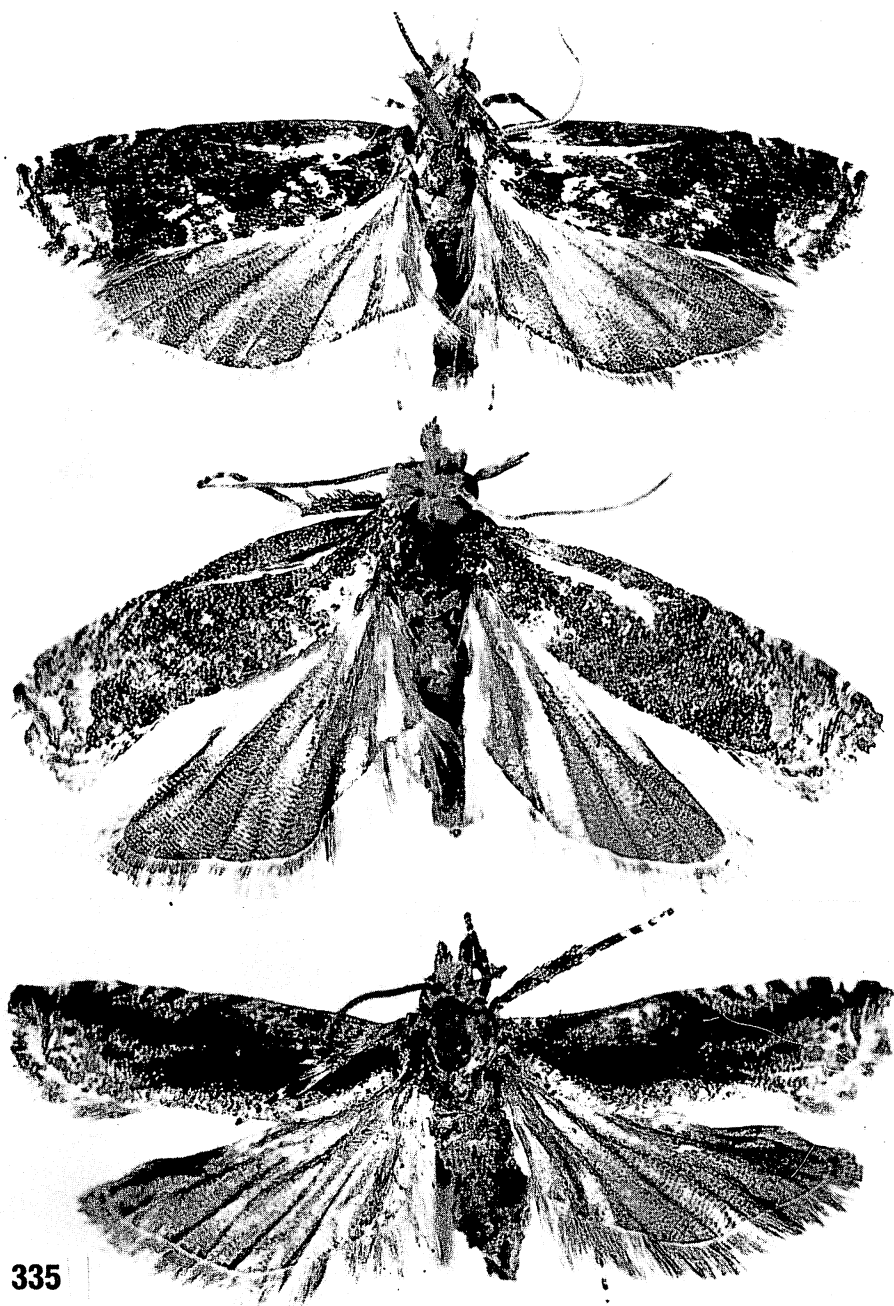


Figure 335—*Eccoptocera*. Top, new species 4, male (BM genitalia figured here; BM slide 14283); Haleakala, 5,000 feet, Maui; expanse 15 mm. Middle, new species 8, male (BM slide 14281); Kilauea, Hawaii; expanse 14 mm., as set. This specimen is figured in *Fauna Hawaiiensis*. Bottom, new species 6, female (genitalia figured here, BM slide 14282); Kona, Hawaii; expanse 13 mm.

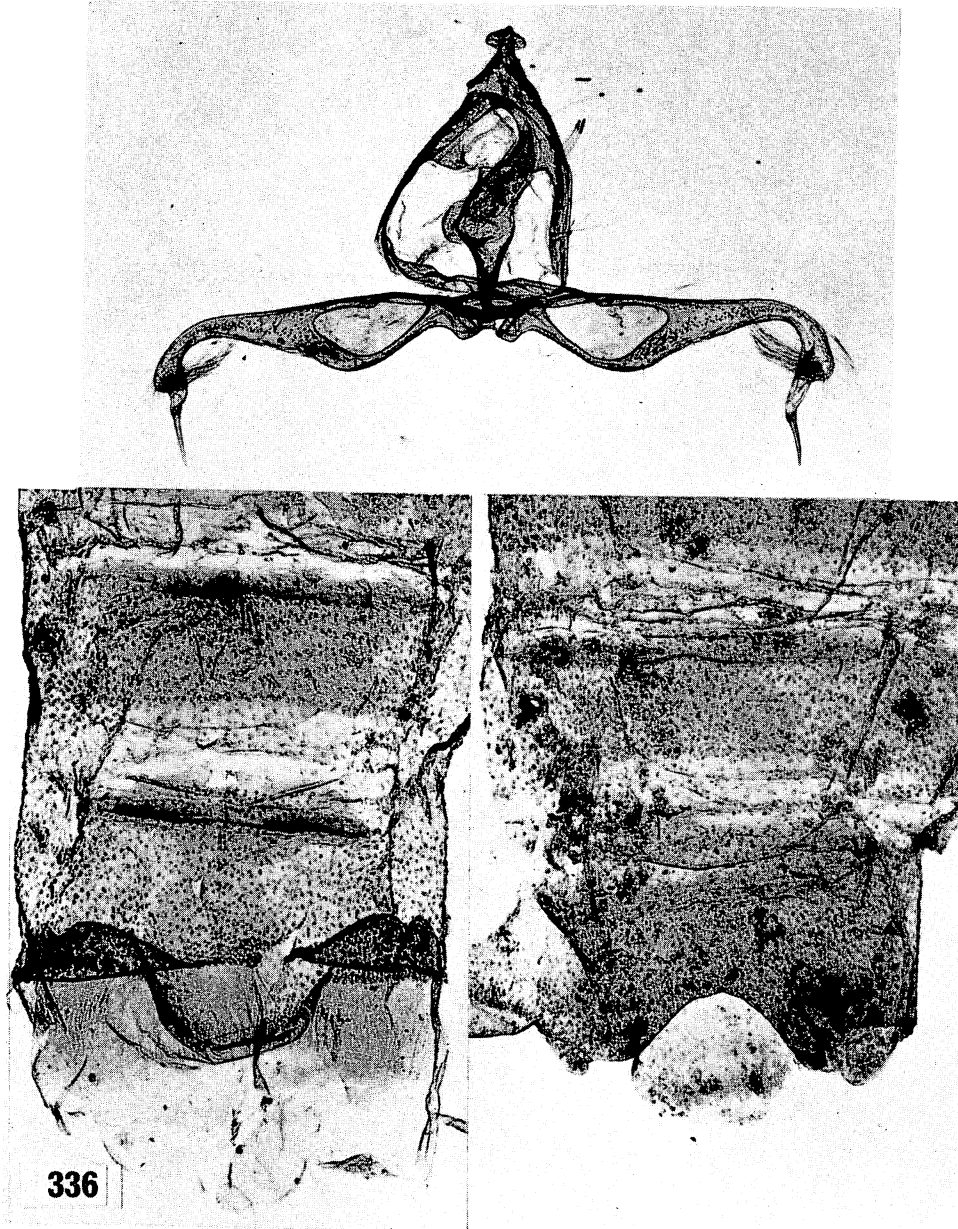


Figure 336—*Eccoptocera*. Top, male genitalia of *foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu; caudal part of the abdominal pelt of the same at lower left. Bottom, the same of new species 2 (BM slide 14279); mountains near Honolulu, 2,000 feet; see figure 338 for the genitalia of this specimen.

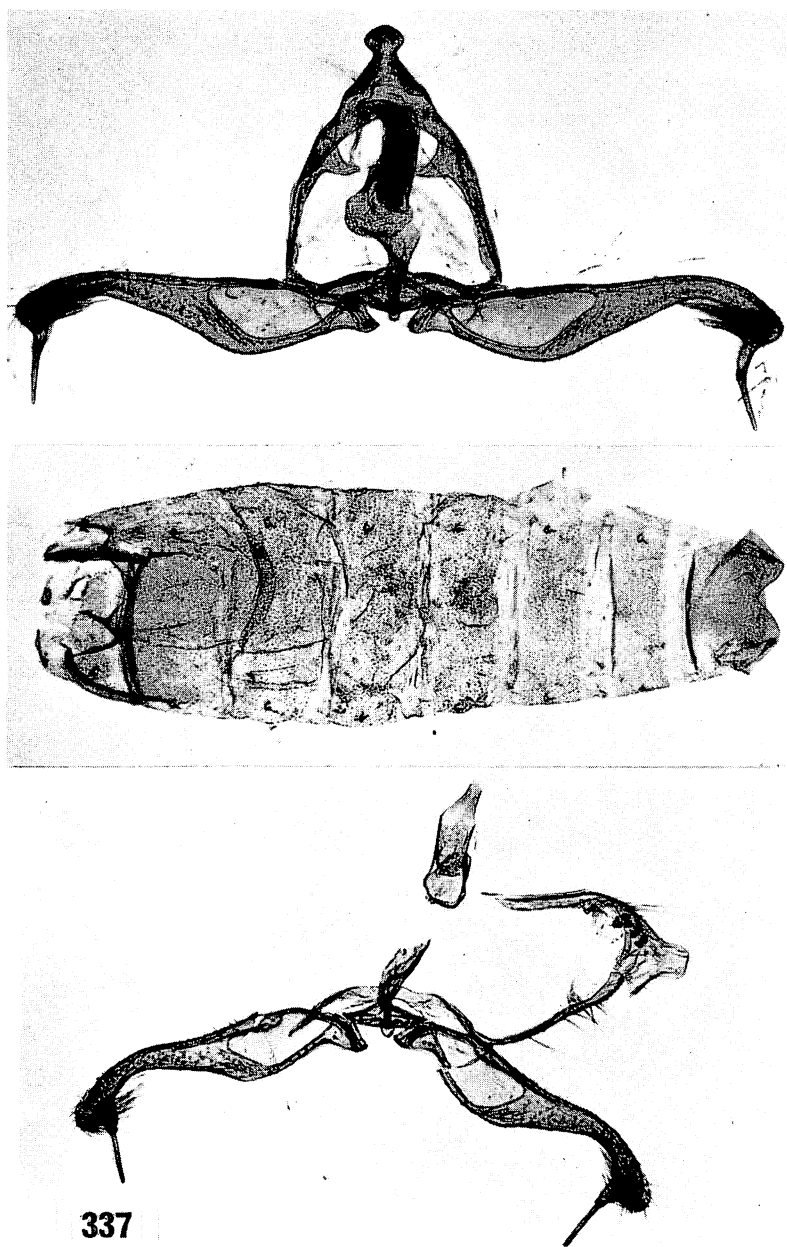


Figure 337—Male *Eccoptocera*. Top and middle, new species 4 (BM slide 14283); Haleakala, 5,000 feet, Maui; the dark-colored moth is illustrated on figure 335. Bottom, *osteomelesana* (Swezey); Wailupe Valley, Oahu (slide Z-VI-24-61). Comparison will show the aedeagus and uncus of this species to differ from the other species.

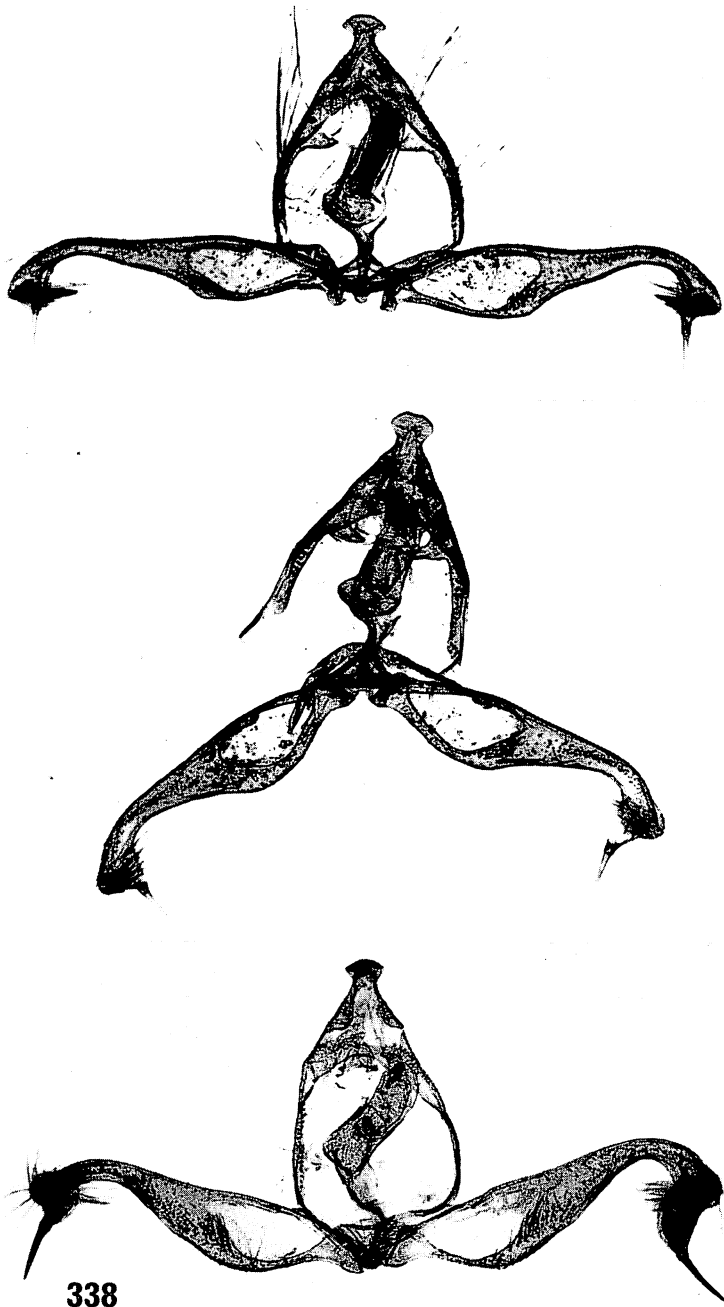
**338**

Figure 338—Male genitalia of *Eccoptocera*. Top, new grey species 2; mountains near Honolulu (BM slide 14279); see abdomen on figure 336. Middle, the same species from a specimen from the northwest Koolau Mts., Oahu (BM slide 14286). Bottom, brownish new species 7; Olaa, Hawaii (slide Z-I-16-65-A).

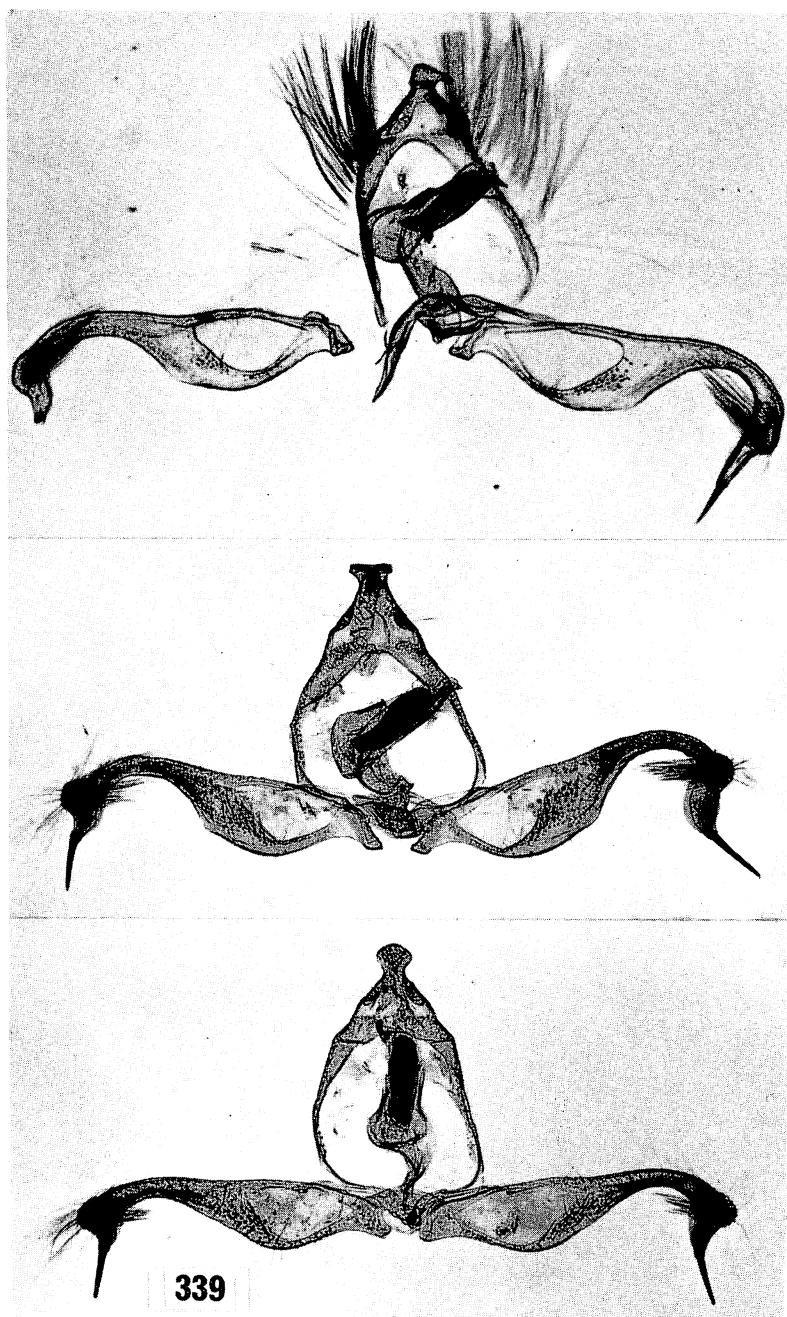


Figure 339—Male genitalia of *Eccoptocera*. Top, new species 9; Kaholuamano, Kauai (BM slide 1870). Middle, the same species from the same locality (slide Z-I-16-65-B). Forewing darkly maculate with a mostly pale posterior part. Bottom, new species 5; Haleakala, 5,000 feet, Maui (slide Z-I-16-65-C; Walsingham specimen 28177, in the Bishop Museum); possibly the same as new species 4 illustrated in figure 335, top. The aedeagi of these species are quite distinct from that of *foetorivorans*.

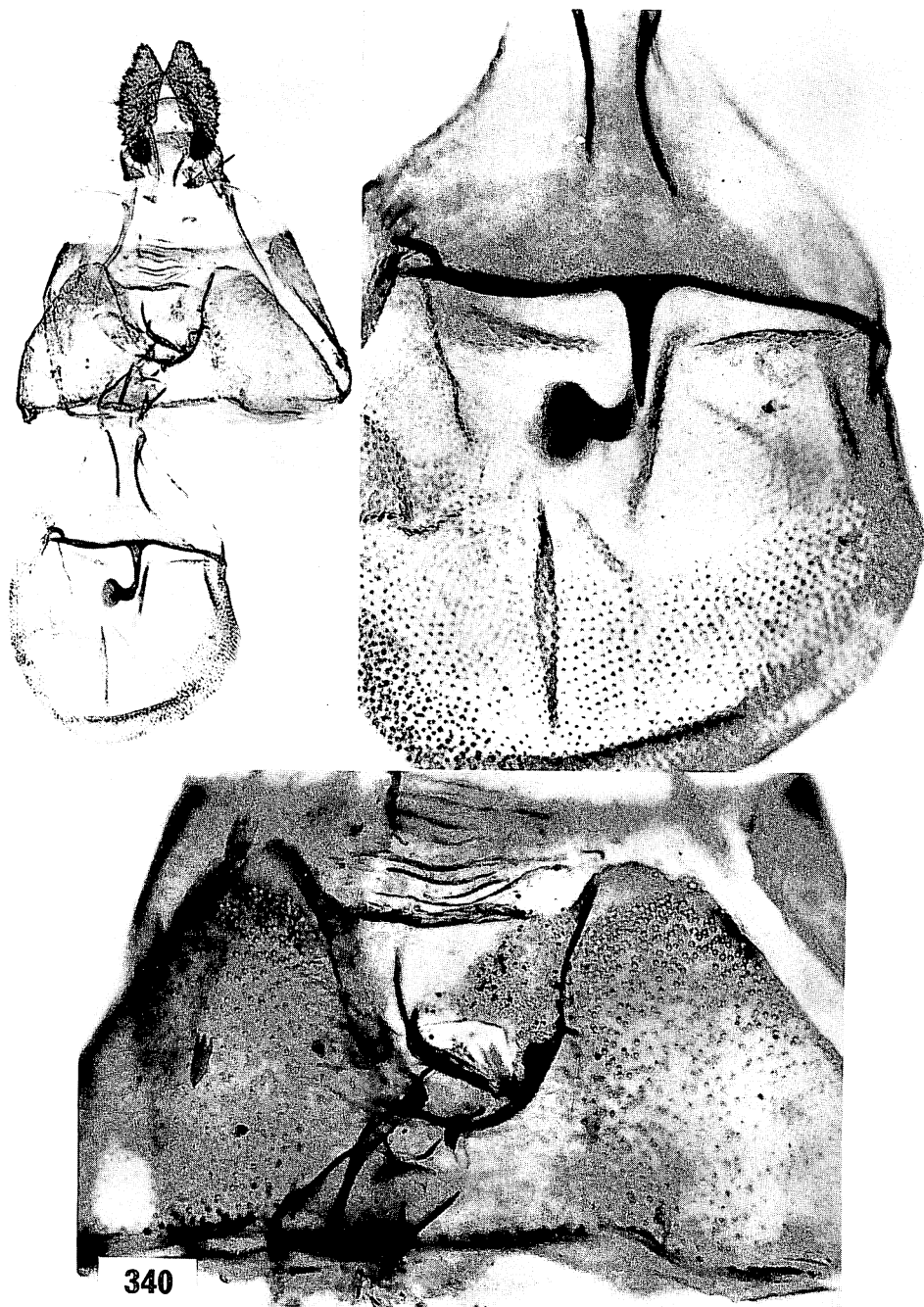


Figure 340—Genitalia of the female holotype of *Eccoptocera foetorivorans* (Butler) (BM slide 1871); mountains of Oahu ("Hawaiian Islands 81.7 66", Blackburn).



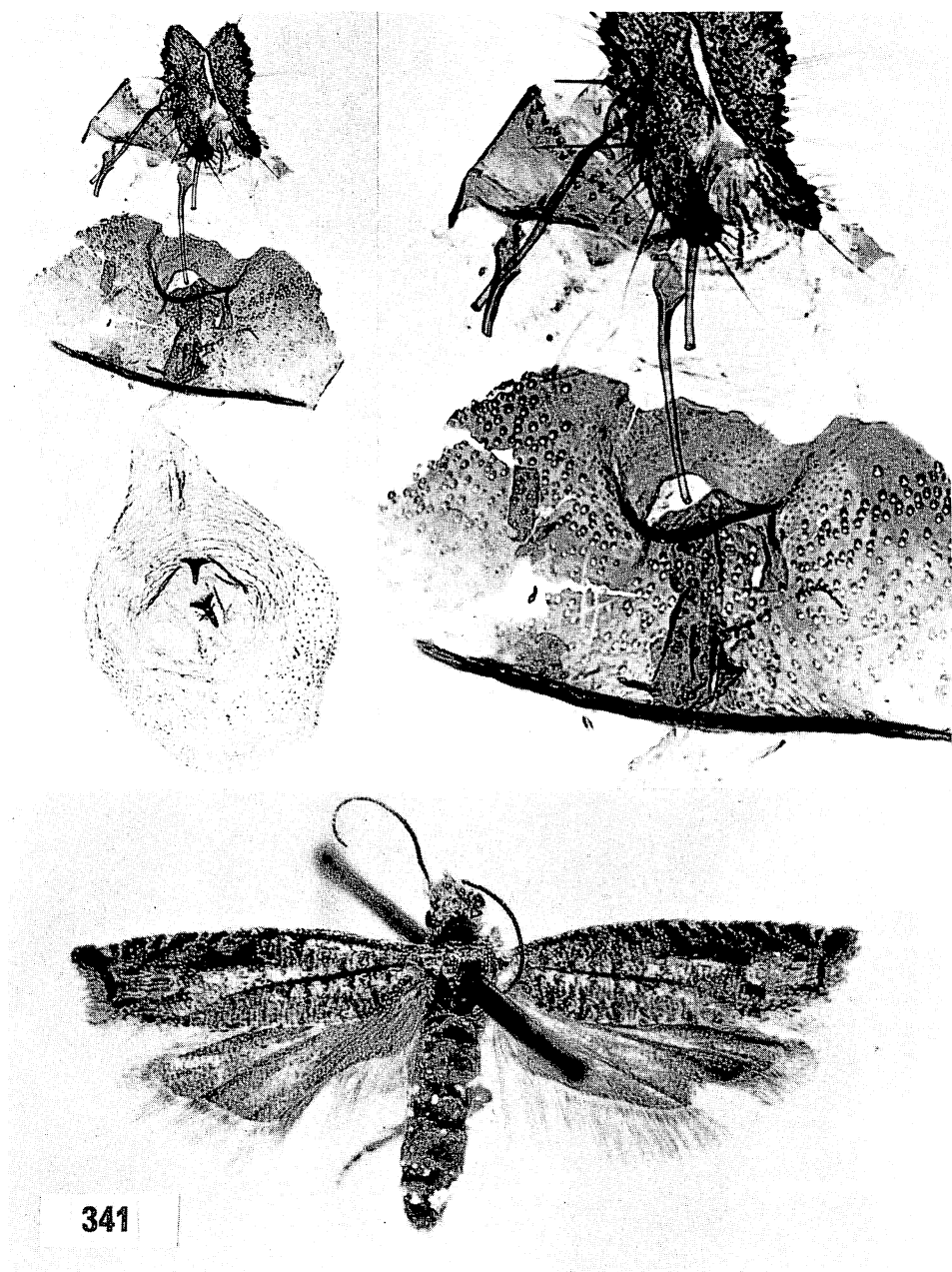
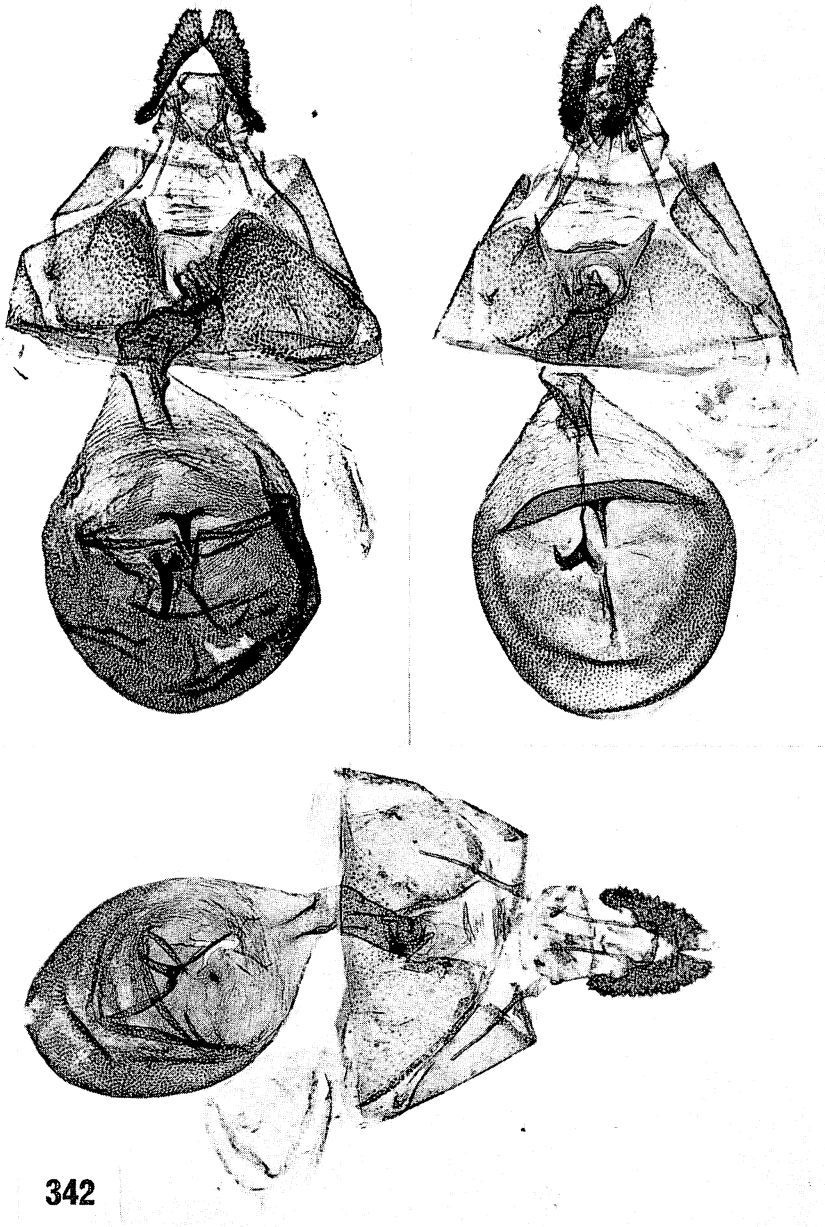


Figure 341—Details of the female holotype of *Eccoptocera osteomelesana* (Swezey) (slide Z-V-5-61); Manoa, Oahu; forewing length 4 mm.



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Figure 342—Female genitalia of *Eccoptocera*. Top left, new species 3 (BM slide 14285; Walsingham specimen 29086), a boldly maculate species; northwest Koolau Mts., Oahu; moth illustrated in figure 334. Top right, new grey species 2 (BM slide 14280; Walsingham specimen 28906); northwest Koolau Mts., Oahu; moth illustrated in figure 334; note the strong transverse plate at the base of the posterior signum. Bottom, new dark species 6 (BM slide 14282; Walsingham specimen 25261); Kona, Hawaii; moth illustrated in figure 335. Note the differences in the signa.

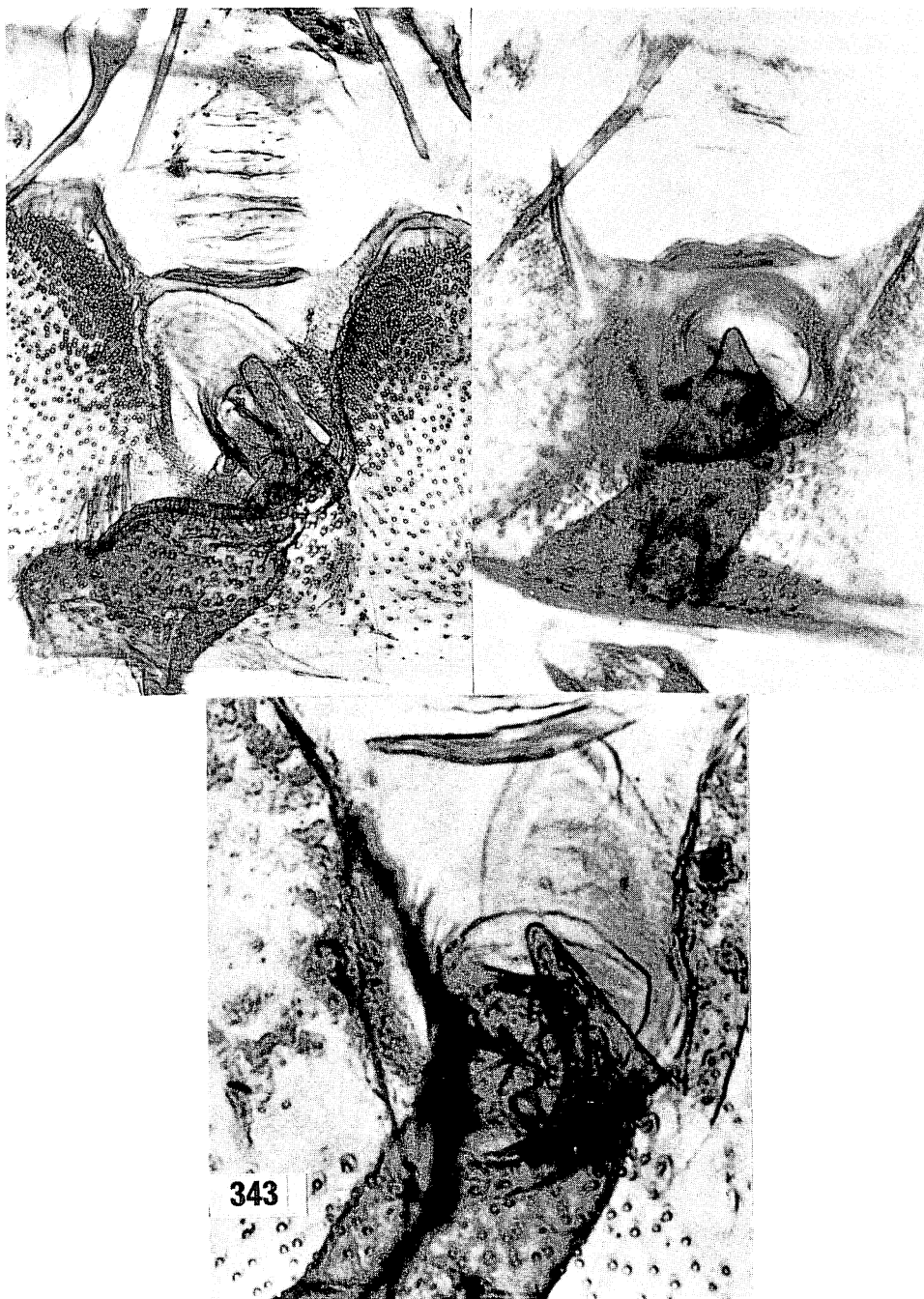


Figure 343—*Eccoptocera*. Enlargements of the female genital ostia of the specimens shown in the preceding figure. Top left, new species 3 (BM slide 14285). Top right, new species 2 (BM slide 14280). Bottom, new species 6 (BM slide 14282). See figure 342 for other data.

Genus **BACTRA** Stephens

*Bactra* Stephens, 1834 (1829–1934):124. Type-species: *Tortrix lanceolana* Hübner.

Heinrich, 1926:81. Diakonoff, 1956*a*, 1962, 1963, revisions.

For extensive synonymy and redescription, see Diakonoff, 1956*a*:2.

*Bactra* is a genus of many species, and it is nearly worldwide in tropical and subtropical regions. Diakonoff has written extensively on the genus in recent years, and he has brought considerable order out of chaos. His papers should be consulted for detailed discussions. He has divided the genus into a number of subgenera which are based upon characters of the male genitalia. The largest and most widespread subgenus is *Chiloides* (Butler).

Subgenus **CHILOIDES** (Butler)

*Chiloides* Butler, 1881:392. Type-species: *Chiloides straminea* Butler, 1881:393.

*Bactra* subgenus *Chiloides* (Butler) Diakonoff, 1956*a*:19.

Diakonoff, 1963:287, defines this subgenus as *Bactra* whose male genitalia have “a well-developed, clavate and coronate valvula present between cucullus and sacculus” and “cucullus diversely shaped [but not short and broad], usually elongate, not sclerotized, always with normal spines and bristles.”

The two species in Hawaii are externally similar in appearance, and each is so extremely variable that I have been unable to prepare a satisfactory key to them based upon external characters. An examination of the illustrations, however, will demonstrate that the species may be distinguished easily by the many differences in genitalia. Most parts of the male genitalia are distinctive, and attention is directed to the very different signa of the female bursa copulatrix as well as to the region of the ostium.

***Bactra (Chiloides) straminea*** (Butler) (figs. 344, head, wing venation; 347, moths; 348, 350, male genitalia; 349, 351, female genitalia; 353, larva of another species for comparison).

*Chiloides straminea* Butler, 1881:393.

*Bactra straminea* (Butler) Walsingham, 1907*b*:687, pl. 11, fig. 5.

*Bactra (Chiloides) straminea* (Butler) Diakonoff, 1956*a*:26, figs. 4, 24, 25; 1964:34.

*Bactra iomolybda* Meyrick, 1932:224. Synonymy by Diakonoff, 1959*a*:183, pl. 1, fig. 2, who gave it the status of *Bactra (Chiloides) straminea* male forma *iomolybda*.

Kauai, Oahu (type locality: salt marshes near Honolulu [now destroyed by landfill and covered by the city of Honolulu]), Molokai, Maui, Lanai, Hawaii (type locality of *iomolybda* Meyrick: Kilauea).

Immigrant? Source not determined, but Indo-Pacific or Palaearctic; possibly a natural immigrant in recent geologic time and possibly endemic.

Meyrick (1885:142) recorded it from New Zealand, but this was a misidentification of *Bactra noteraula* Walsingham, as noted by Meyrick (1892d [1891]:217) and Walsingham (1907b:689). Meyrick determined material from Fiji as *Bactra iomolybda*, but this record also is based upon a misidentification. [Since I wrote this, the Fijian form has been described as *Bactra (Chiloides) cerata insularis* Diakonoff, 1964:49.]

Hostplants: *Carex*, *Cladium angustifolium*, *Scirpus maritimus*. The larvae bore in the stems of these sedges.

Parasites: *Bracon swezeyi* Bridwell, *Horogenes chilonis* (Cushman), *Trathala flavo-orbitalis* (Cameron), *Trichogramma semifumatum* (Perkins).

This species, or complex, is extraordinarily variable in color, pattern, size, and even in genitalia. Diakonoff (1956a:26) said that it was the most variable of all the many species of *Bactra* known to him and he considers it to be most similar to the Palearctic *Bactra robustana*. Could it be that this species is in the early stages of explosive evolution in Hawaii? I am not completely satisfied with the conclusion that we are concerned here with one form only. Perkins (1913:clxviii) said that "*Bactra straminea* is a very widely distributed species in the islands and extremely variable, examples differing greatly in size and pattern. Probably several species are really included under this name, for we have observed scores of specimens in some localities, without remarking any special variability. If there is only one species, then the variation is to a large extent local or racial. Melanochroic forms occur and these are sometimes of gigantic size. In some varieties there is constant and conspicuous sexual dimorphism."

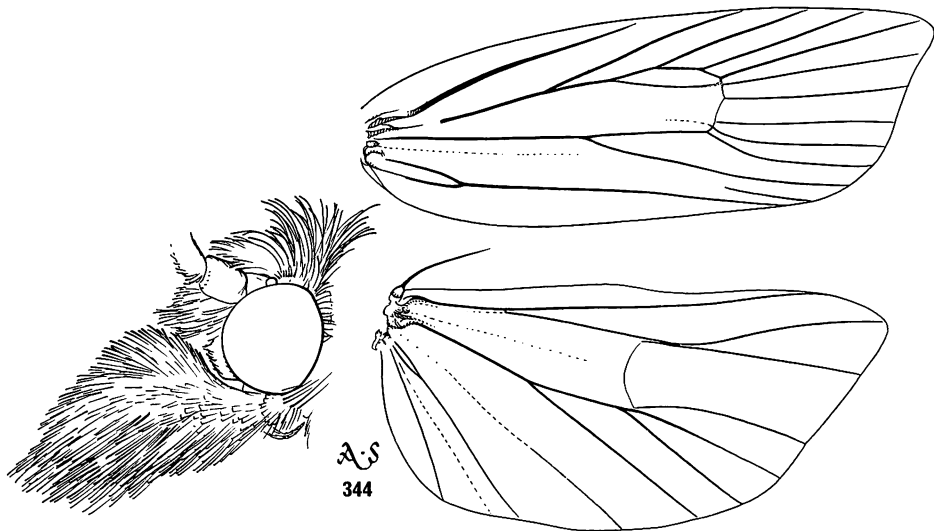


Figure 344—Head and wing venation of *Bactra straminea* (Butler); Hawaiian specimens (BM slide 3848). These specimens were labeled "cotype" in the old sense of meaning "similar to the type", but they are not members of the type-series.

Some workers in the past have found difficulty separating this species from the European type of the genus, *lanceolana* Hübner. It superficially resembles *lanceolana*, but the genitalia are distinctive. Walsingham (1907b:688) believed that it might be considered a “geographical and local race”, and he said: “After examining a very long series of this species I find I can separate it from *lanceolana*, Hb., by one character only, viz., the comparative length of the palpi which in the European species are distinctly shorter. In all other respects the numerous varieties found in both regions can be absolutely matched.” He noted further that “Butler called attention to the ‘separate emission of the second and third median branches’ of the hindwings, this observation applies equally to very numerous specimens of our common *Bactra lanceolana* although not to all, and in the Hawaiian series exactly similar specimens from the same locality taken on the same day vary in this particular.” Had Walsingham examined the genitalia, which were ignored in his work, he would have noted major differences between the species.

In 1958, when we were both at the British Museum, Diakonoff and I studied the type material of *straminea* and *iomolybda* and concluded that they were probably the same species. In 1959a:183, Diakonoff summarized the details as follows:

A comparison of the genitalia of the type specimen and close study of further material at the British Museum revealed that *Bactra iomolybda* Meyrick is only a synonym of *straminea* Butler. The only slight differences between the types which is traceable is a transverse series of additional moderate spines across the inner side of the disc of the sauculus [sacculus], running beside and parallel to the base of the median coronate appendage of the valva (valvula). . . . This difference, however, is very slight and occurs in several male specimens from Hawaii studied by me.

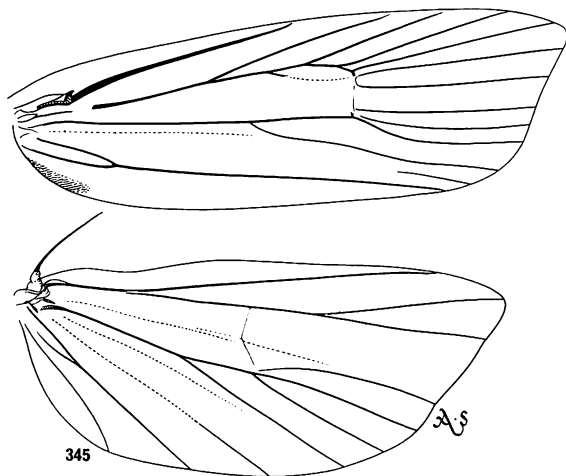


Figure 345—Wing venation of *Bactra venosana* (Zeller); a male from Lihue, Kauai (BM slide 5429).

**Bactra (Chiloides) venosana** (Zeller) (figs. 345, wing venation; 346, pupa; 347 moth; 348, male genitalia; 349, female genitalia; 350, male genitalia; 352, female genitalia; 353, larva of another species for comparison).

*Phoxopterus venosana* Zeller, 1847b:738.

*Aphelia venosana* (Zeller) Herrich-Schäffer, 1849(1843–1856):244.

*Bactra venosana* (Zeller) Rebel, in Staudinger and Rebel, 1901:113.

*Bactra (Chiloides) venosana* (Zeller) Diakonoff, 1956a:33, figs. 31–33.

*Bactra truculenta* Meyrick, 1909c:586. Ghosh, 1921:125, pl. 23, fig. 1. Clarke, 1958:315, pl. 156, figs. 4, 4a.

*Bactra (Chiloides) truculenta* Meyrick, Diakonoff, 1956a:27, figs. 28–30; 1956b:147; 1959a:184, fig. 4; 1963:331 (synonymy); 1968 (1967):64, fig. 536.

*Bactra scythropa* Meyrick, 1911c:284. Diakonoff, 1950:289.

*Bactra geraropa* Meyrick, 1931:147. Diakonoff, 1950:289. Clarke, 1958:308, pl. 153, figs. 4–4b.

See Diakonoff, 1956a:27 and 1968 (1967):64 for detailed synonymy and bibliography.

See F. X. Williams, 1931:309, figs. 141–143, and Poinar, 1964:417–423, for biology.

The nutsedge (nutgrass) borer.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Introduced from the Philippines in 1925 by Pemberton and first released in Hawaii on the grounds of the Experiment Station, Hawaiian Sugar Planters' Association, in Honolulu. The type locality of *venosana* is Sicily, and *truculenta* was described from Coorg, 3,500 feet, India. The moth is widely distributed from southern Europe, North Africa, and Asia Minor to India, Ceylon, South China, Malaya, Australia and into many Pacific islands including Java, Borneo, the Philippines, Formosa, Timor, Solomons, Carolines, Fiji, and others. "This is the most common species of *Bactra* in the eastern part of South Asia." (Diakonoff, 1956a:31).

Hostplants: *Cyperus rotundus* (nutsedge, nutgrass), *Kyllingia brevifolia*, *Kyllingia monocephala*.

Parasites: *Chelonus blackburni* Cameron, *Eriborus* species, *Trathala flavo-orbitalis* (Cameron), *Trichogramma minutum* Riley (often over 90 percent parasitism of the eggs).

I have compared Hawaiian specimens, including the genitalia, with the lectotype of *truculenta* in the British Museum, and they agree perfectly. After detailed study, Diakonoff has concluded that *truculenta* is a synonym of *venosana*.

This is one of the insects purposely introduced by the entomologists of the Hawaiian Sugar Planters' Association Experiment Station to aid in the fight against the nutsedge (nutgrass) weed pest. Specimens were first brought to Honolulu in 1922 by F. X. Williams for experimentation, but the moth was not released at that time. In 1925, C. E. Pemberton brought in another culture which was released and quickly became established. Subsequently, cultures were sent to the outer islands. For a few years after its introduction, the moth became very common, and its work on nutsedge was conspicuous.

In some areas nearly 100 percent of the nutsedge was attacked by the larvae.

F. X. Williams (1931:311), in quoting from his report on the activities of the moth on Maui in 1929, said "Brown patches of nutgrass showed the good work of *Bactra*, which was extraordinarily numerous, for its pupal shells, sometimes averaging more than one per square inch of ground, could be seen protruding from the base of the plants or from the soil. . . . The nutgrass, of course, is not being extirpated here; very often the plant is killed, sometimes new shoots appear from the basal bulb, while the 'nut,' deeper in the ground is unharmed. However, the growth subsequent to the attack is comparatively sparse and the work of the *Bactra* caterpillar may be said to substitute in some measure, the process of hoeing and has proved useful beyond expectation." Most unfortunately, parasitism by *Trichogramma* gradually became greater and greater, and finally such a high percentage of the moth eggs were destroyed

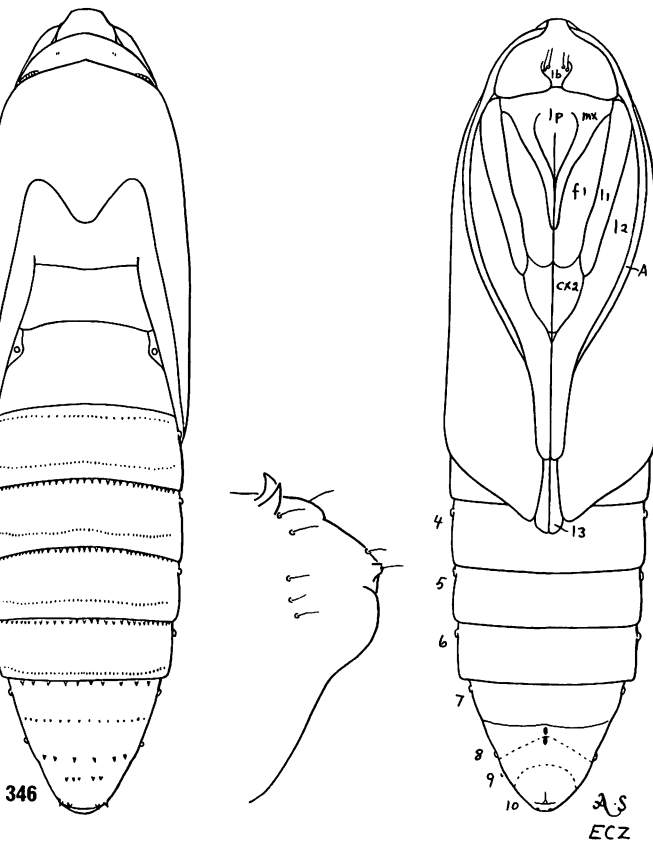


Figure 346—Pupa of *Bactra venosana* (Zeller). Honolulu; ex nut grass; length 8.5 mm. A sketch of the cauda in left lateral aspect is inserted. The setae are very short, inconspicuous, and they are mostly omitted from the drawings. *A*, antenna; *Cx2*, mesocoxa; *f1*, profemora; *lb*, labrum; *l1*, *l2*, *l3*, legs; *mx*, galea of maxilla (proboscis); *W2*, hindwing.



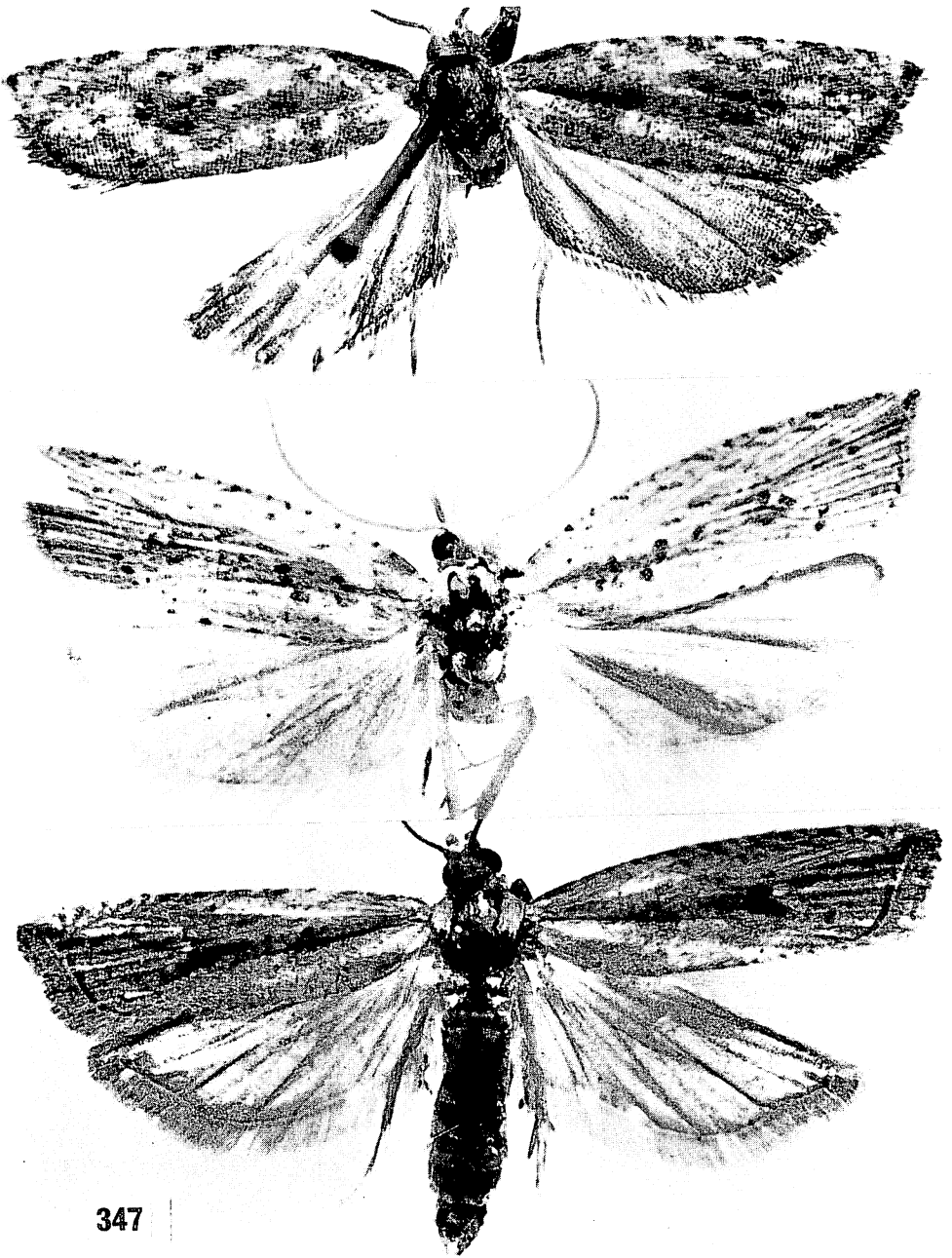


Figure 347—*Bactra* (*Chilodes*). Top, *straminea* (Butler), from the lectotype male of the synonym *iomolybda* Meyrick (BM slide 9545 Clarke); Kilauea, Hawaii; expanse 14.5 mm. Middle, *straminea* (Butler), holotype male (abdomen lost); Honolulu; expanse 18 mm. Bottom, *venosana* (Zeller); Honolulu; ex nutgrass; expanse 16.5 mm.

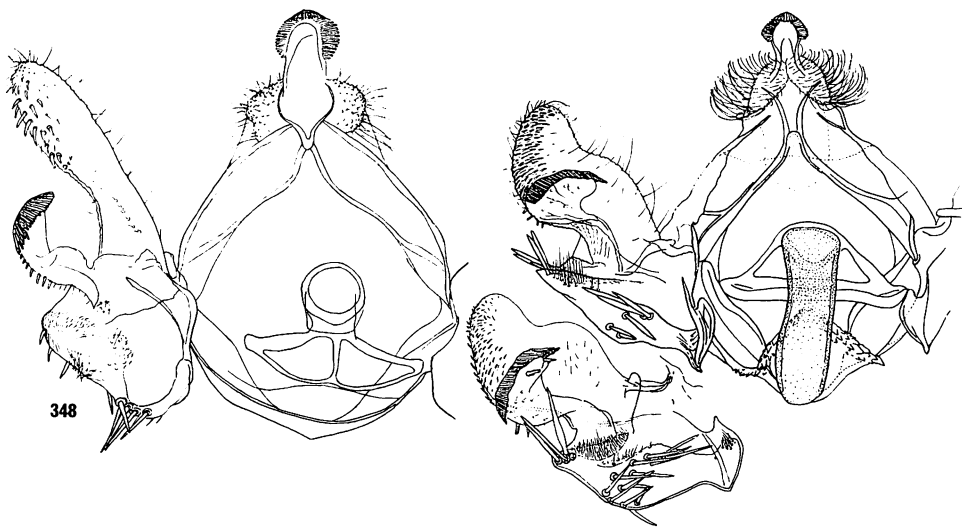


Figure 348—Male genitalia of *Bactra*. Left, *straminea* (Butler). Right, *venosana* (Zeller) with the left valva of another specimen below to show variation. (Drawings loaned by A. Diakonoff.)



Figure 349—Female genitalia of *Bactra*. Left, *venosana* (Zeller). Right, *straminea* (Butler). (Drawings loaned by A. Diakonoff.)

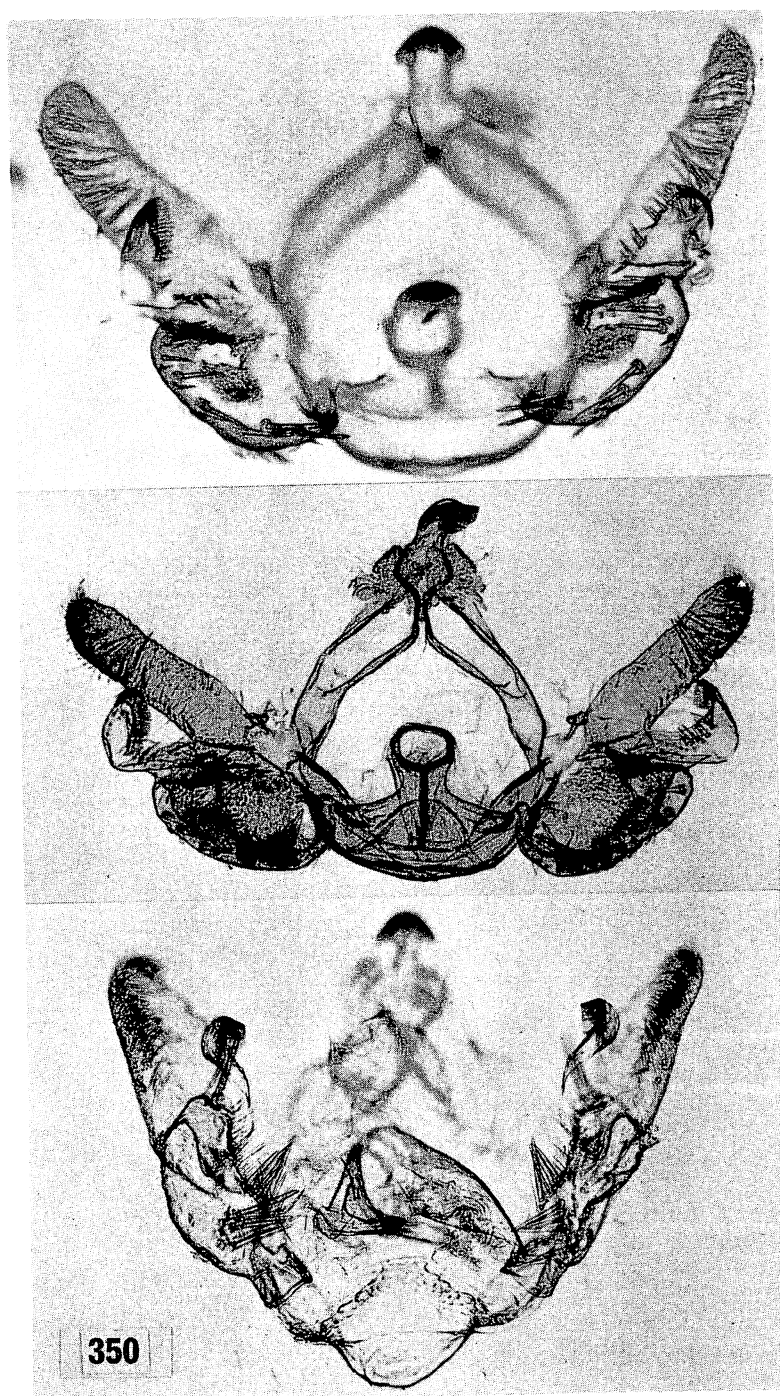


Figure 350—Male genitalia of *Bactra*. Top, *straminea* (Butler), from the lectotype of the synonym *iomolybda* Meyrick (BM slide 9545 Clarke); Kilauea, Hawaii. Middle, *straminea* (Butler) (BM slide 3848); mountains near Honolulu, 2,000 feet; from the specimen illustrated in *Fauna Hawaiiensis* and photographed at a different focal level from the top figure. Bottom, *venosana* (Zeller) (BM slide 5429); Lihue, Kauai; aedeagus in situ.

by the parasite that the effectiveness of the moth in the control of nutgrass was greatly reduced. On occasion, 100 percent of the egg clusters of the moth are parasitized. Because of this parasitism, the moth today is unable to contribute much to the control of the weed pest. Poinar (1964:418) said that "parasitized eggs appear totally black to the naked eye, in contrast to the yellow color of unparasitized eggs. The color appears to be due to a darkening of the inside of the chorion and not to the body of the parasite itself."

Dr. Williams stated further (1931:309, figs. 141–143) that:

It is a very active insect that, when disturbed from the herbage, dashes off in a short low flight, then alighting, wraps its wings about the body and remains quiet and usually unseen. The female lays a number of flat oval eggs measuring about 0.60 by 0.90 mm., in the midrib groove of the upper side of a nutgrass leaf, arranging them in a single line of from two or three to perhaps twenty slightly overlapping eggs; these are in part sculptured with a delicate network of raised lines; at first they are pale green but darken and become blackish when it is time for them to hatch. They hatch in 3 or 4 days. The young were observed not to eat the egg shells; they immediately enter the central leaf bundle and tunnel the stem and, in many cases, destroy the bulb, which may be bored [*sic*] from top to bottom. The affected plant first shows a withering of inner leaves, which become yellow and finally die, causing 'deadheart', the whole plant eventually succumbing. The freshly hatched young is pale, glassy yellowish, excepting that the head is

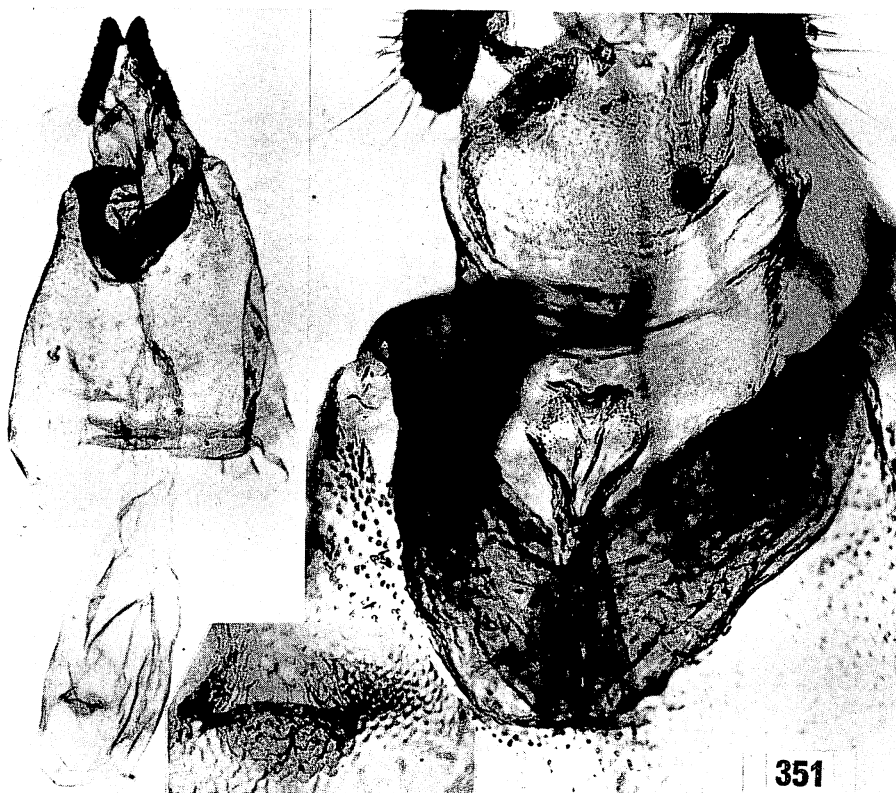


Figure 351—*Bactra straminea* (Butler), female genitalia (BM slide 6448); Kauai, 4,000 feet; an enlargement of the signum is inserted at the bottom.

shining black, the prothoracic shield nearly black and the rest of the prothorax permeated with pinkish. The full-fed caterpillar is a half-inch or more in length, when it may be green or pale yellowish. It spins a tube of silk in the stem and in this cocoon sheds its skin to turn into a pupa about 5 to 7 mm. in length. At the end of a few days the pupa, by means of some backward-pointing spines on the abdomen, which it now moves actively, works its way out of the cocoon and, pushing itself part way through a specially made hole in the *Cyperus* stem, splits at the fore end and liberates the moth. Mr. Swezey who reared an adult to maturity found the caterpillar stage to be less than 25 days, and the time from the hatching of the eggs to disclosing the moth occupied 31 days. In another case approximately 38 days were required for the transformation. We have found that only one borer matures in a single stem.

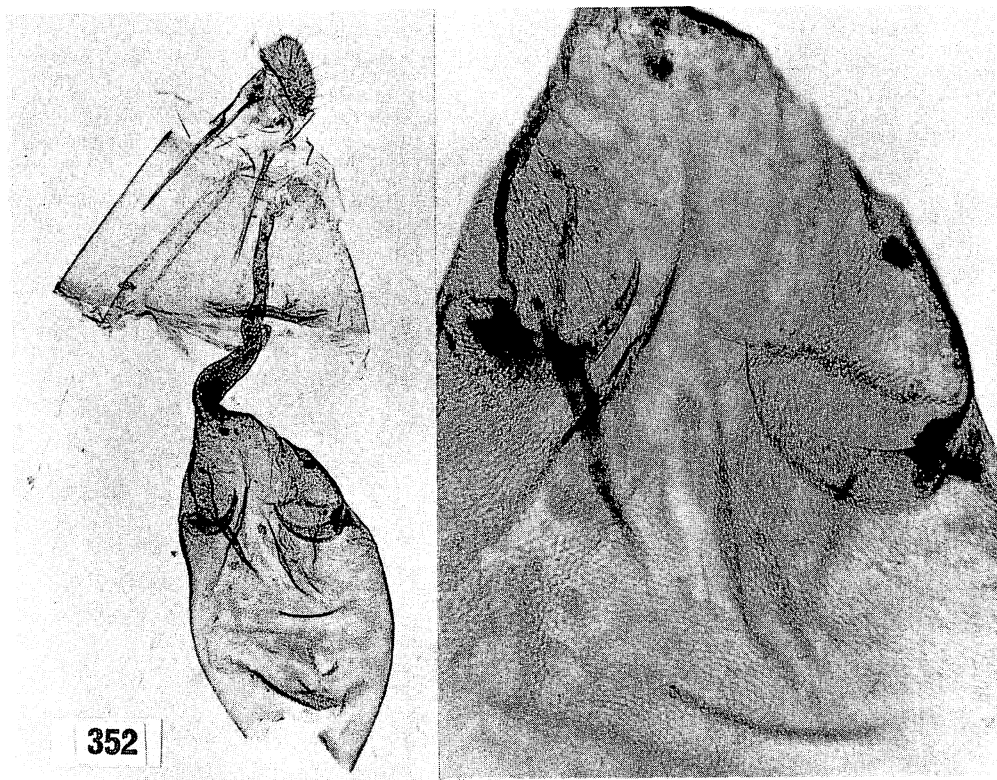


Figure 352—*Bactra venosana* (Zeller), female genitalia (BM slide 7548); Kaiva, Dakar, Africa.

Figure 353—Details of the larva of *Bactra verutana* (Zeller), or a closely allied species. This American (?) species does not occur in Hawaii. Because of the lack of a similar plate of details for the Hawaiian species, however, this illustration is reproduced for comparative purposes and should assist in the separation of larvae of the Hawaiian members of the genus from the larvae of other genera. Diakonoff places the species in his subgenus *Nannobactra* (1964:62).

*a*, setal map of the pro- and mesothorax and abdominal segments 1,2,6, and 7; *b*, the same of abdominal segments 8 and 9; *c*, dorsal setae, pinacula, and dermal spinules of an anterior abdominal tergite; *d*, crochets of a mid-abdominal and an anal proleg; *e*, dorsal aspect of abdominal segments 8, 9, and 10; *f*, spinneret and labial palpi; *g*, ocellar area of the left side of the head; *h*, V1 setae on the midline of abdominal sternites 7, 8, and 9; *i*, lateral aspect of a thoracic leg; *j*, prothoracic shield; *k*, frontal aspect of the head. (Plate loaned by Margaret MacKay.)

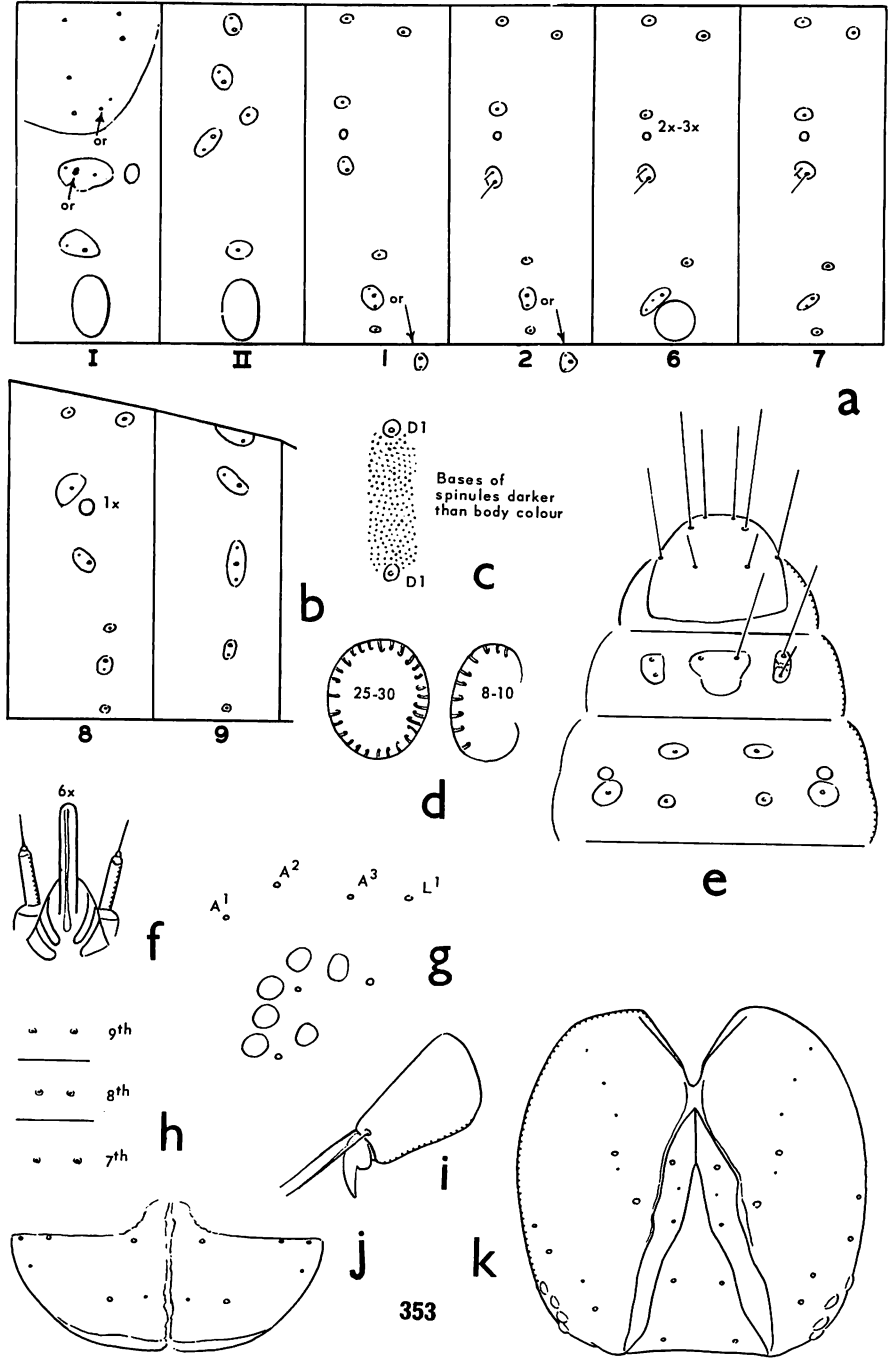


Figure 353—See page 558 for legend.

Poinar (1964:418) found that under laboratory conditions and at about an average of 75°F as many as 130 eggs were laid by one female and the incubation period was from 5.5 to 6.0 days. "The eggs are white when first laid, and the embryo can be distinguished after two to three days. The eyes are visible after three to four days and the internal organs in five to six days. At the time of hatch, the larva is pale yellow with a black prothoracic shield and head capsule." He found the larval period to range from 18 to 20 days, the pupal period about 7 days and the females were able to oviposit in about 2 days after emergence.

Genus **CRYPTOPHLEBIA** Walsingham

*Cryptophlebia* Walsingham, 1899:105. Type-species: *Arctophora* (?) *ombrodelta* Lower, 1898:48 (= *Cryptophlebia carpophaga* Walsingham, 1899:106). Walsingham, 1907b:680.

*Pogonozada* Hampson, 1905a:586. Type-species: *Pogonozada distorta* Hampson (from China).

Swezey and Zimmerman, 1946:629–631, fig. 1. Bradley, 1952:679–689, figs. 1–8, pls. 24, 25. Diakonoff, 1957a:136; 1968(1967):89.

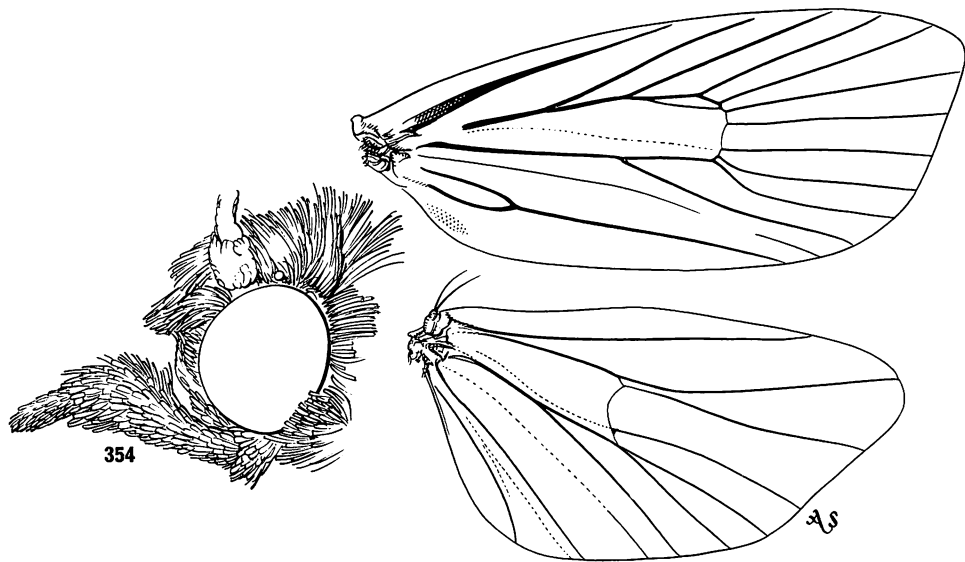


Figure 354—*Cryptophlebia illepidia* (Butler). Head of a female ("cenotype") from the Waianae Mts., Oahu. Wing venation of a female ("homotype"; BM slide 1889); Waianae Mts., 2,000 to 3,000 feet, Oahu. The hindwing of the male has a conspicuous, irregularly formed "sex patch" on the underside of the hindwing beneath the distal parts of veins 1a and 1b which contains a large mass of peculiarly modified squamae.

Meyrick erroneously referred the Hawaiian species to the genus *Argyroploce*, a course also followed by T. B. Fletcher, and in Hawaiian literature the species are found under both generic names. Bradley (1952) and Diakonoff (1957a) have done much to clarify many problems in the genus, and they have laid a firm base for future work on *Cryptophlebia*.



Figure 355—*Cryptophlebia*. Ental aspects of the hindlegs of males to show the differences in structure. Top, *ombrodelta* (Lower); Java. Bottom, *illepida* (Butler); Honolulu; ex stem of *Acacia farnesiana*.



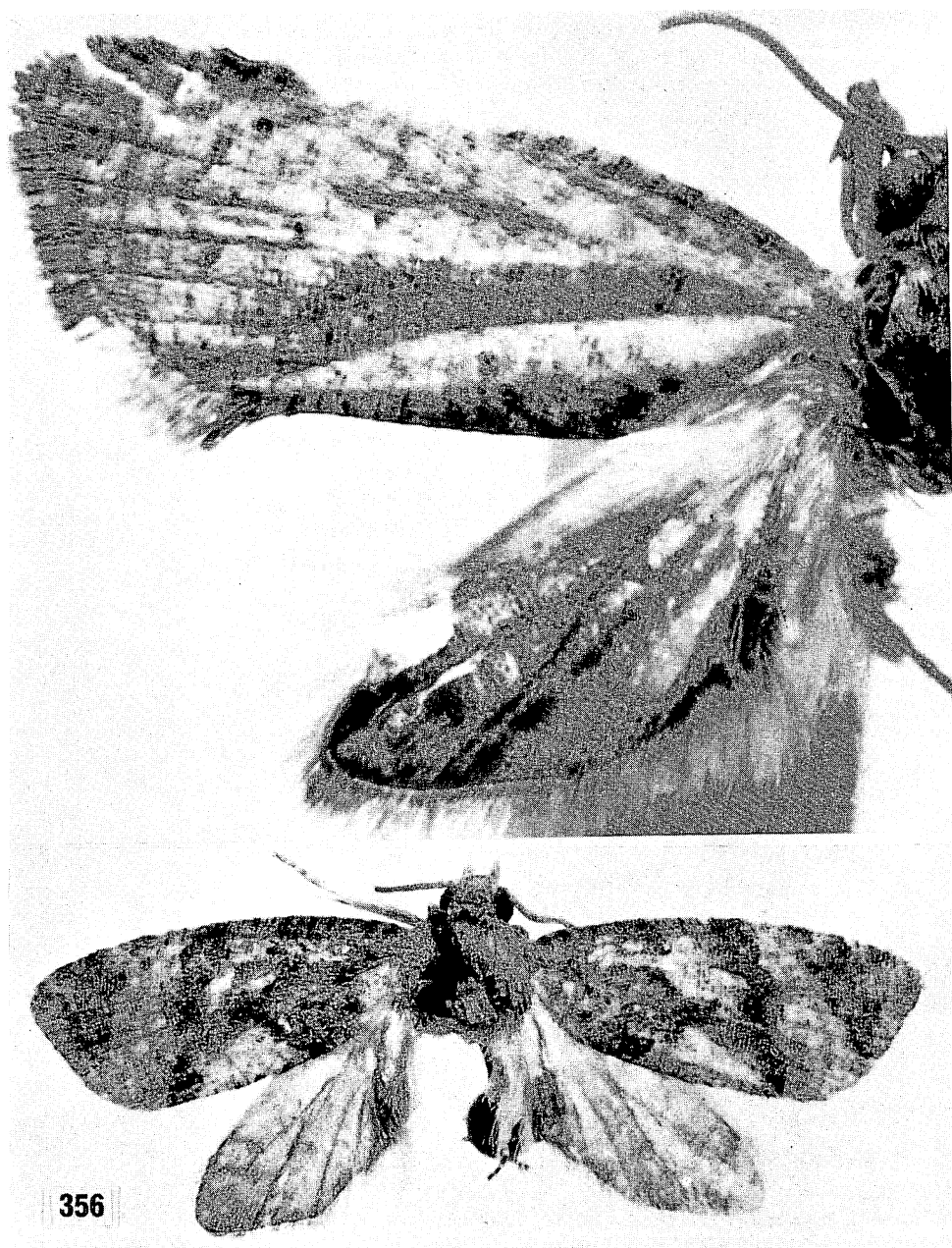


Figure 356—*Cryptophlebia*. Top, *illepida* (Butler), holotype male (abdomen lost); near Honolulu; forewing 7.5 mm. Bottom, the color form "*fulva*" Walsingham, holotype male (BM slide 1890); Kona, 4,000 feet, Hawaii; expanse 11 mm.

MacKay (1959:79) noted the close similarity between the larvae of *Cryptophlebia*, *Pseudogalleria* Ragonot, and *Ecdytolopha* Zeller (= *Gymnandrosoma* Dyar, synonymy by Diakonoff, 1957a:132), and her discoveries support the conclusions reached by Diakonoff (1957a) from his studies of the moths.

*Cryptophlebia* is widespread from Africa and Madagascar through the Oriental Region and out through the islands of the Pacific as far as the Mar-

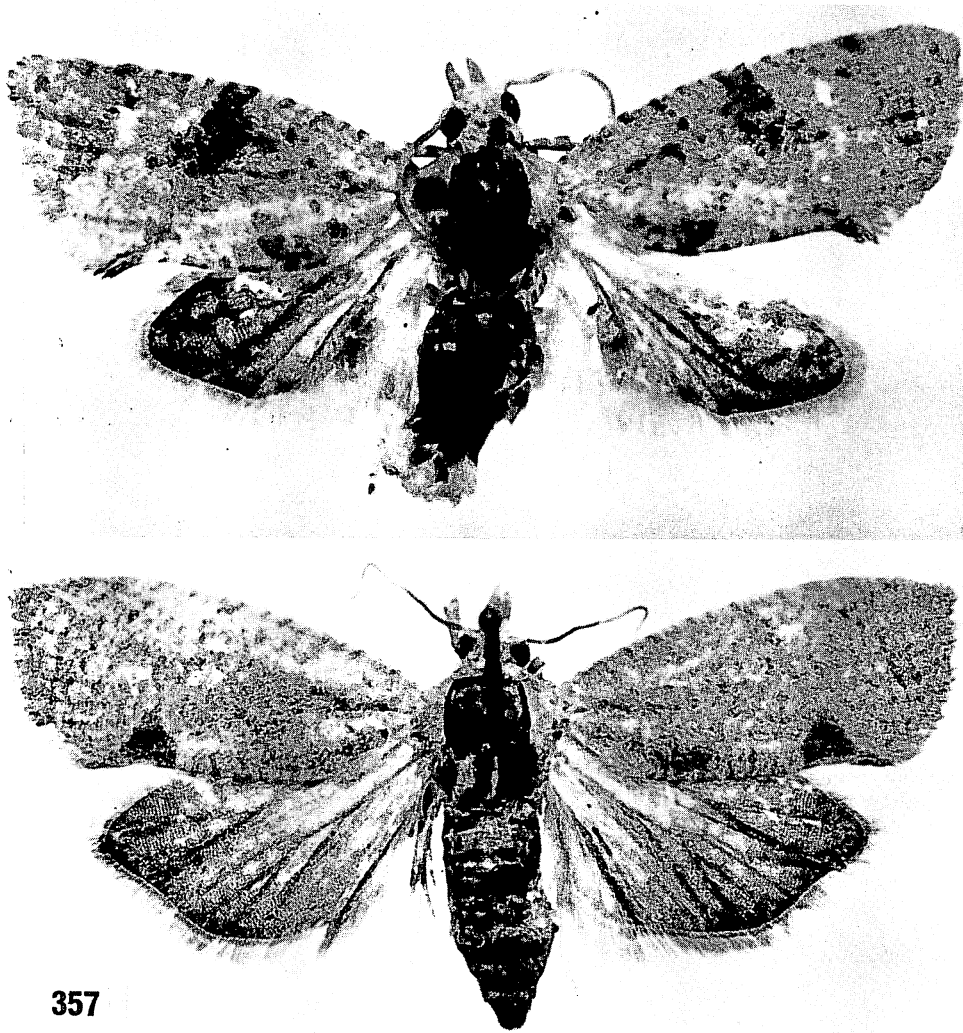


Figure 357—*Cryptophlebia illepada* (Butler), color forms. Top, a male from Honolulu; expanse 17.5 mm. Bottom, a female from Honolulu; expanse 21 mm.

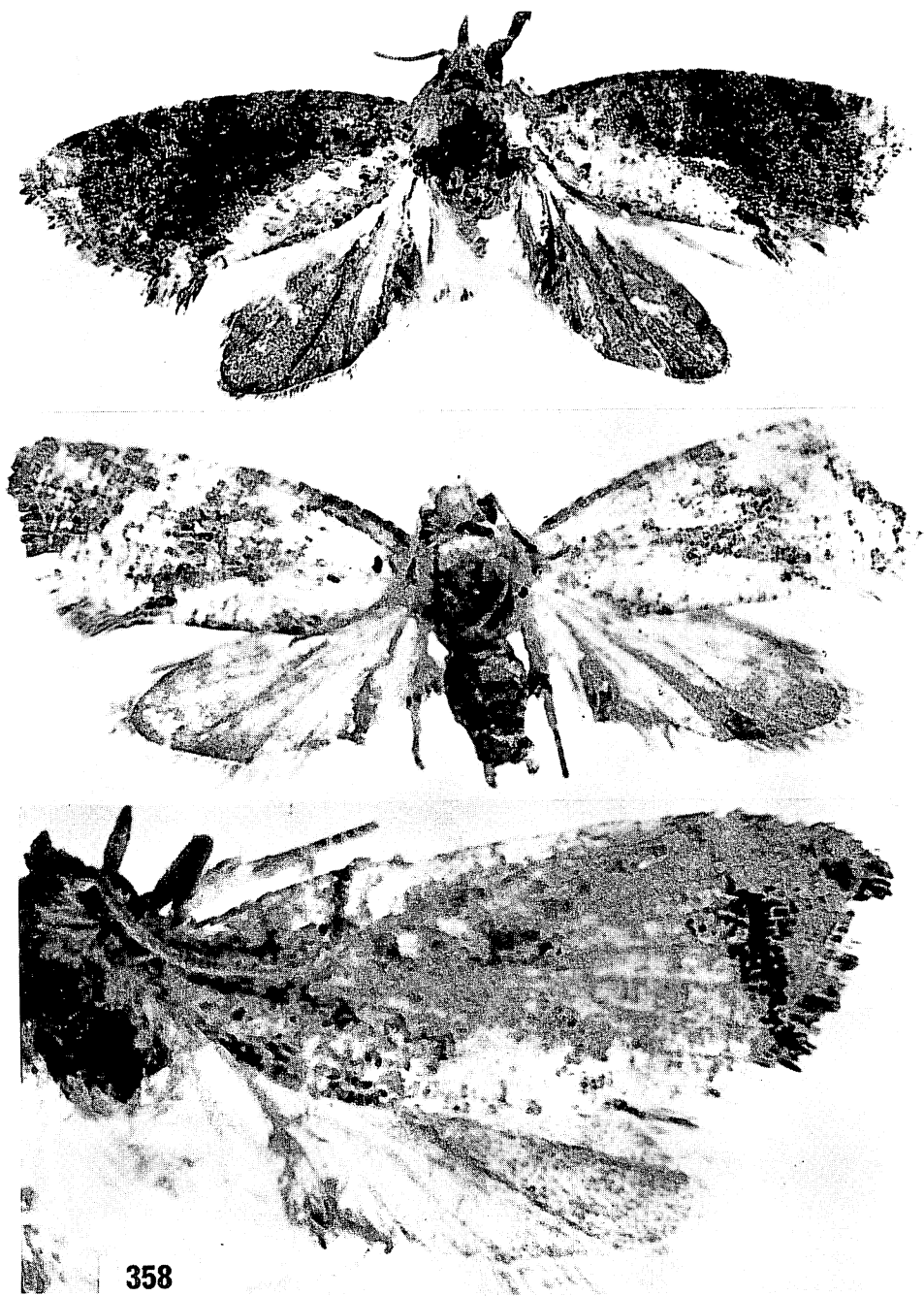
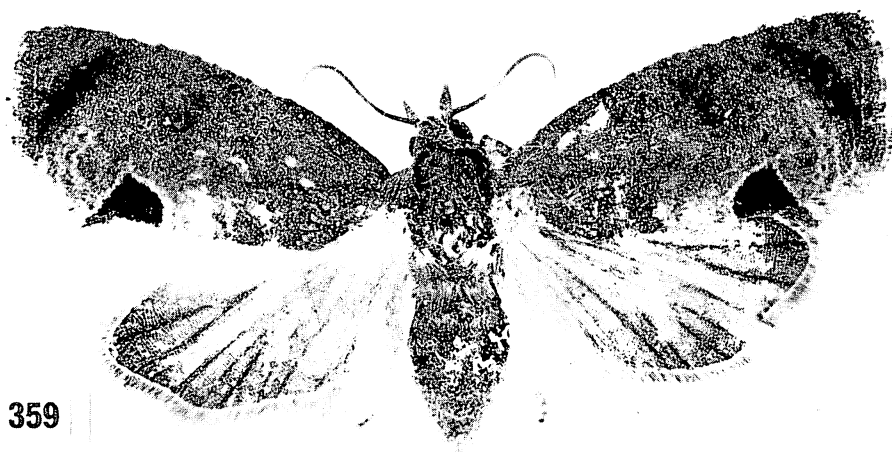


Figure 358—*Cryptophlebia illepida* (Butler), synonymous color forms. Top, "*suffusa*" Walsingham, holotype male (BM slide 1891); Kona, 4,000 feet, Hawaii; expanse 20 mm. Middle, "*tetrao*" Walsingham, holotype male; Kona, 3,500 feet, Hawaii; expanse 14 mm. Bottom "*vulpes*" Walsingham, holotype male (BM slide 2565); Kilauea, Hawaii; forewing 5 mm.



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Figure 359—*Cryptophlebia ombrodelta* (Lower). Top, a male from Buitenzorg, Java; expanse 19 mm. This shows the large scale and hair tufts on the metatibia and tarsus, but this dorsal view does not show the huge mass to best advantage. See the separate enlargement in figure 355. Bottom, a female from Queensland, Australia; expanse 19.5 mm.

quesas. There are more than 25 species; the greatest concentration of species is in the Indo-Pacific area. Four or more species occur in Fiji. A single species (*carpophagoides* Clarke, 1951) has been described from Argentina, but there is reason to suspect that it is not a native of that country. *Cryptophlebia* includes several species of economic importance.

Externally, there are not many striking features to separate this group from most other Hawaiian olethreutids; the male genitalia are very distinctive, however, and they do serve easily to separate the genus from all others in Hawaii.

Diakonoff (1957a:136–142) split *Cryptophlebia* into two subgenera: *Cryptophlebia*, *sensu stricto*, and *Phanerophlebia* Diakonoff (from Indonesia). Only *Cryptophlebia*, *sensu stricto*, is represented in Hawaii. The two subgenera, as defined by Diakonoff, may be distinguished as follows:

1. Valva of male genitalia with a stout, toothlike projection from the lower margin near the apex of sacculus; maculations of male forewing ill-defined, consisting of a pattern of small strigulae, distinctly maculate in female, and coloring pale tawny without any violet. . . . . **Phanerophlebia.**
2. Valva lacking a tooth on ventral margin near apex of sacculus; maculations of forewings strongly marked in both sexes and of the *ombrodelta* type and the coloring more or less dark brownish violet. . . . . **Cryptophlebia.**

Subgenus **CRYPTOPHLEBIA** Walsingham, Diakonoff

*Cryptophlebia* subgenus *Cryptophlebia* Walsingham, Diakonoff, 1957a:138.  
Type-species: *Cryptophlebia ombrodelta* (Lower).

## KEY TO THE SPECIES OF CRYPTOPHLEBIA IN HAWAII

1. Male: metatibia and first metatarsal segment with the large tufts of hair mostly ochreous (but some scales usually apically dark and some specimens might be confused with *ombrodelta*); inner surface of metatibia with a differentiated mass of erect setae but no bare area (figure 355); distal part of genital valva with two long, heavy spurs and many shorter spines distad of these around the apical margin of the valva. Female: genitalia as illustrated (note especially the differences in the ostium) (figure 362) . . . . . **illepida** (Butler).
2. Male: metatibia and first metatarsal segment with the large tufts of hair mostly distally fuscous or dark and iridescent; metatibia with a large, conspicuous, ovate, mostly bare, concave area on inner side (figure 355);

distal part of genital valva with three long, heavy spurs placed in a subapical triangle and with few or no shorter stout spines distad of these. Female: genitalia as in figure 363.....**ombrodelta** (Lower).

The dorsum of the abdomen of the male of *ombrodelta* is clothed with much more long wooly hair than is that of *illepida*.

**Cryptophlebia illepida** (Butler) (figs. 354, head, wing venation; 355, male metatibia; 356–358, moths; 360–361, male genitalia; 362, female genitalia; 364, pupa; 366, larva, pupa; 367, larval damage).

*Teras illepida* Butler, 1882:42.

*Cryptophlebia illepida illepida* (Butler) Walsingham, 1907b:681, pl. 10, fig. 23.

*Cryptophlebia illepida* variety *fulva* Walsingham, 1907b:681, pl. 10, fig. 24.

Synonymy by Zimmerman, in Swezey and Zimmerman, 1946:631.

*Cryptophlebia illepida* variety *suffusa* Walsingham, 1907b:682, pl. 10, fig. 25.

Synonymy by Zimmerman, in Swezey and Zimmerman, 1946:631.

*Cryptophlebia tetrao* Walsingham, 1907b:683, pl. 10, fig. 26. Synonymy by Zimmerman, in Swezey and Zimmerman, 1946:631.

*Cryptophlebia vulpes* Walsingham, 1907b:683, pl. 10, fig. 27. Synonymy by Zimmerman, in Swezey and Zimmerman, 1946:631.

*Argyroplote illepida* (Walsingham) Meyrick, 1910c:218. Swezey and Zimmerman, 1946:629, fig. 1, male genitalia. Swezey, 1954:4, fig. 2.

*Cryptophlebia illepida* (Butler), Bradley, 1952:684, fig. 1, male genitalia; pl. 24, fig. 3, adult female; pl. 25, figs. 3, 3a, female genitalia.

Namba, 1957:284, fig. 1, biology.

The koa seedworm (also called: klu tortricid, koa seed moth, litchi borer, litchi moth, macadamia nut borer, or macadamia nut moth).

Kauai, Oahu (type locality: "In the neighborhood of Honolulu"; the holotype bears the following Blackburn label: "Hawaiian Isl. 82.9 99"), Molokai, Maui, Lanai, Hawaii.

Immigrant? Although, to my knowledge, this species has not been found outside of Hawaii, it appears to be an immigrant. Perkins considered it to be an immigrant. Records for the species from outside of Hawaii, such as that by T. Bainbrigg Fletcher (1921 [1920]:55, for example) are erroneous and are based upon misidentifications. The situation regarding the immigrant or endemic status of this moth is comparable with that of *Bactra straminea* discussed above, and it is possible that *Cryptophlebia illepida* is a native insect which reached Hawaii in recent geologic time and is in the preliminary stages of evolving new endemic Hawaiian forms. The species appears not far removed from such forms as the widespread *ombrodelta*.

Hostplants: *Acacia confusa*, *Acacia farnesiana* ("klu"), *Acacia koa*, *Acacia koaia*, *Alectryon macrococcum*, *Cassia glauca*, *Dodonaea viscosa*, *Inga edulis*, *Litchi chinensis*, *Macadamia ternifolia*, *Mangifera indica* (mango), *Mezoneuron kauaiense*, *Phaseolus* (garden beans), *Pithecolobium dulce*, *Sapindus oahuensis*, *Sapindus saponaria*.

Parasites: *Brachymeria obscurata* (Walker), *Bracon mellitor* Say, *Coccygomimus punicipes* (Cresson), *Coccygomimus sanguinipes* (Cresson), *Ephialtes hawaiiensis* (Cameron), *Euderus metallicus* (Ashmead), *Eupelmus*, *Horogenes chilonis* (Cushman), *Perisierola emigrata* Rohwer, *Pristomerus hawaiiensis* Perkins, *Sierola cryptophlebiae* Fullaway, *Sierola koa* Fullaway, *Sierola* species, *Trathala flavo-orbitalis* (Cameron).

In some earlier literature, *Cryptophlebia ombrodelta* (Lower) and *Cryptophlebia carpophaga* Walsingham have been listed as synonyms of this species. However, Dr. Swezey and I demonstrated (1946) that *illepida* and *ombrodelta* are distinct species, and Bradley (1952) has shown that *carpophaga* is the same as *ombrodelta*.

This is a common, widespread, extremely variable species. Its variability led Walsingham to describe two "varieties" and two "species" as new in *Fauna Hawaiiensis*. It is possible that, had more examples been available to Walsingham, he would have described additional forms. I have found a wing expanse range of from 12 to 25 mm., and the great variability in color, pattern, and size may easily lead to confusion. The genitalia, however, display good characters which make positive identification in Hawaii easy. A study of the variations of the moth is desirable.

The larvae are particularly fond of the developing seeds of *Acacia* and destroy large numbers of them. Each larva may eat several seeds and may leave one seed pod and enter another. In addition to feeding on the seeds, the larvae also feed upon the pulp of the pods. Seed production in Hawaiian endemic acacias is considerably reduced by the attacks of this species, and it is sometimes difficult to obtain good seeds for reforestation projects following the depredations of the larvae. Dr. Swezey (1919: 102-105, figs. 1-6) examined 200 pods of *Acacia koa* from a hill above Honolulu, and he found all 473 seeds contained in these pods destroyed. He said that the "trees everywhere blossom profusely, but the growing pods are attacked by the larvae of four different species of Tortricid moths (*Adenoneura rufipennis*, *Enarmonia walsinghami*, *Cryptophlebia vulpes* and *C. illepida*) [These are listed in this text as *Cydia rufipennis* and *C. walsinghamii*; *Cryptophlebia vulpes* is a color form of *illepida*.] The larvae of these moths devour the young growing seeds, traveling from one to another in order to obtain a sufficiency for their nourishment and growth. Sometimes they reach the neighboring seeds of the same pod at the place where a seed has been eaten, proceed to the position of another seed, and then burrow to reach it. Several seeds may be eaten by one larva, the number depending on the size of the growing seeds at the time." The larvae also feed in mango pulp, litchi fruits, and on many other hosts, and the species is the most important pest of macadamia nuts in Hawaii (see Namba, 1957: 284). When feeding upon macadamia fruits, the larvae usually damage only the husks, but their attacks may prevent normal development of the nuts or may permit other organisms to enter through the husk and destroy the kernels. Attacked fruits may produce malformed or undersized nuts. Namba found as many as seven larvae in a single macadamia fruit.

It is possible that some of the records for this species in Hawaii are in error and really refer to the more recently established *Cryptophlebia ombrodelta*.

Dr. Swezey (1908:14), who reported upon the immature stages and habits, described the egg, larva, and pupa. His descriptions have been mostly replaced by the modern work of Namba (1957:284) who discussed the biology and gave a more accurate and extensive description and figures of the larva and pupa. Namba discussed the species in relation to macadamia nut culture. The following details are abstracted and modified from his report. The flat, circular or oval eggs are 0.8 mm. long and have a finely reticulated shell. They are white or ivory when first laid, but after the first day red maculations appear which grow more extensive and then disappear before the eggs hatch. They are laid on the surface of the host fruit, and several may be laid together, in which case they are slightly imbricated. The incubation period of the egg is three to five days. There are five larval instars which occupy 8 to 34 days, with an average of about 16 days. The larvae are whitish and often have a pink tinge. The pupal period ranges from 8 to 12 days. Thus, the egg-to-adult cycle may occupy between 19 and 51 days. Namba found that as many as 367 eggs are laid by a single female, and as many as 128 eggs are laid in one day by one individual. He also reported that mature females lay fertile eggs the same day that they are mated; that only males more than two days old are able to fertilize females; that some females lay fertile eggs up to four days after contact with males; that oviposition, once begun, usually occurs daily; and that the oldest female to oviposit was 11 days old.

I have included Namba's illustrations of the larva and pupa. The reader is referred to his 1957 paper for detailed description. Margaret MacKay (1959:81) gave a brief summary of characters of the larva of some specimens from macadamia nuts from Honolulu which she had examined, and there are certain details which do not agree with Namba's descriptive notes. These may reflect differences of interpretation and descriptive method. Miss MacKay's diagnosis (1959:81) is as follows: length 13 to 14 mm., "spiracle apparently oval; V1s on segment 9 slightly farther apart than or twice as far apart as those on segment 8; SV group on segments 1, 2, and 7 usually 3:3:3 and on 9 a single seta; D2s on segment 8 with no tendency to be either closer together or farther apart than D1s; anal fork absent; crotchets numerous, biordinal or even triordinal, noticeably short laterally on the ventral prolegs, even forming a mesal penellipse on some of the prolegs."

Miss MacKay said that the larva of *Cryptophlebia ombrodelta* had "characters as for *C. illepida* Btlr. but indications of an anal fork on some of the specimens."

Namba reported that the pupa has two transverse rows of stout spines on the dorsal tergites of abdominal segments 2 to 7 and that the spines of the anterior rows are larger than those of the posterior rows of each pair. This is an opposite arrangement to that found on some genera where the spines on the caudal row in each pair are the larger. The tenth abdominal segment has two to five spines dorsad and one on each side of the anal opening. The apices of the wing sheaths extend to the anterior part of abdominal segment 3.

Namba (1957:288) found that the larva on macadamia nuts "often after emerging from the egg... will insert its head back into the egg to eat the contents. Usually the larva crawls away from the egg shell and bores into the husk, but less frequently it bores directly into the husk from within the egg shell.





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Figure 360—Male genitalia of *Cryptophlebia*. Top left, *illepida* (Butler); Oahu (Busck slide 220). Top right and bottom, *ombrodelta* (Lower), from the type of the synonymous *Argyroploce lasiandra* Meyrick (BM slide 7179 Clarke); the top right photograph is of the male structures at the apex of the abdomen; Ceylon.

When the hole is about one-half body length in depth, the first-instar larva forms a shield over the hole and itself with silk and excrement and appears to rest before continuing to bore. It bores directly to the shell [of the nut] and then along the husk next to the shell. If the shell is still soft, it may bore through the shell to the kernel; however, this does not occur until the second or later instars. Sometimes a larva will leave one fruit and enter another." And he noted that "the larva, if it enters the husk in the third or later instars, will

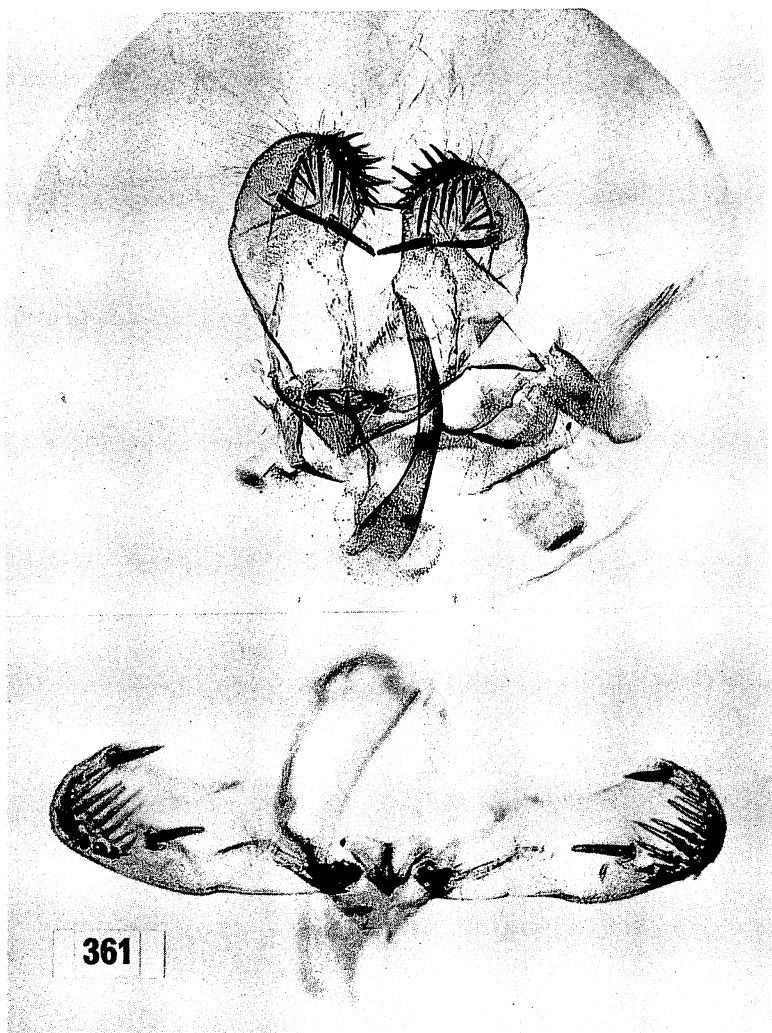


Figure 361—Male genitalia of *Cryptophlebia illepida* (Butler) from an old photograph of the first slide of lepidopterous genitalia made by the author. Bottom, from the holotype of the synonymous color form "*illepida fulva*" Walsingham, Kona, 4,000 feet, Hawaii (BM slide 1890).



Figure 362—Female genitalia of *Cryptophlebia illepida* (Butler); Waianae Mts., 2,000 to 3,000 feet, Oahu (BM slide 1889).

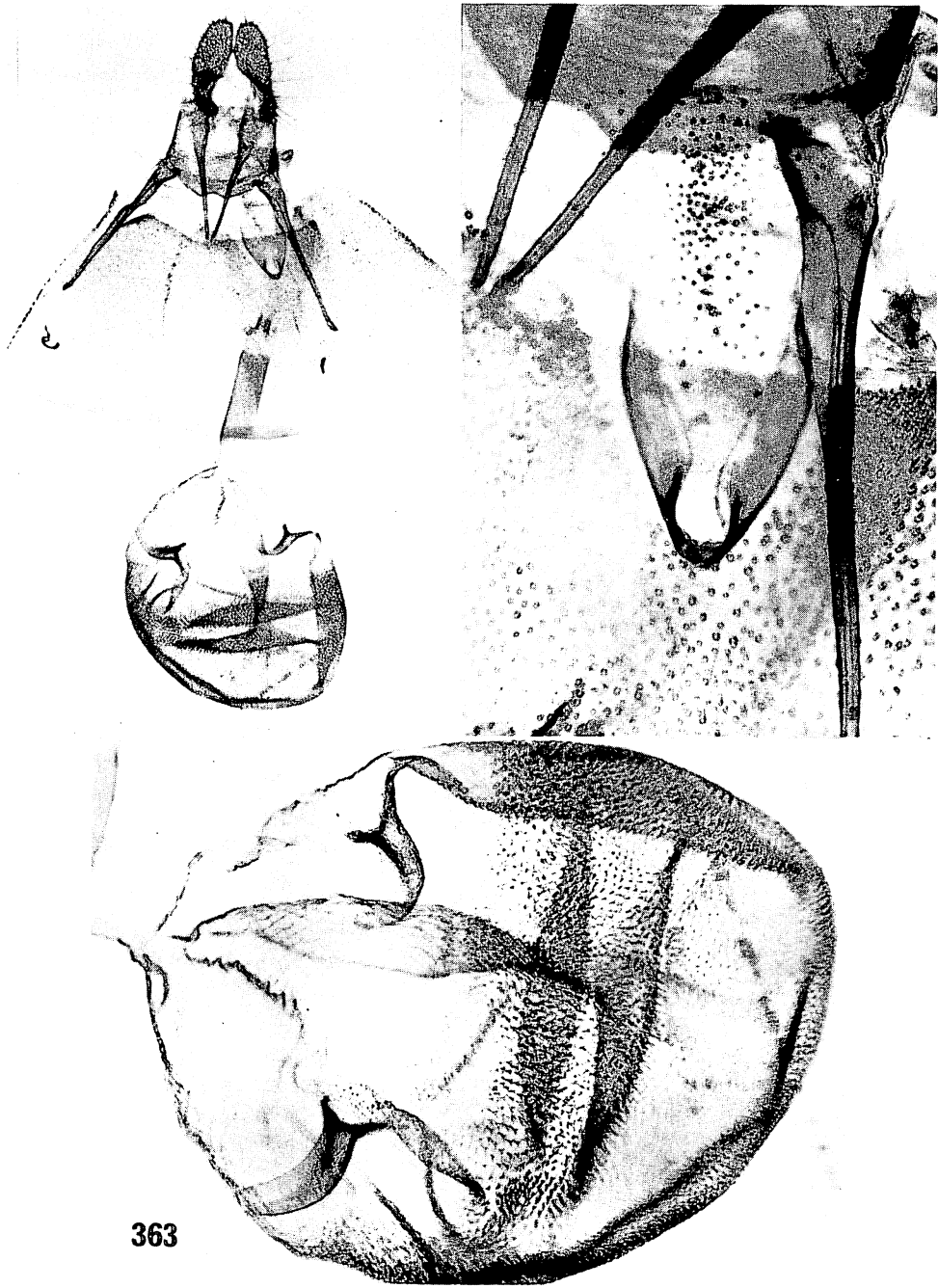


Figure 363—Female genitalia of *Cryptophlebia ombrodelta* (Lower); Queensland, Australia (BM slide 1924).

manifest its presence within the fruit by extruding excrement through the entrance hole of its tunnel. If it enters the husk in the first instar, the hole calluses over with the disappearance of the excrement shield and only a black dot remains." Namba stated further that "as many as seven larvae, a mixture of all instars, have been observed in one fruit. All stages, including the first instar to the pupa, can be found on matured but not-yet-dried-up fallen fruits. The larva does not feed on dried husk; therefore, it must pupate before this condition occurs in order to survive." He continued, "Pupation occurs in the tunnel near an exit hole in the husk. Sometimes, when the husk splits before pupation, the cocoon may be built along one edge of the crack. When the pupa is first formed it is light brown, then gradually becomes darker, and when time for adult emergence it is almost black. The pupa wriggles two-thirds of the way out of the cocoon and extends through the exit hole when nearing eclosion."

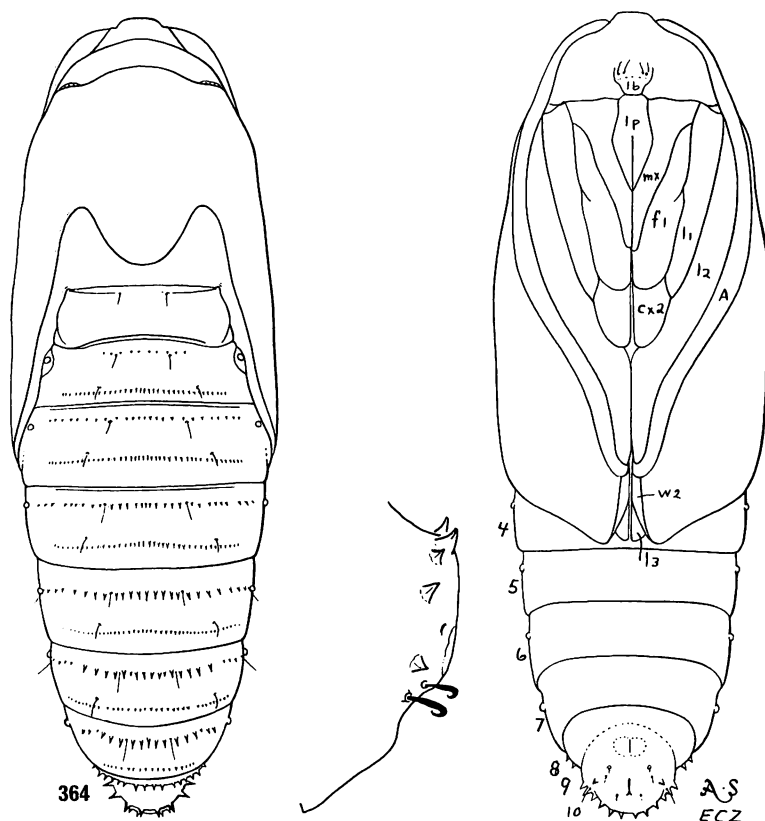


Figure 364—Pupa of *Cryptophlebia illepidia* (Butler); a male from Oahu, length 8.5 mm., with an inset drawing of the cauda in left lateral aspect. A, antenna; Cx2, mesocoxa; f1, profemora; lb, labrum; l1, l2, l3, legs; mx, galea of maxilla (proboscis); W2, hindwing.

**Cryptophlebia ombrodelta** (Lower) (figs. 355, male metatibia; 359, moths; 360, male genitalia; 363, female genitalia; 365, pupa).

*Arotrophora* (?) *ombrodelta* Lower, 1898:48.

*Cryptophlebia ombrodelta* (Lower) Bradley, 1952:682, pl. 24, fig. 1, pl. 25, fig. 1, 1a. Diakonoff, 1957a:139, figs. 11–15, 20, 22, synonymy, bibliography, redescription, discussion.

*Cryptophlebia carpophaga* Walsingham, 1899:106, pl. 7, fig. 1a–d; described from Calcutta. Synonymy by Bradley, 1952:682.

*Argyroplce lasiandra* Meyrick, 1909c:592; described from Ceylon. Synonymy by Clarke, 1958:327.

Meyrick, 1910c:218, incorrectly synonymized this species under *illepida*, which he placed in *Argyroplce*. Some other authors have followed this error, and there are various records in literature under the name *illepida* that belong to *ombrodelta*.

The litchi fruit moth.

Kauai, Oahu, Hawaii.

Immigrant. Widespread from Ceylon and southern India through Malaya, Indonesia, Formosa, the Philippines, Australia (type locality: Sydney), Solomon Islands, and Guam. Probably accidentally introduced to Hawaii from Guam during or soon after the Second World War. First reported from Hawaii by C. J. Davis in 1961 (*Proc. Hawaiian Ent. Soc.* 18:2, 1962), but specimens were taken by J. W. Beardsley in light traps in 1958 (same reference).

Hostplants: *Acacia farnesiana* ("klu"), *Bauhinia* seedpods, *Cassia javanica* × *Cassia fistula* (rainbow shower), *Coccolobis uvifera* (seagrape), *Cocos nucifer* (coconut), *Euphorbia longan*, *Filicium decipiens* (fern tree, Sapindaceae), *Indigofera suffruticosa* (damages terminal stems and seedpods), *Litchi chinensis* (= *Nephelium Litchi*), *Macadamia*, *Phaseolus limensis* (lima bean), *Phaseolus vulgaris* (garden beans), *Pithecolobium dulce*, *Poinciana pulcherrima*, *Poinciana regia*, *Prosopis pallida* ("kiawe" or mesquite) seedpods.

Dr. Swezey (1940c:173) reported upon this species (under the name *Argyroplce carpophaga*) in Guam, as follows: "The larvae fed on the seeds in pods of both pole beans and lima beans. The larvae also destroy a large proportion of the seeds of such leguminous trees as *Pithecolobium dulce*, *Adenanthera pavonina*, *Poinciana regia*, and *Acacia farnesiana*. In two counts made of seeds in

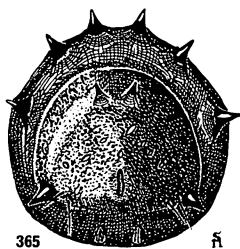


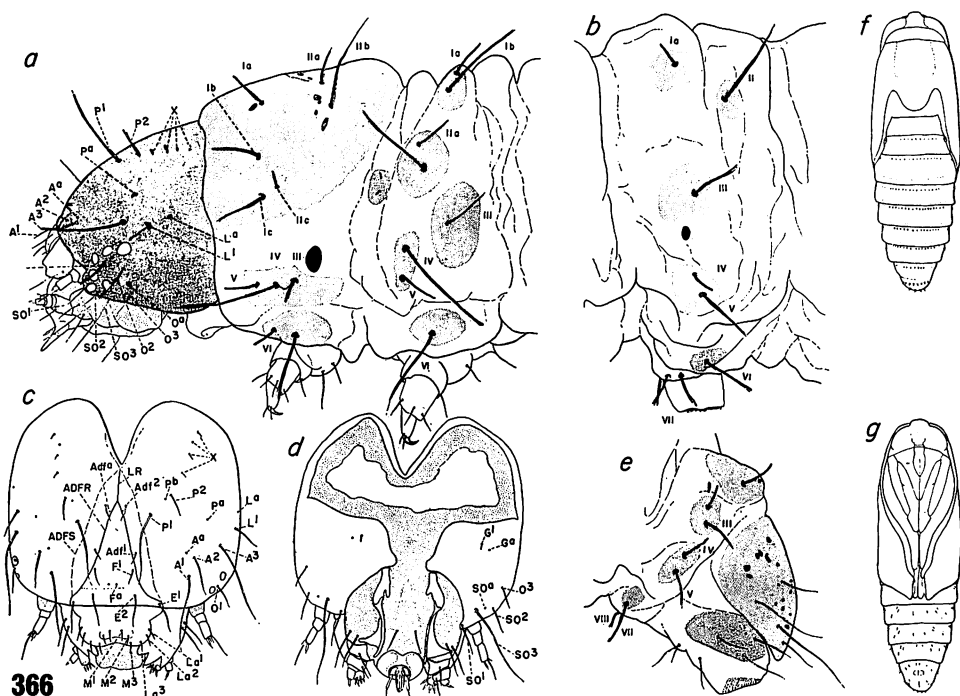
Figure 365—Caudal aspect of a pupa of *Cryptophlebia ombrodelta* (Lower); Pusa, India.

*Adenanthera* pods, 67 per cent and 77 per cent respectively of the seeds were destroyed. In a similar count, 21 per cent of *Poinciana* seeds were destroyed. *Acacia farnesiana* seeds were nearly all eaten."

Diakonoff (1957a:139) considers that it is "apparently of Indian origin", and he lists the following genera of plants which are not mentioned in my details under hostplants above: *Aegle*, *Feronia*, *Parkinsonia*, *Sesbania*, and *Tamarindus*. Bradley (1952:692) also records orange fruit as a host.

Beardsley (*Proc. Hawaiian Ent. Soc.* 19:15, 1965) reported severe damage to young ornamental shade trees of *Cassia* and *Filicium* on Oahu. The larvae bored in and killed numerous young twigs of the hostplants.

J. Nichols (*Proc. Hawaiian Ent. Soc.* 19:20, 1965) found a larva in the stem end of a coconut fruit being mailed from Honolulu to California, and this larval habit may have assisted in the wide dispersal of the moth.



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Figure 366—Larva and pupa of *Cryptophlebia illepida* (Butler). *a*, head, pro- and mesothorax in lateral aspect; *b*, third abdominal segment from left side; *c*, frontal aspect of head; *d*, caudal view of head (removed from body); *e*, left lateral aspect of abdominal segments 9 and 10; *f* and *g*, dorsal and lateral aspects of pupa. (After Namba, 1957.)

Margaret MacKay (1959:81) reported that the larvae she had examined were much like those of *Cryptophlebia illepida*, but that on some larvae she found indications of an anal fork, which structure is missing from the larva of *illepida*.

It would appear that this newly established moth may become a pest in Hawaii.

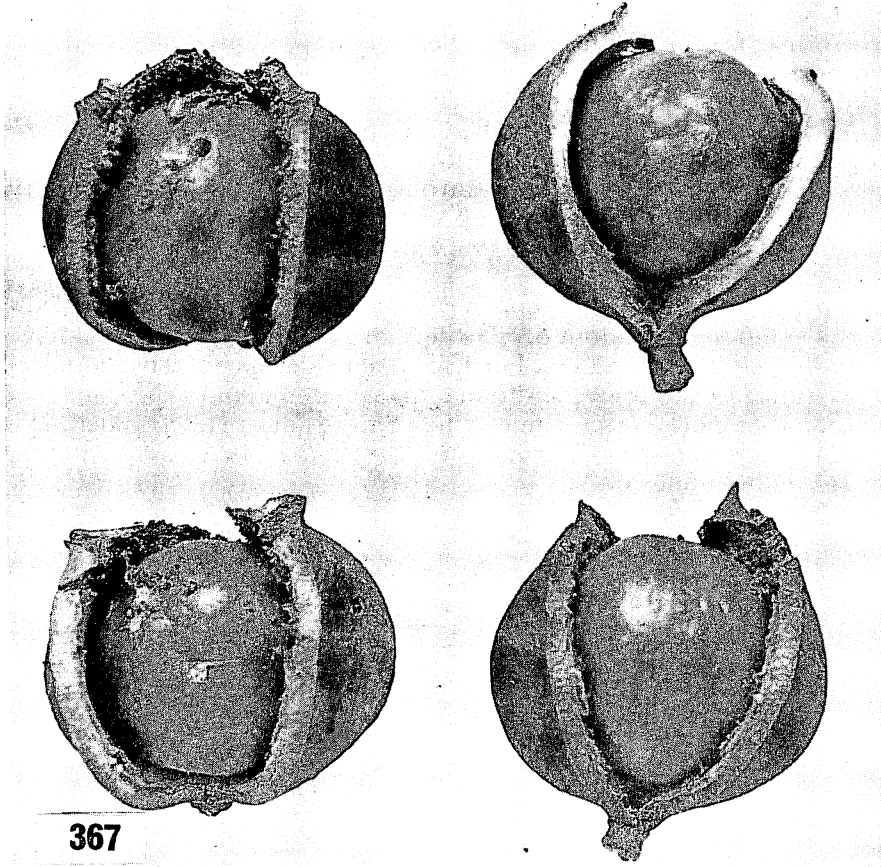


Figure 367—Macadamia nuts showing evidence of attack by the larvae of *Cryptophlebia illepida* (Butler); Honolulu. (University of Hawaii photograph.)



Genus **MACRAESTHETICA** Meyrick

*Macraesthetica* Meyrick, 1932:256. Type-species: *Tortrix rubiginis* Walsingham, by monotypy.

This monotypic genus has escaped the notice of Hawaiian entomologists, for it does not appear in their named collections or literature. The wing venation is similar to that of *Cryptophlebia*, but the unusual male genitalia make this a distinctive group in Hawaii. Its relationships and status require further elucidation. Meyrick placed the genus in the "Tortricidae", but it should be placed with the Olethreutinae. [Since this manuscript was written, Clarke, 1958:476, has transferred it to the "Olethreutidae".]

**Macraesthetica rubiginis** (Walsingham) (figs. 368, head, wing venation; 369, moths; 370, male genitalia).

*Tortrix rubiginis* Walsingham, 1907*b*:702, pl. 11, fig. 24.

*Eulia rubiginis* (Walsingham) Meyrick, 1913*b*:38.

*Macraesthetica rubiginis* (Walsingham) Meyrick, 1932:256. Clarke, 1958:476, pl. 237.

Endemic? Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

This moth was described from one female specimen (which has lost its abdomen), and it has seldom been collected. Fortunately, we now know the male with its singular genitalia, but I have not examined a female abdomen.

I regret that I cannot give additional information about this strange moth. I do not know whence it has come or to what it is most closely allied. Does it belong in association with *Olethreutes* and *Argyroplote*? Is it really an endemic insect or is it an immigrant?



Figure 368—*Macraesthetica rubiginis* (Walsingham). Head of a specimen from the northwest Koolau Mts., Oahu. Wings of the male holotype (BM slide 9603 Clarke); Waianae Mts., Oahu.

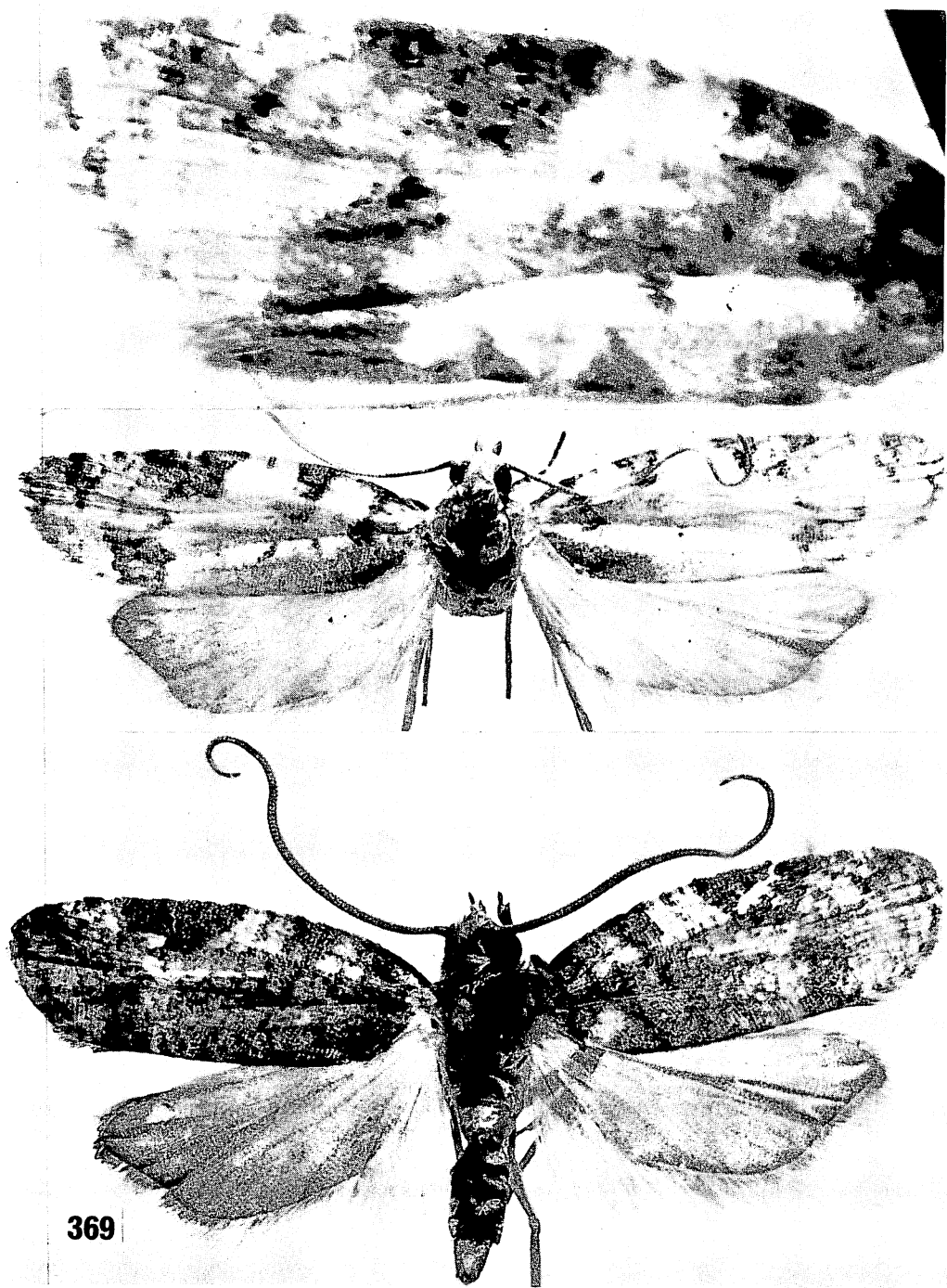


Figure 369—*Macraesthetica rubigenis* (Walsingham). Top, left forewing of the holotype male (BM slide 9603 Clarke); Waianae Mts., Oahu; length 7.5 mm. Middle, a female from the northwest Koolau Mts., Oahu (abdomen lost); expanse 17.5 mm. Bottom, a male from the Koolau Mts., Oahu; expanse 14 mm. Note the difference in the thickness of the antennae in the two sexes.

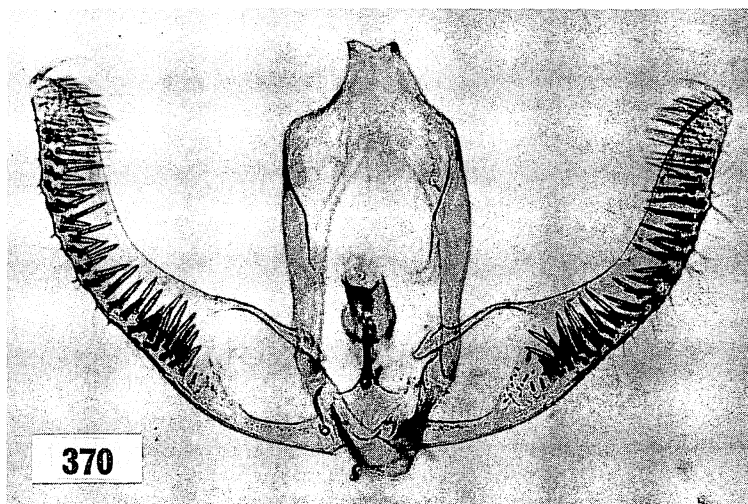


Figure 370—Male genitalia of *Macraesthetica rubigenis* (Walsingham), holotype (BM slide 9603; Clarke); Waianae Mts., Oahu.

#### Genus **CYDIA** Hübner

*Cydia* Hübner, 1825(1816-1826):375. Type-species: *Phalaena Tinea Pomonella* Linnaeus, 1758:538. Walsingham, 1897*b*:130. Genitalia figured by Pierce and Metcalfe, 1922:82, pl. 28, and by Heinrich, 1926:70, figs. 37, 169, 329.

*Laspeyresia* Hübner, 1825(1816-1826):381. Type-species: *Laspeyresia corollana* Hübner. Genitalia figured by Pierce and Metcalfe, 1922:92, pl. 32. Head, wings and genitalia figured by Obraztsov, 1959:175, figs. 26–28.

*Carpocapsa* Treitschke, 1829:160. Type-species: *Phalaena Tinea Pomonella*. Heinrich, 1926:69.

*Endopisa* Guenée, 1845*a*:182. Type-species: *Pyralis nigricana* Stephens.

*Cerata* Stephens, 1852:77. Type-species: *Penthina servillana* Duponchel.

*Adenoneura* Walsingham, 1907*b*:677. Type-species: *Adenoneura falsifalcellum* Walsingham, by original designation. **New synonym.**

Obraztsov, 1959:175, extensive synonymy and redescription.

There has been much confusion and extensive debate concerning the name to use for this genus. Most workers now use *Cydia*, although Obraztsov used *Laspeyresia* in his major Palearctic monograph (1959:175), and I had been inclined to follow him. *Laspeyresia* Hübner is held to be a homonym of *Laspeyresia* “R.L.” (Jena. Allg. Lit. Zeitung 1:288, 1817; reference not seen by me) which is either an unjustified emendation or an erroneous spelling for *Laspeyria* Germar, 1811. Under the Code of Nomenclature, Article 33(a) ii, the *Laspeyresia* of “R.L.” (whoever that may be) “has status in nomenclature” and thus

has precedence over Hübner's *Laspeyresia*. One might hold the view that the emended or erroneously spelled name of "R.L." should be considered stillborn, and that it should not effect the use of Hübner's *Laspeyresia*.

Walsingham's *Adenoneura* was based upon a secondary sexual character, and that name must fall as a synonym of *Cydia*. The Hawaiian species of *Cydia* that have the sex pouch on the hindwing of the male were placed in *Adenoneura* by Walsingham, and he placed the two species known to him which lack the sex pouch in *Enarmonia*. When he knew only the female, he could not decide under which name to place the species; therefore, he placed several species known only from the females into "*Enarmonia* (?)".

In Hawaii, *Cydia* forms a complex of many closely allied, mostly poorly understood species. Numerous species probably remain to be described. There is great variation in color and pattern in some of the species. Elsewhere the genus includes species of paramount economic importance and, of these, *Cydia pomonella* (Linnaeus) (*Carpocapsa*, *Laspeyresia*) is the most notorious. It is the widely distributed, well-known pest, the codling moth (a codling is a kind of European apple used for cooking purposes). Many species of *Cydia*, including the widespread pea moth pest, *Cydia nigricana* (Stephens), attack legumes such as peas and alfalfa (lucerne); some attack fruits and nuts; and others attack conifers and a wide variety of other plants. For an extensive review of some of the well-known pest species, see Bovey in Balachowsky et al., 1966:632:738.

The males of most of the described Hawaiian species have a peculiar, strongly developed "pocket" or sex pouch that extends conspicuously below the ventral surface of the hindwing; it opens through a long slit in the dorsal

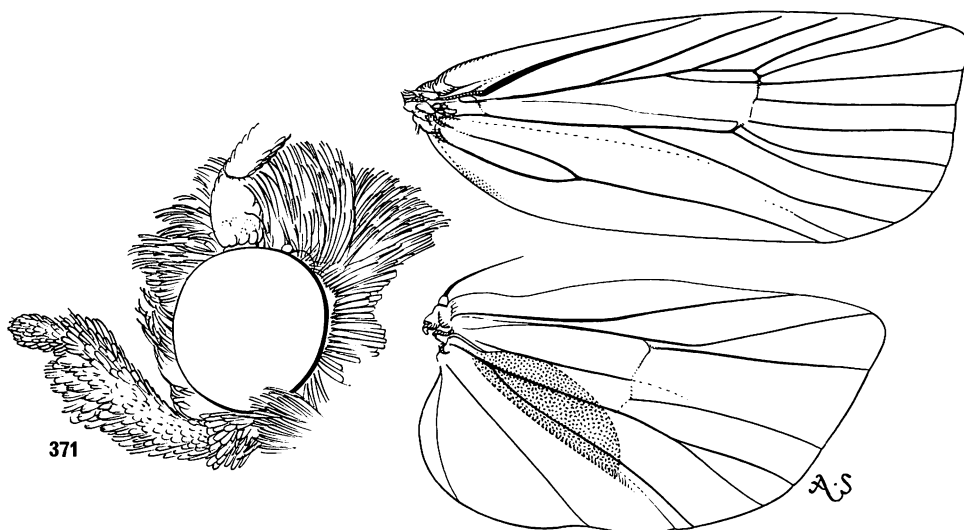


Figure 371—Head and wing venation of *Cydia falsifalcella* (Walsingham), holotype male (BM slide 2051); Olaa, 2,000 feet, Hawaii. The stippled area in the hindwing indicates the large male sex pouch which extends beneath the wing. Compare the paratype in figure 373.

surface of the wing near vein 2, as is shown in the drawings of the wings of several of the species herewith (figures 371–375). The pouch encloses a mass of long hairs and scales, and it is presumed to function as a scent-disseminating structure. It is strange that this is not a constant feature of all Hawaiian species, but some of them lack the pouch. I have examined the males of 10 of the 13 described species of Hawaiian *Cydia*, and, of these, the males of *crassicornis* and *walsinghamii* lack the pouch which is present on *conspicua*, *falsifalcella*, *gypsograptia*, *latifemoris*, *montana*, *parapteryx*, *plicata*, *rufipennis*, and new species 1. I have not seen the males of *chlorostola*, *obliqua*, and *storeella*. It is noteworthy that on the males of those species which do have the pouch, vein 2 leaves the cell farther basad than it does on the species which lack the pouch (see my illustrations). The North American *Melissopus* Riley has a similar but less-developed pouch, but is *Melissopus* really a different genus?

There are obvious differences in the genitalia, but they are not clearly shown in all of my illustrations. The details require drawings from various aspects when the dissections are in fluid, because various features become difficult or impossible to see on single microscope slide mounts.

There are probably many species remaining to be found in Hawaii, and we have only begun to study the group. It would appear that the genus came to Hawaii from the Holarctic, and I would guess that it came from the Palaearctic. The genitalia of some Hawaiian species are quite similar to those of the widespread European pea moth, *Cydia nigricana* (Stephens).

Specimens of *Cydia* have been collected on all of the main islands except Molokai and Lanai. The genus no doubt occurs on those islands also, and it is strange that we have no records from them. According to type locality, Kauai has one species; Oahu, four; Maui, four; and Hawaii, five, with one of these shared in type locality with Maui (because the male type is from Hawaii and the female is from Maui). One species is supposed to be distributed over

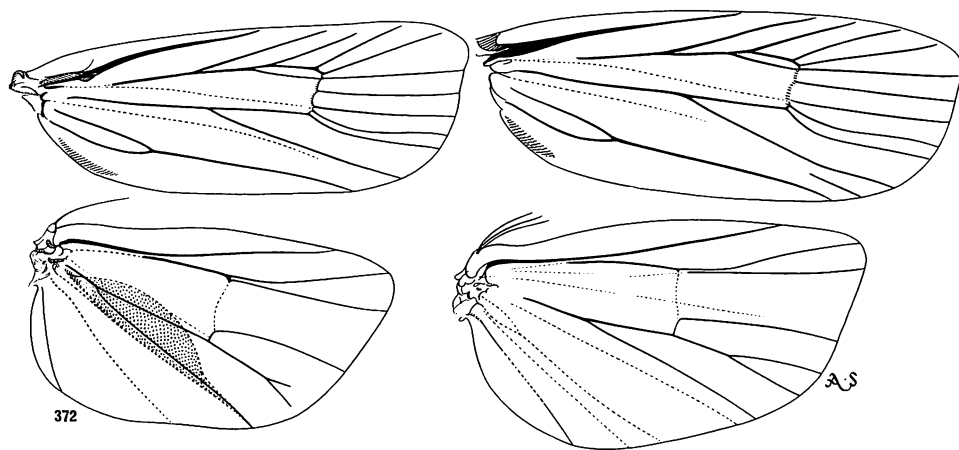


Figure 372—*Cydia conspicua* (Walsingham), wing venation of the male (slide Z-XII-62-4), Kahanaiki, Oahu, and the female (slide Z-XII-62-5), Mt. Tantalus, Oahu.

Kauai, Oahu, Maui, and Hawaii, but the records may be partly in error. Two species are found on both of the adjacent islands of Maui and Hawaii; one species shares the adjacent islands of Kauai and Oahu; and one, Oahu and Maui. The other eight species have each been found on one island only.

The hostplants of five species are unknown, but all the known hostplants, including *Acacia koa*, *Acacia koaia*, *Sophora*, *Canavalia* and *Strongylodon*, are Leguminosae. It will be interesting to learn whether all of the Hawaiian *Cydia* species are attached to Leguminosae. It would appear that the ancestor which gave rise to the Hawaiian complex was a legume-eater.

Meyrick, 1932:222, said "Some mental confusion is probably responsible for Lord Walsingham's use of his generic name *Adenoneura* as neuter, which is grammatically impossible. Walsingham's *marcidella*, placed doubtfully in [*Enarmonia*], is really referable to *Crociosema*; on the other hand his *conspicua*, placed doubtfully in *Enarmonia*, is truly referable to *Adenonenra* [*sic*], and I think probably also *storeella* and *obliqua*."

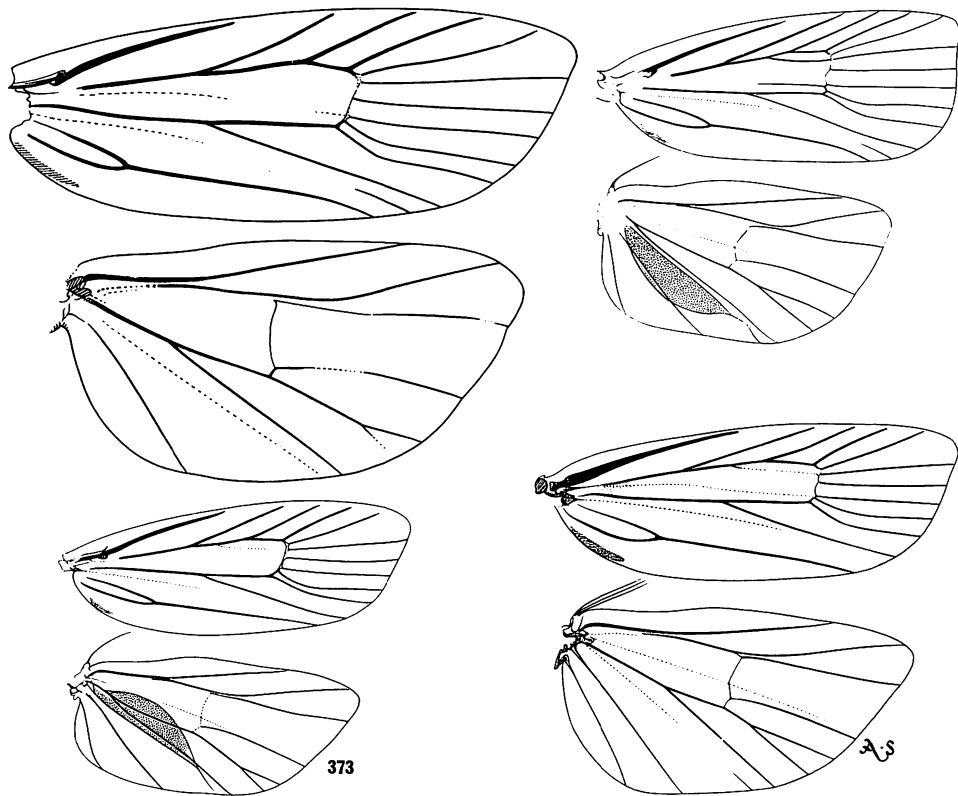


Figure 373—Wing venations of *Cydia*. Top left, *crassicornis* (Walsingham), paratype (BM slide 8038); Kona, 4,000 feet; this is a male, but it lacks a sex pouch on the hindwing. Top right, *falsifalcella* (Walsingham), paratype (BM slide 7530); Olaa, 2,000 feet, Hawaii; compare figure 371 of the holotype. Bottom left, *montana* (Walsingham), paratype (BM slide 7531); Kilauea, Hawaii. Bottom right, *latifemoris* (Walsingham), holotype female (BM slide 2054); Haleakala Crater, Maui.

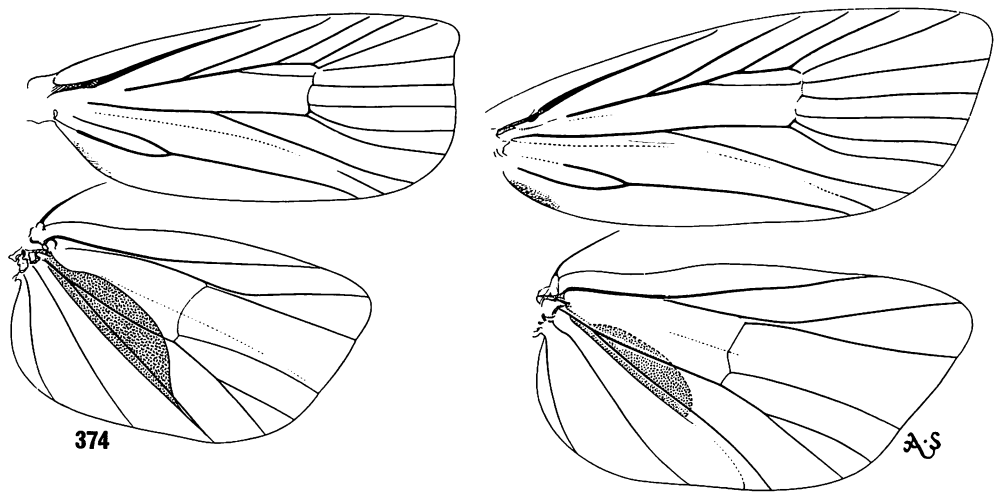


Figure 374—Wing venations of *Cydia*. Left, *parapteryx* (Meyrick), paratype (BM slide 7532); Honolulu. Right, *plicata* (Walsingham), paratype (BM slide 7570); summit crater of Mt. Hualalai, Kona, 8,000 feet, Hawaii.

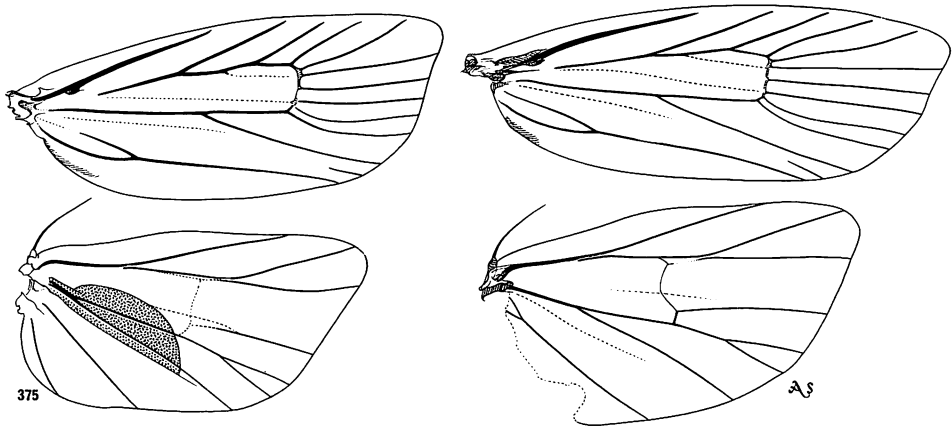


Figure 375—Wing venations of *Cydia*. Left, *rufipennis* (Walsingham), Lihue, 4,000 feet, Kauai (BM slide 2058). Right, *walsinghamii* (Butler), Kilauea, Hawaii (BM slide 1892). Note that this male lacks a sex pouch on the hindwing. These specimens were determined by Walsingham.

The inadequate material available for study and the unknown range of variability in this variable group make it unwise now to attempt to present a key (which might easily lead to confusion), and I refer my readers to the illustrations and the text for details which should assist in the identification of the described species. This is not an easy group to understand.

See color plate 2, figures 7, 8.

**Cydia chlorostola** (Meyrick), **new combination** (figs. 378, moth; 389, female genitalia).

*Laspeyresia chlorostola* Meyrick, 1932:226.

Endemic. Oahu (type locality: Waialua).

Hostplant: unknown.

This moth was described from one female collected by Perkins in 1909. Meyrick said, "This species is almost certainly introduced with some leguminous plant, and is probably of Asiatic origin, but is not at present known to me elsewhere." I believe that Meyrick was wrong and, until more definite evidence to the contrary is obtained, I shall consider this to be an endemic species.

**Cydia conspicua** (Walsingham), **new combination** (figs. 372, wing venation; 376, pupa; moth; 385, male genitalia; 390–391, female genitalia).

*Enarmonia* (?) *conspicua* Walsingham, 1907a:684, pl. 10, fig. 28.

*Adenoneura conspicua* (Walsingham) Meyrick, 1928c:98; 1932:222.

Endemic. Oahu, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: *Acacia koa*.

Parasite: *Pristomerus hawaiiensis* Perkins.

Dr. Swezey told me that he had bred this species from larvae which he had taken from dead bark and seeds of *Acacia koa* on Oahu and Maui. Only the female holotype was known to Walsingham.

The caudal segment of the pupa, in caudal view, has a corona of seven or eight conical spirelike processes.



Figure 376—Details of the cauda of the pupa of *Cydia conspicua* (Walsingham); Kahanaiki, Oahu. Determined by Meyrick.

**Cydia crassicornis** (Walsingham), **new combination** (figs. 373, wing venation; 378, moth; 384, male genitalia).

*Enarmonia crassicornis* Walsingham, 1907b:685, pl. 11, fig. 2.

Endemic. Hawaii (type locality: Kona, above 4,000 feet).

Hostplant: unknown.

This is one of the two described Hawaiian species that lack the sex pouch beneath the hindwing of the male (other undescribed species also lack the pouch); compare *walsinghamii*. I have not seen the female.



***Cydia falsifalcella*** (Walsingham), **new combination** (figs. 371, head, wing venation; 373, wing venation; 379, moth; 384, male genitalia).  
*Adenoneura falsifalcellum* Walsingham, 1907b:677, pl. 10, fig. 17.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: unknown.

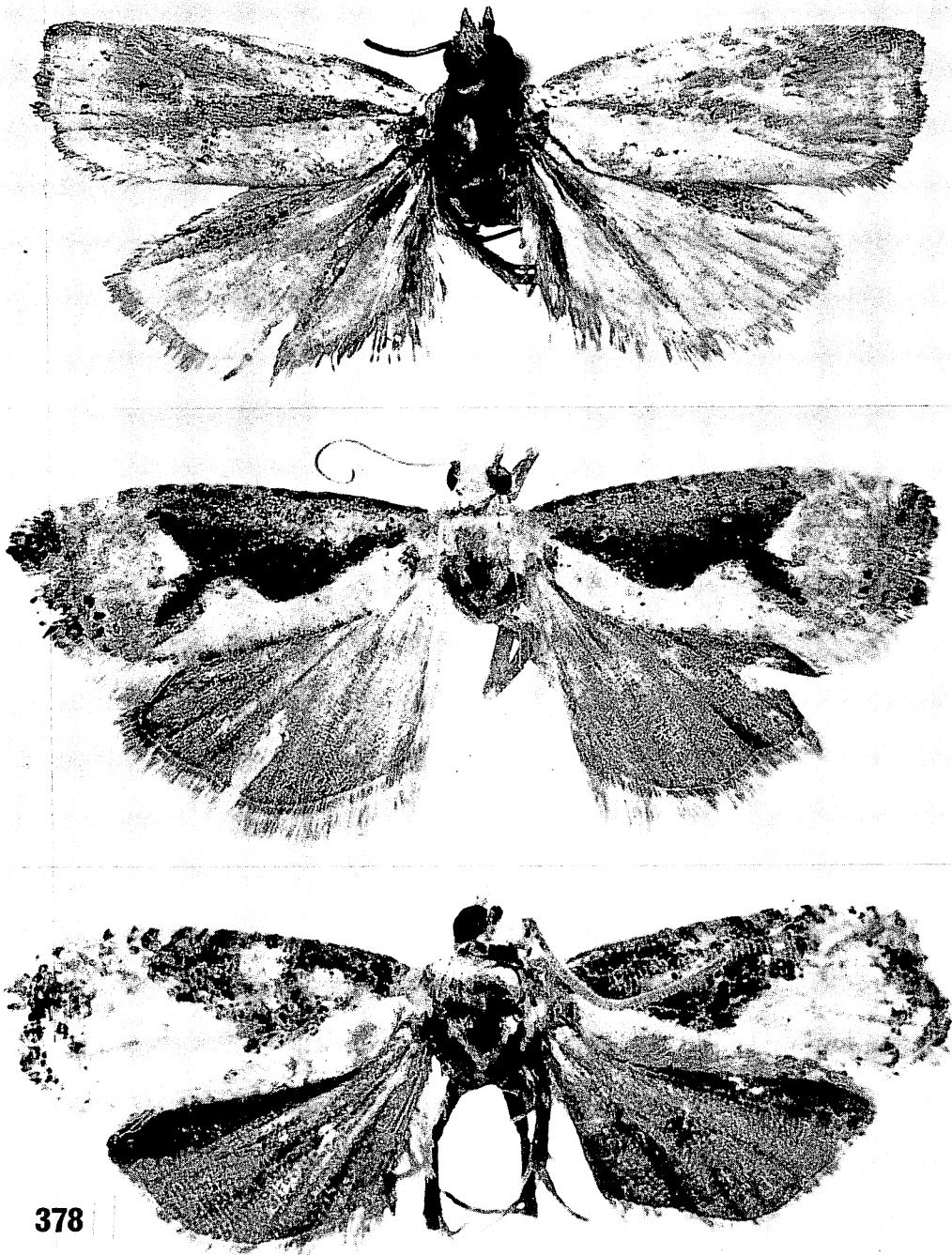
Nothing is known regarding the habits of this species, and the records on distribution and hostplants previously published under this name by Perkins and Swezey apply to *parapteryx*.

This species is closely similar in external appearance to *parapteryx*, and it may be the Hawaii representative of that species. See the commentary under *parapteryx*.

I regret that I have not seen and cannot illustrate the female.



Figure 377—*Acacia koia*, showing the results of a heavy infestation by a new species of *Cydia*. Almost all the defoliated twigs had emergence holes, and 50 to 75 percent of the crowns of some trees were infested at the *Acacia koia* sanctuary on the Kohala Road, 3,500 feet, Hawaii, in February, 1965, according to C. J. Davis who took this photograph.



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Figure 378—*Cydia*. Top, *chlorostola* (Meyrick), holotype female (BM slide 9546); Waialua, Oahu; expanse 15 mm. This is an unusual, very pale yellowish, nearly white species. Middle, *conspicua* (Walsingham), holotype female (BM slide 2052); Haleakala, 5,000 feet, Maui; expanse 18 mm. Bottom, *crassicornis* (Walsingham), holotype male (BM slide 1880); Kona, over 4,000 feet, Hawaii; forewing 5.5 mm.

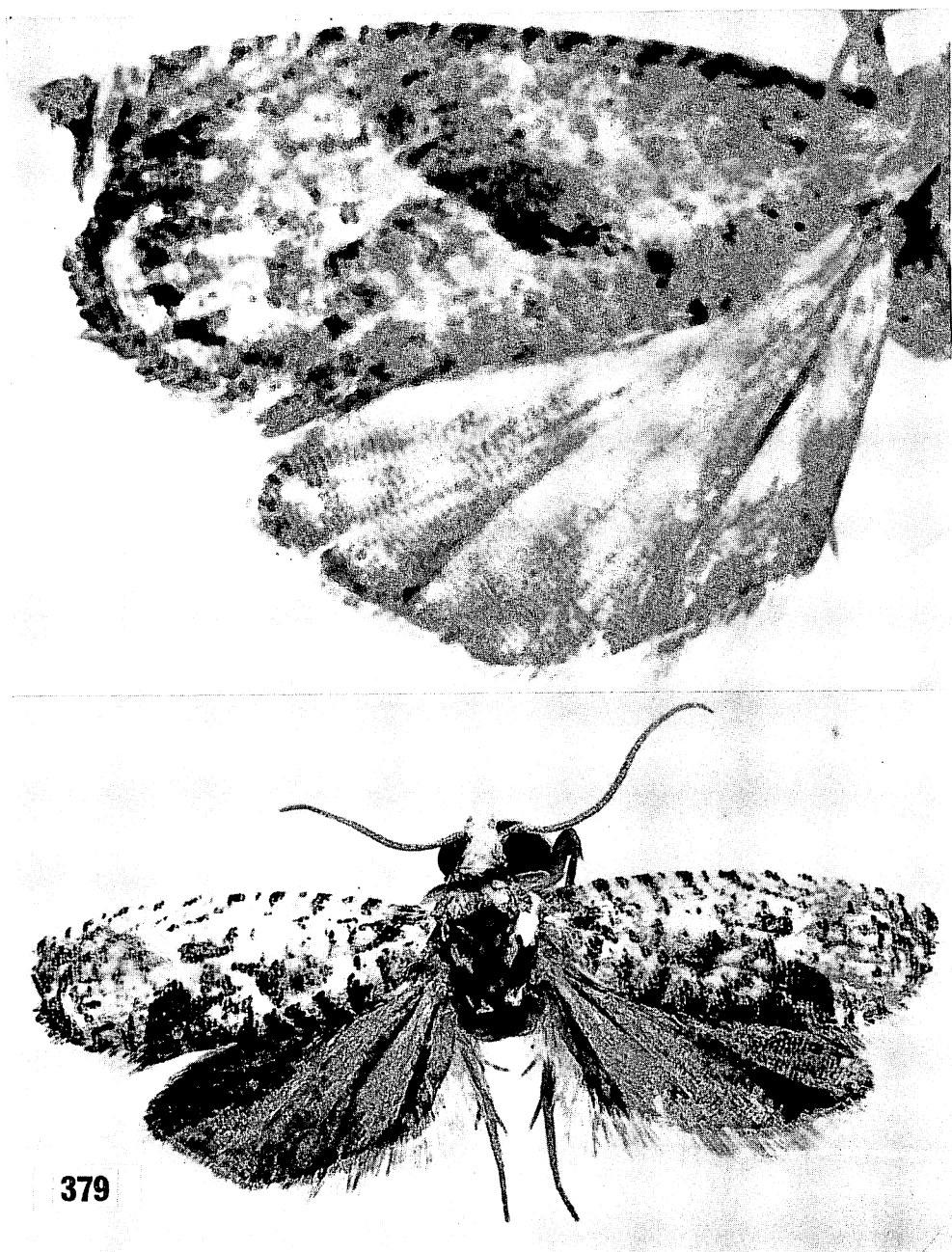


Figure 379—*Cydia*. Top, *falsifalcella* (Walsingham), holotype male (BM slide 2051); Oloa, Hawaii; forewing 9 mm. On some examples the entire area basad of the oblique dark fascia at mid-wing is dark scaled. Bottom, *gypsograptia* (Meyrick), holotype male (BM slide 9543); Honolulu, Oahu; expanse 13 mm.

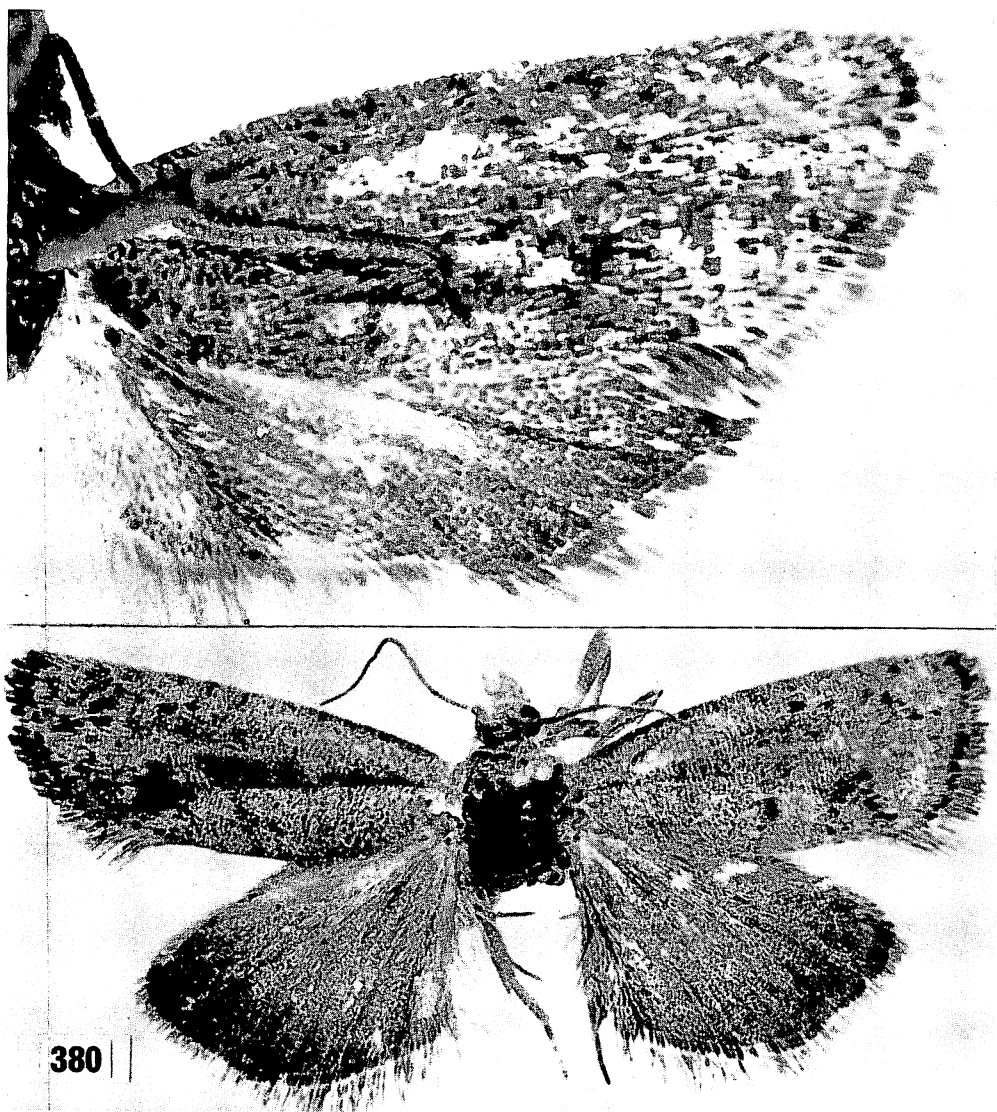


Figure 380—*Cydia latifemoris* (Walsingham). Top, allotype male (BM slide 2053); summit of the crater of Hualalai, 8,000 feet, Hawaii; forewing 6 mm. Bottom, holotype female (BM slide 2054); Haleakala Crater, Maui; forewing 7 mm.

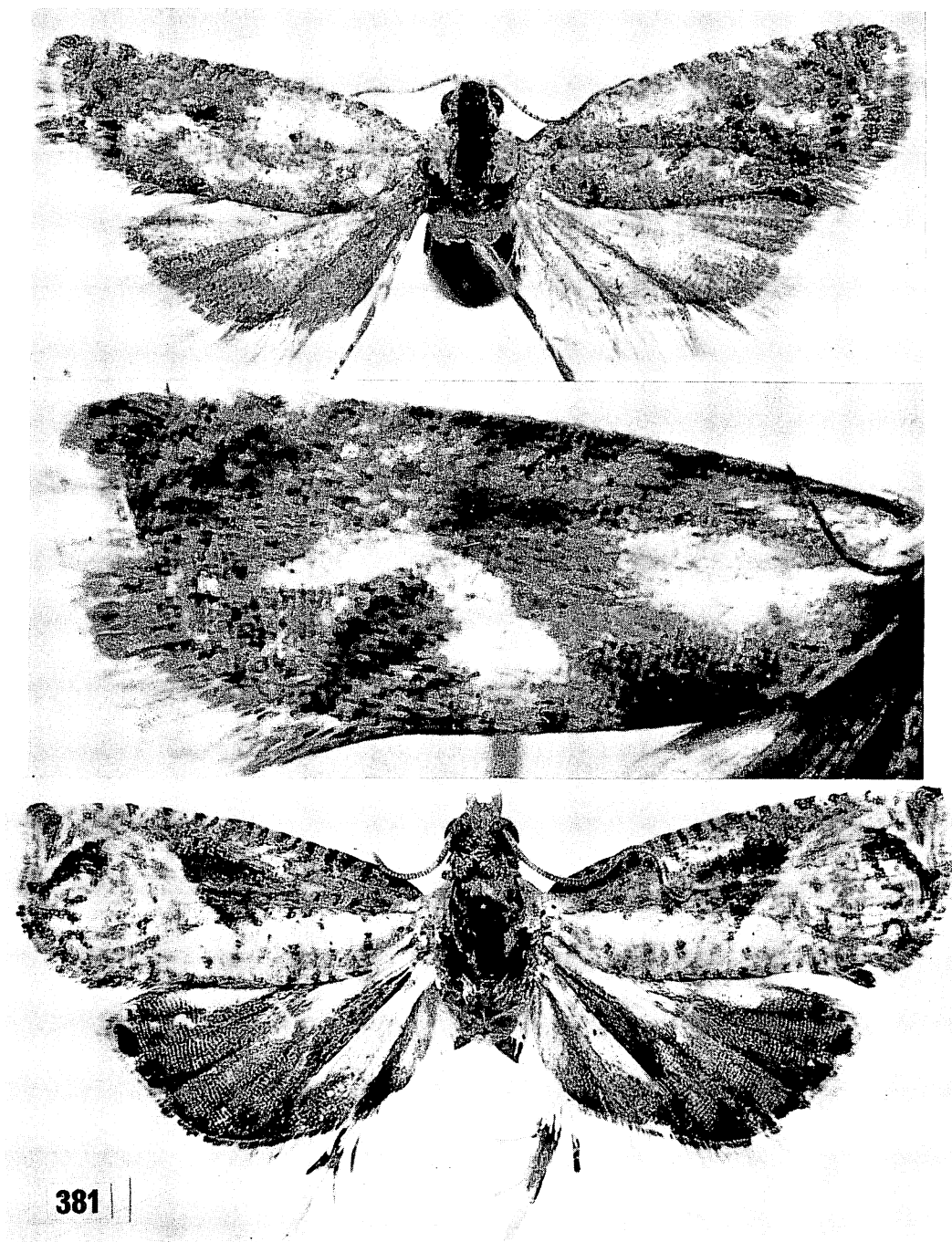


Figure 381—*Cydia*. Top, *montana* (Walsingham), allotype female (abdomen lost); Kona, 4,000 feet, Hawaii; expanse 10.5 mm. Middle, *obliqua* (Walsingham), holotype female (BM slide 1882); Hualalai, Kona, 5,000 feet, Hawaii; forewing 7 mm. Bottom, *parapteryx* (Meyrick), lectotype (BM slide 9544 Clarke); Honolulu, Oahu; expanse 19 mm.

**Cydia gypsograpt** (Meyrick), **new combination** (figs. 379, moth; 384, male genitalia).

*Adenoneura gypsograpt* Meyrick, 1932:222.

Endemic. Oahu (type locality: Honolulu).

Hostplant: unknown.

Only the male holotype is known.

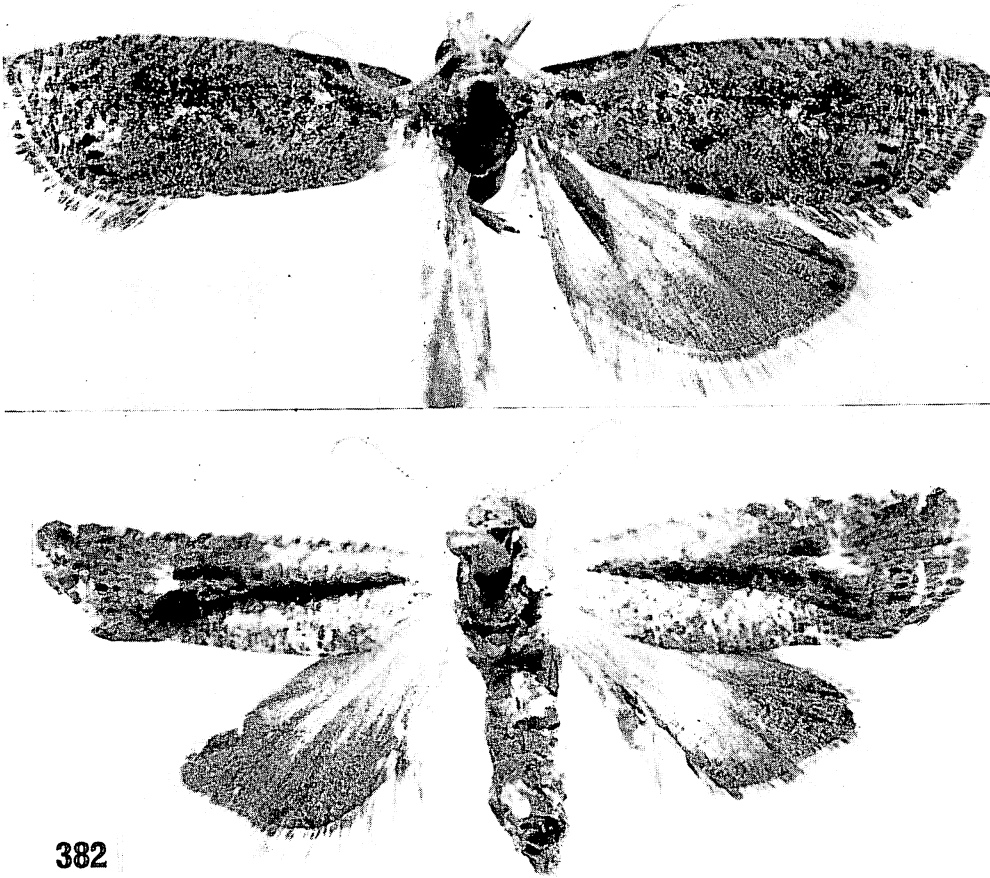


Figure 382—*Cydia*. Top, *plicata* (Walsingham), holotype male (note the sex pouch showing on the hindwing) (BM slide 1885); Kona, 4,000 feet, Hawaii; expanse 15.5 mm. Bottom, *rufipennis* (Butler), holotype female (not dissected); Oahu (Blackburn numbers 81.7 109); expanse 9 mm. One may consider from these photographs that these two species are closely similar, but *rufipennis* appears to be a diminutive *plicata* in superficial appearance—note the great difference in size. Compare the illustrations of the genitalia on figures 387 and 388.



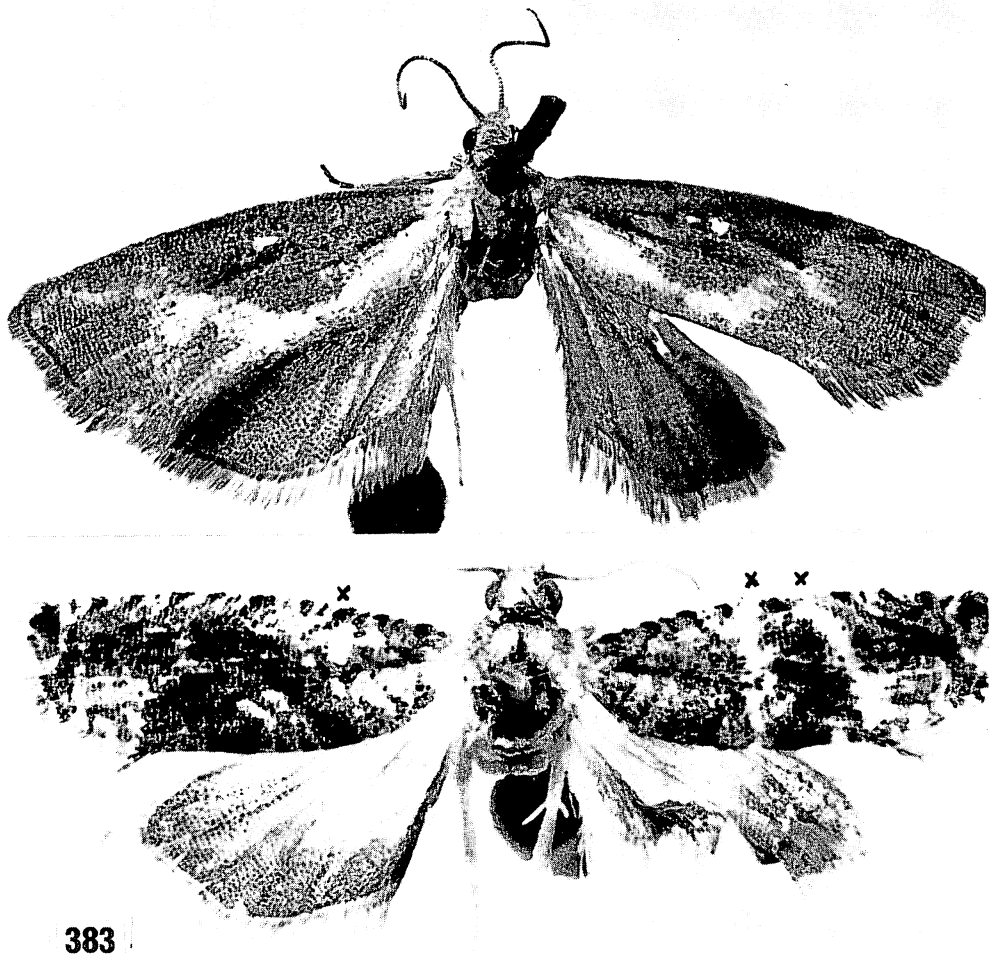
***Cydia latifemoris*** (Walsingham), **new combination** (figs. 373, wing venation; 380, moths 385, male genitalia; 392, female genitalia).  
*Adenoneura latifemoris* Walsingham, 1907b:679, pl. 10, fig. 17.

Endemic. Maui (type locality of the female: Haleakala crater), Hawaii (type locality of the male: Hualalai, summit of crater, 8,000 feet).

Hostplant: *Sophora chrysophylla*.

Dr. Swezey found that the larvae may destroy nearly one-half of the seed crop of *Sophora*.

Further study of specimens from Maui and Hawaii is required to make certain that the male and female types represent the same species.



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Figure 383—*Cydia*. Top, *storeella* (Walsingham), holotype female (BM slide 1881); Haleakala, 5,000 feet, Maui; expanse 13 mm. Bottom, *walsinghamii* (Butler), holotype female (BM slide 3756); near Honolulu; expanse 11.5 mm. The "X" marks indicate abraded areas which appear as a white macula on the left forewing and as two white fascia on the right forewing. This specimen was originally determined to be a male, but it is a female.

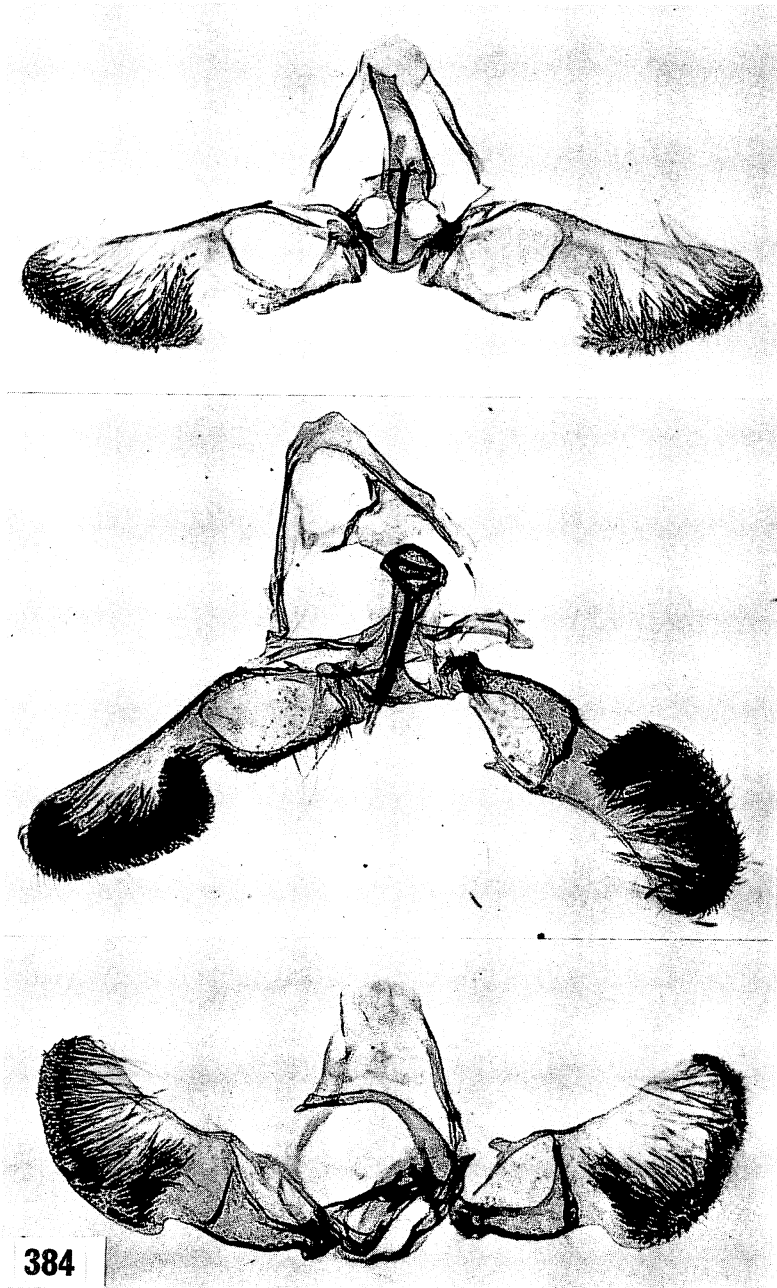
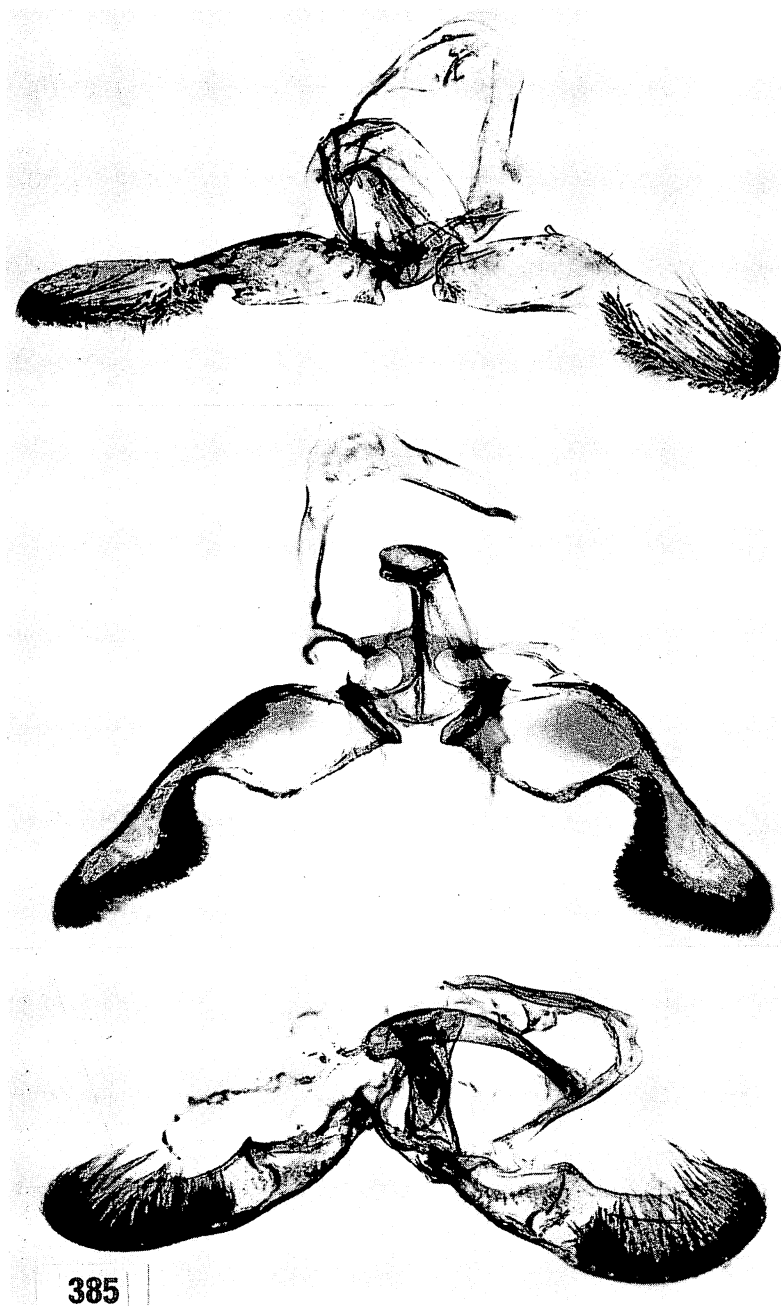


Figure 384—Male genitalia of *Cydia*. Top, *crassicornis* (Walsingham), holotype (BM slide 1880); Kona, above 4,000 feet, Hawaii. Middle, *falsifalcella* (Walsingham), holotype (BM slide 2051); Olaa, Hawaii (right valva turned over). Bottom, *gypsograpt* (Meyrick), holotype (BM slide 9543 Clarke); Honolulu.





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Figure 385—Male genitalia of *Cydia*. Top, *montana* (Walsingham), holotype (BM slide 2055); Kilauea, Hawaii; left valva twisted and broken. Middle, *latifemoris* (Walsingham), allotype (BM slide 2053), summit of crater of Mt. Hualalai, Hawaii; aedeagus out of focus and left valva twisted. Bottom, *conspicua* (Walsingham), determined by Dr. Swezey; Kahauiki, Oahu (slide Z-XII-62-4). Note the emarginate uncus and compare the other species.

**Cydia montana** (Walsingham), **new combination** (figs. 373, wing venation; 381, moth; 385, male genitalia; 393, female genitalia).

*Adenoneura montanum* Walsingham, 1907b:679, pl. 10, fig. 21.

Endemic. Hawaii (type locality: Kilauea, male; Kona, 4,000 feet, female).

Hostplant: *Sophora chrysophylla*.

The larvae feed upon the seeds of the hostplant.

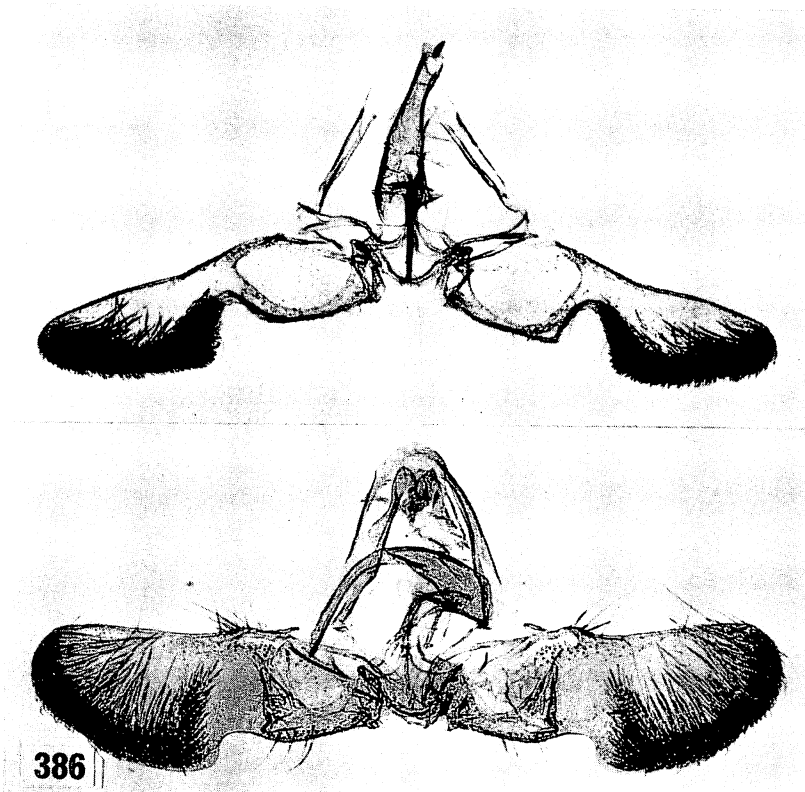


Figure 386—Male genitalia of *Cydia*. Top, *parapteryx* (Meyrick), lectotype (BM slide 9544 Clarke); Honolulu. Bottom, new species 1 (slide Z-II-27-65); Kawaihae Uka, Hawaii; reared from *Acacia koaia* twigs by C. J. Davis.

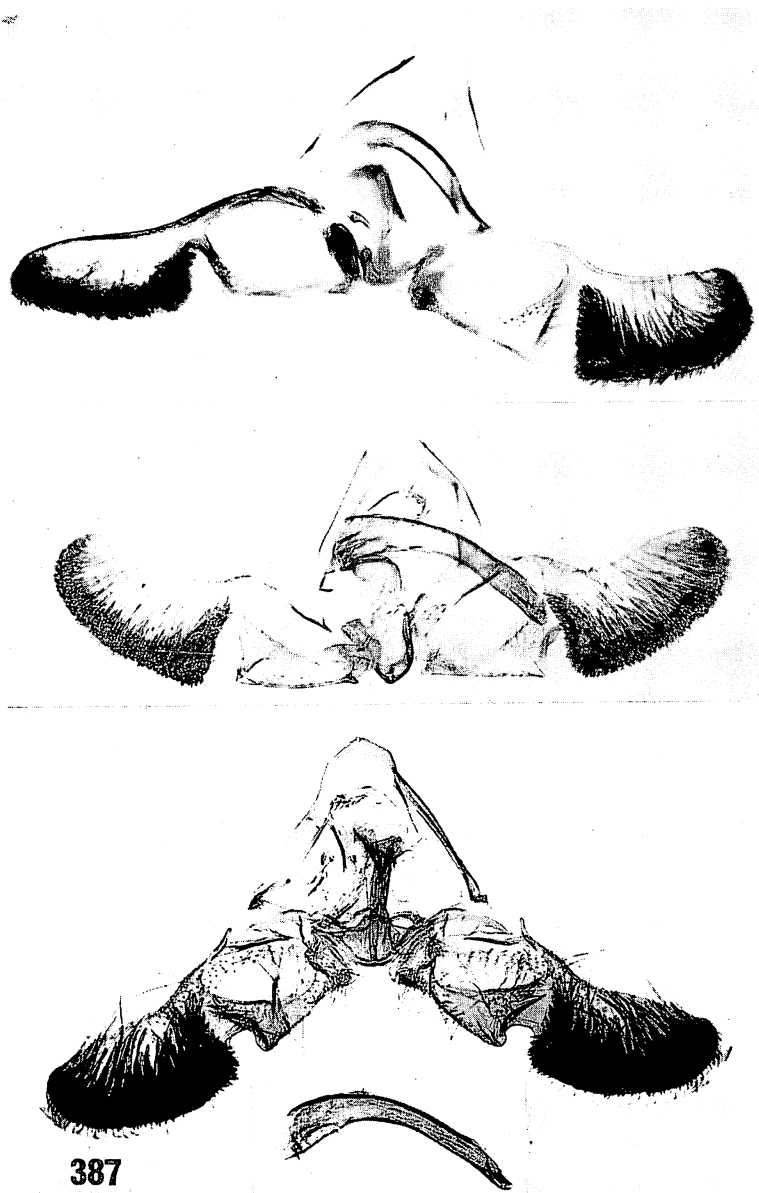
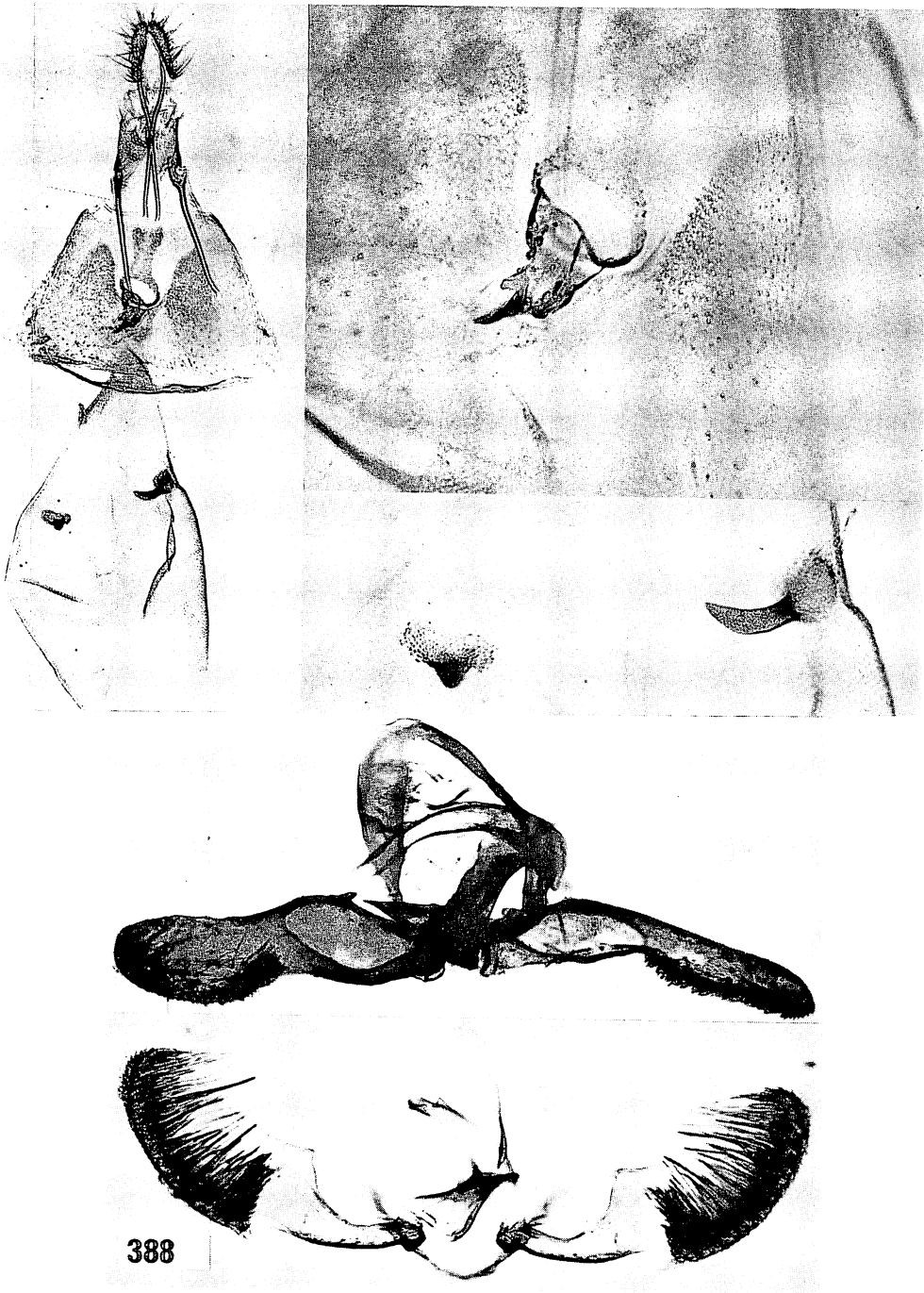


Figure 387—Male genitalia of *Cydia*. Top, *plicata* (Walsingham), holotype (BM slide 1885); Kona, Hawaii. Middle, supposedly a paratype of *plicata* (Busck slide 222; Walsingham specimen 28662), but it may represent another form although the contour of the sacculus of the valva may be somewhat distorted on the slide; Hawaii. Bottom, another specimen of *plicata* from an example reared from *Sophora* seeds at Kilauea, Hawaii (slide Z-VI-21-61).



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Figure 388—Genitalia of *Cydia*. Top three figures, female *walsinghamii* (Butler), determined by Walsingham (BM slide 1893); Kona, 4,000 feet, Hawaii; the left signum is seen in basal view; it is similar to the right signum. Upper male genitalia, *rufipennis* (Butler); Lihue, 4,000 feet, Kauai (BM slide 2058); the right valva is twisted (note the broad, shallow, midventral sinus on the right valva which is correctly displayed as mounted). Bottom male genitalia, *walsinghamii* (Butler) from a specimen determined by Walsingham (BM slide 1892); Kilauea, Hawaii. The sharpness of the points at the lower middles of the valvae is somewhat exaggerated here because of the position of the valvae on the mount.



Figure 389—Female genitalia of *Cydia chlorostola* (Meyrick), holotype (BM slide 9546 Clarke); Waialua, Oahu.



Figure 390—Female genitalia of *Cydia conspicua* (Walsingham), holotype (BM slide 2052); Haleakala, 5,000 feet, Maui. Note the approximation of the signa; compare *plicata* and *storeella*. Compare figure 391.

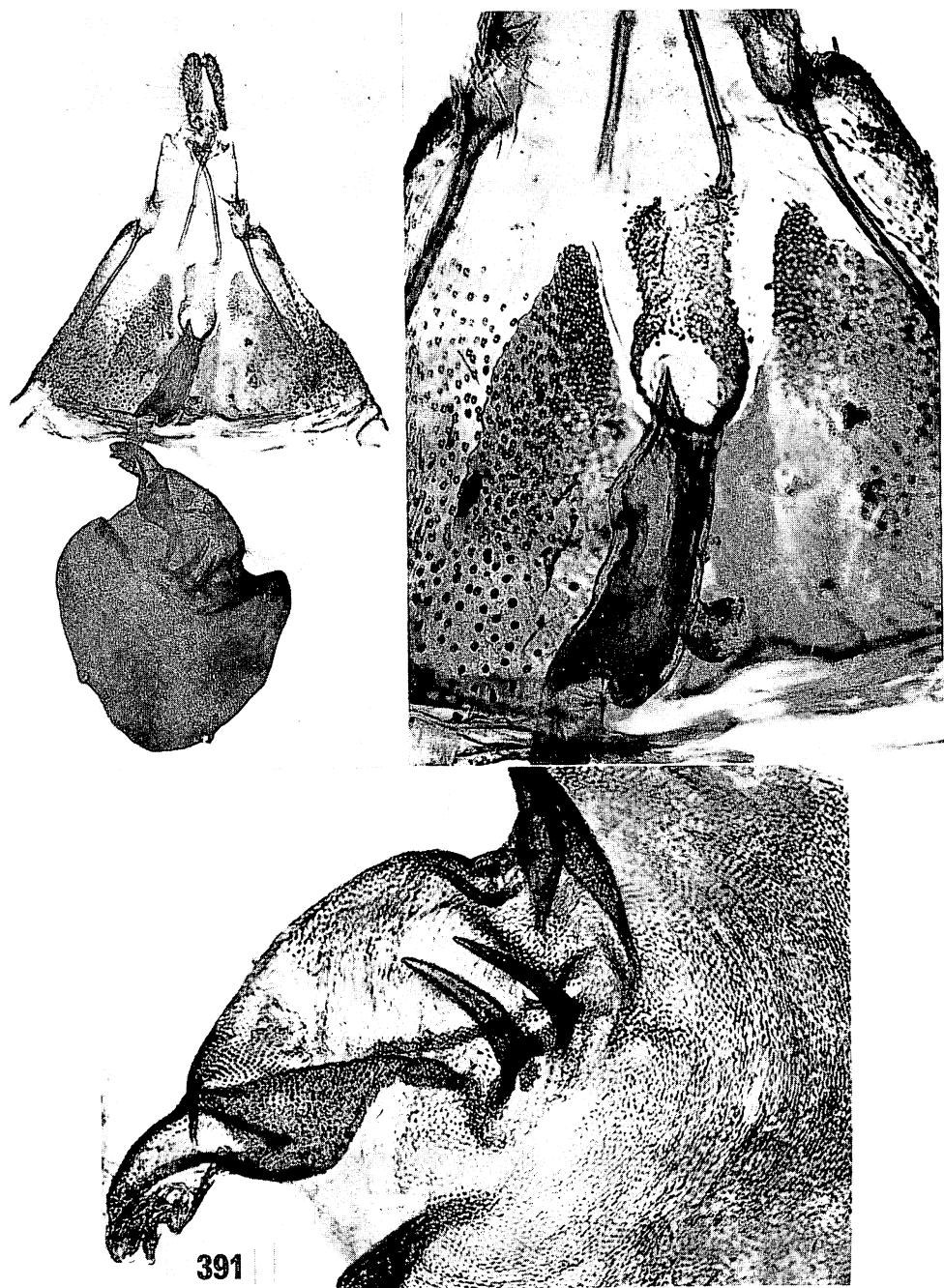


Figure 391—Female genitalia of a specimen of *Cydia conspicua* (Walsingham) from Mt. Tantalus, Oahu (slide Z-XII-62-5). Compare figure 390.

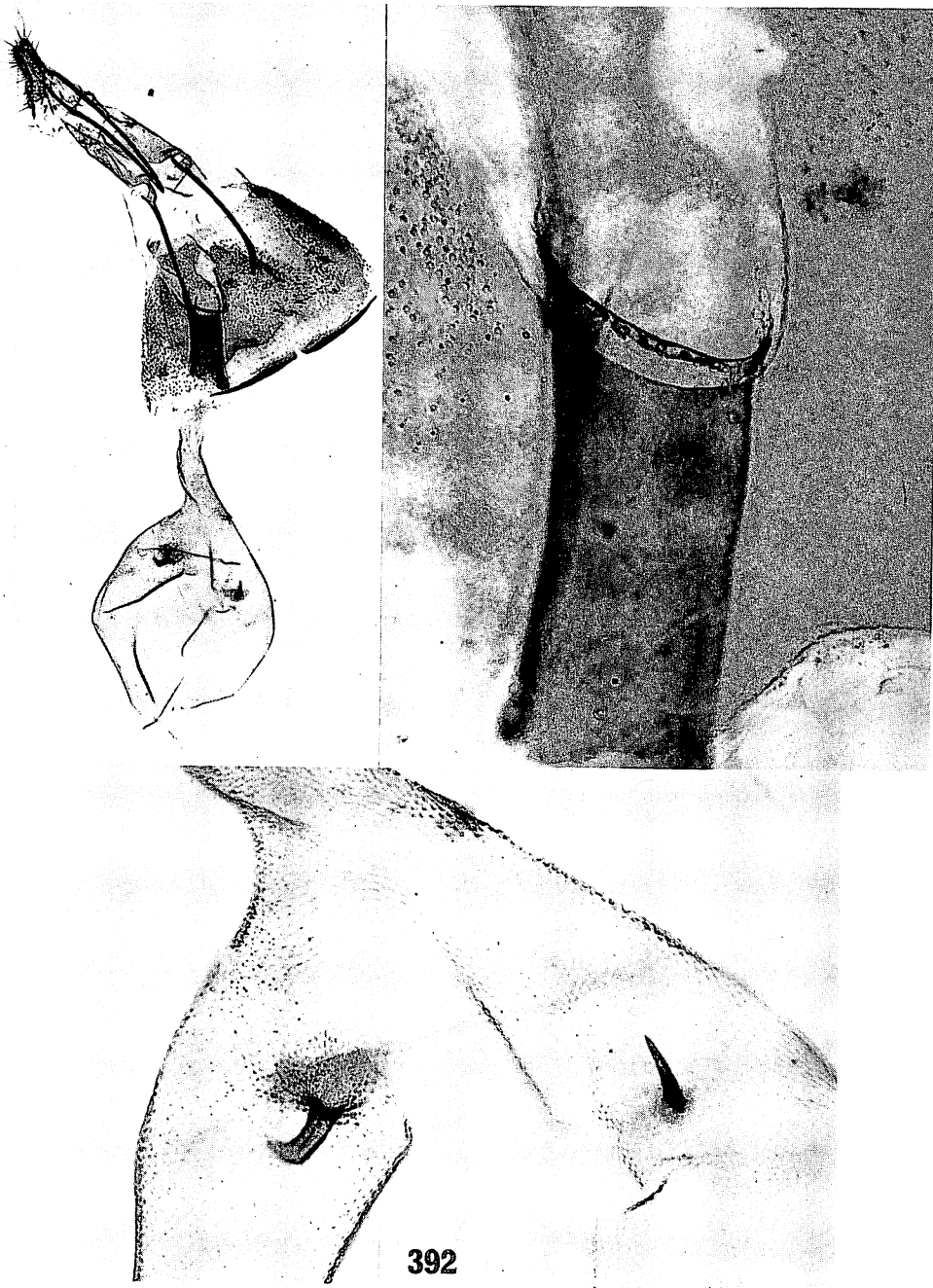


Figure 392—Female genitalia of *Cydia latifemoris* (Walsingham), holotype (BM slide 2054); Haleakala Crater, Maui.



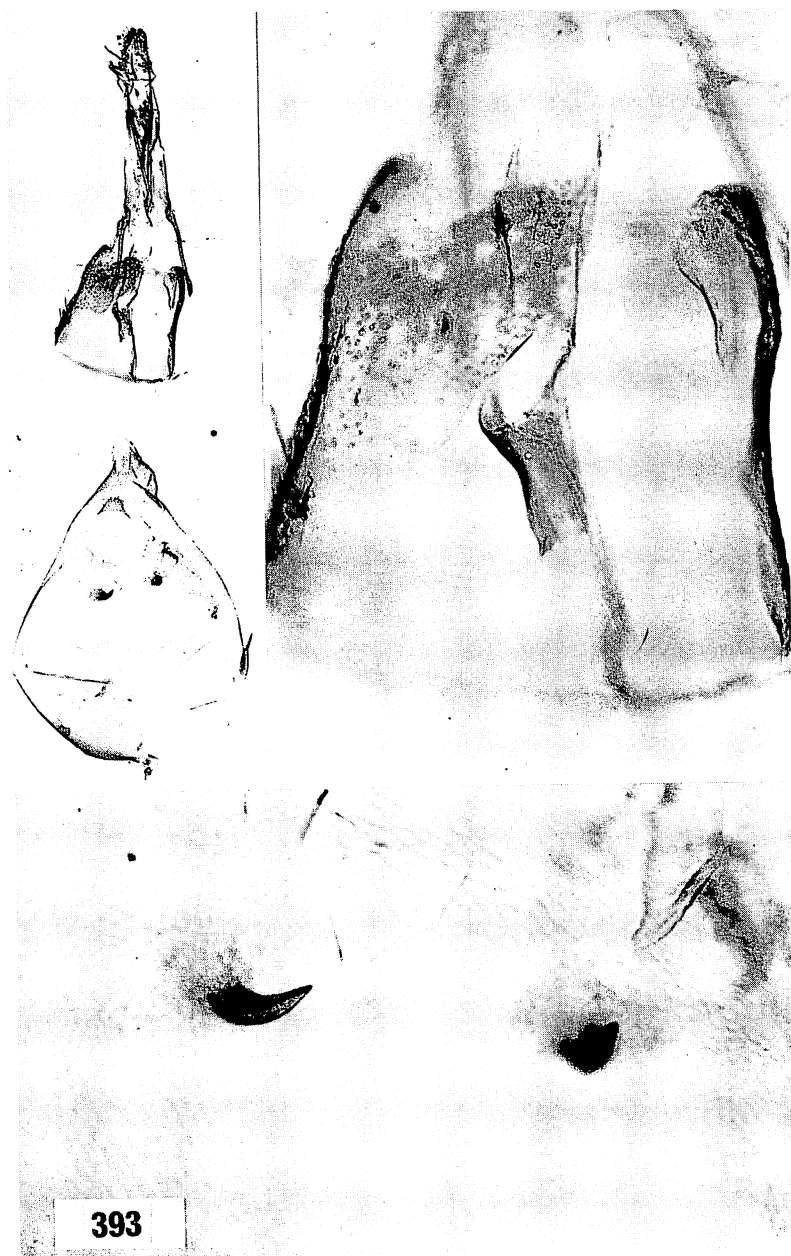


Figure 393—Female genitalia of *Cydia montana* (Walsingham), paratype (BM slide 2056); Kilauea, Hawaii.

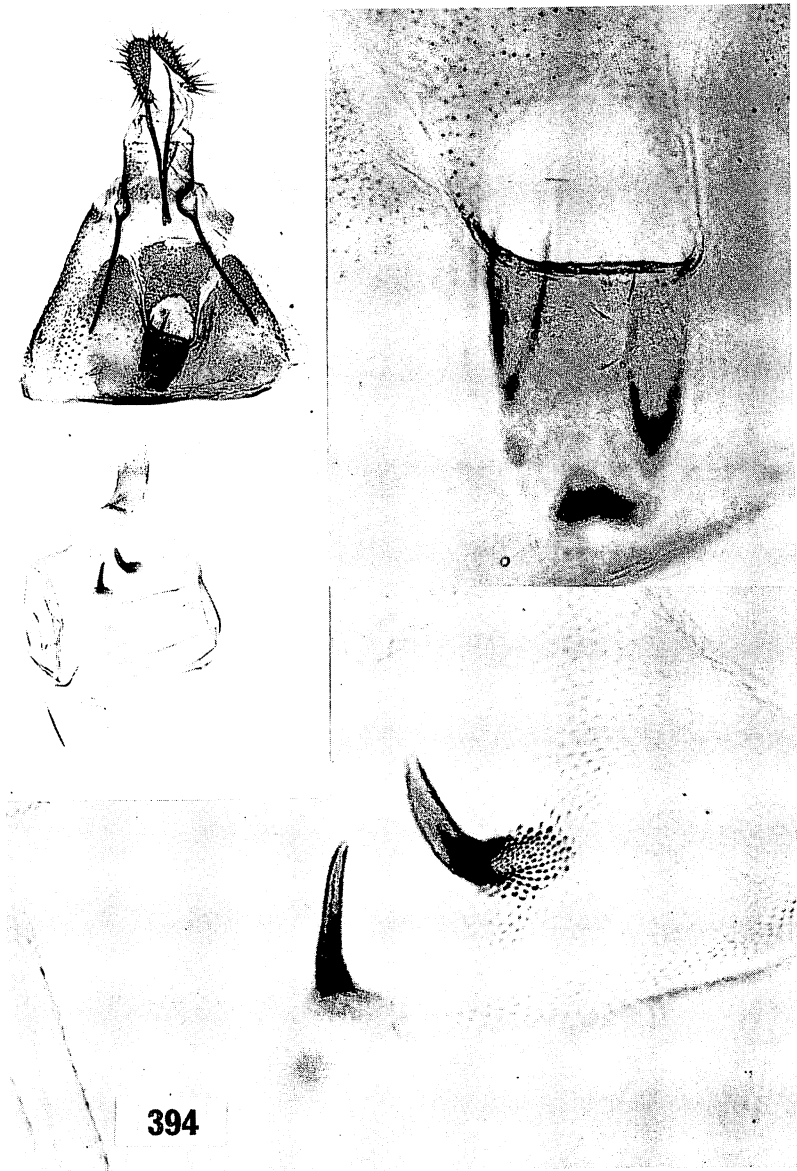


Figure 394—Female genitalia of *Cydia obliqua* (Walsingham), holotype (BM slide 1882); Hualalai, 5,000 feet, Hawaii.

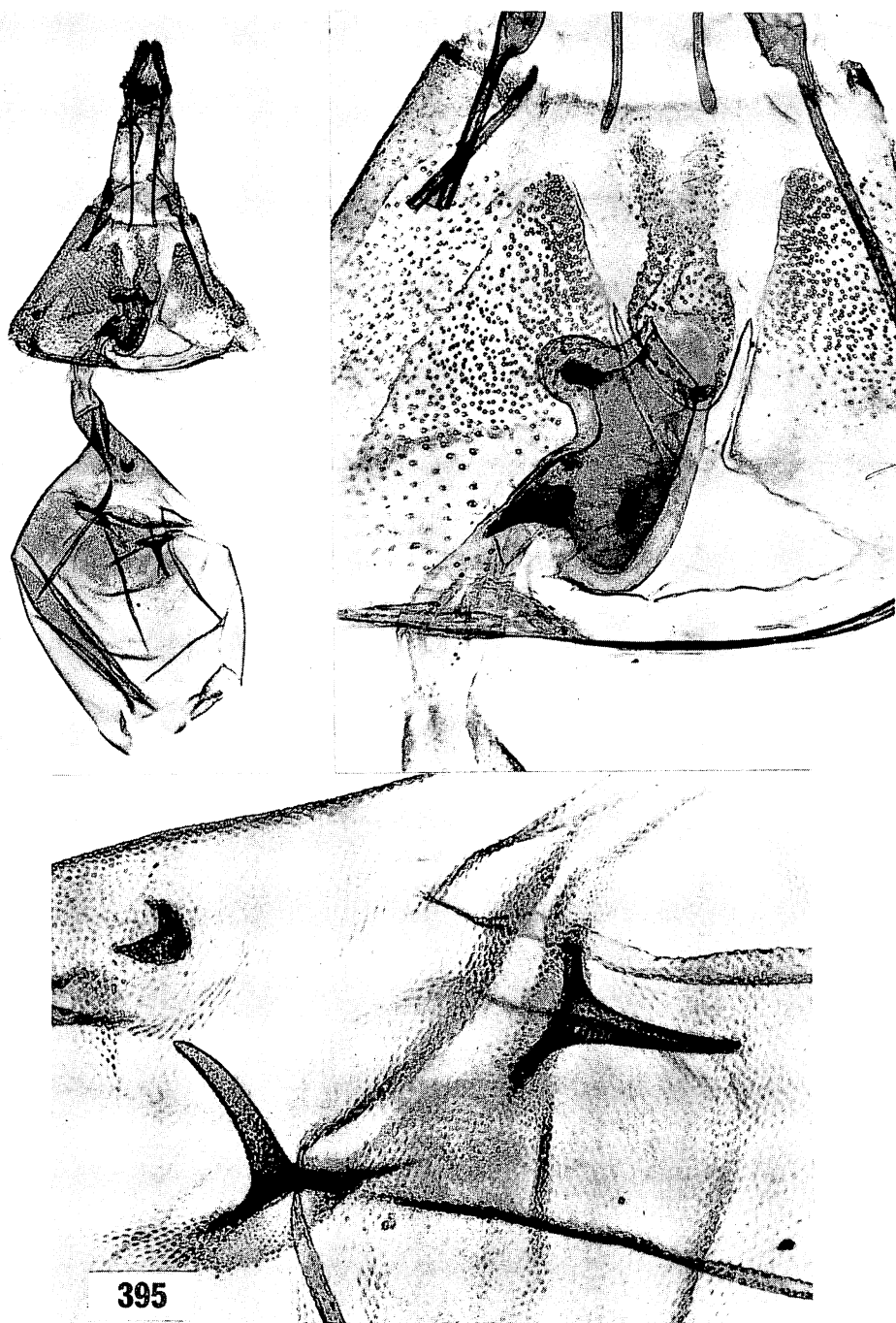


Figure 395—Female genitalia of *Cydia parapteryx* (Meyrick), paralectotype (BM slide 7549); Honolulu.

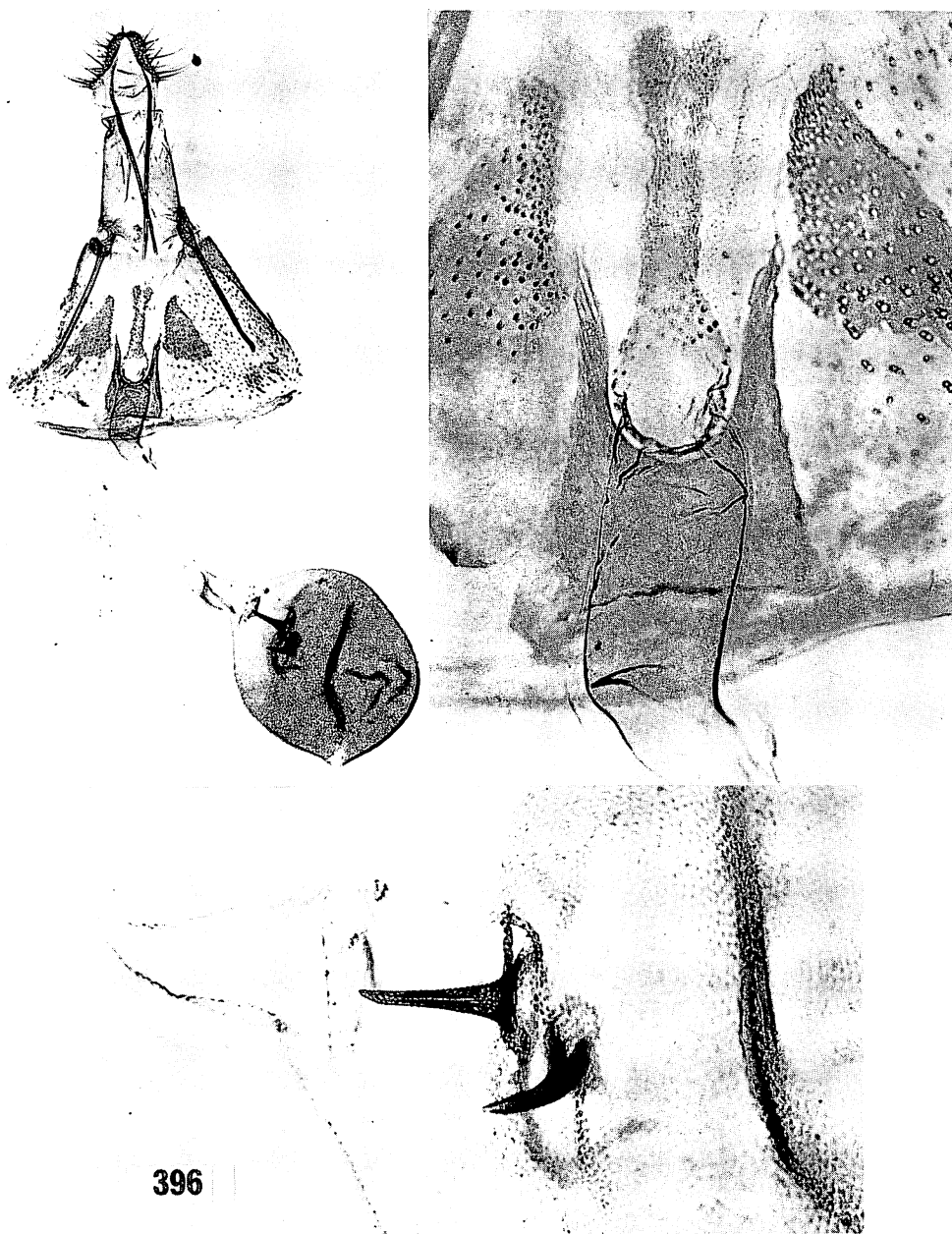


Figure 396—Female genitalia of *Cydia plicata* (Walsingham), allotype (BM slide 1886); Kona, over 6,000 feet, Hawaii. Note the closeness of the signa; compare *conspicua* (figure 390) and *storeella* (figure 398).

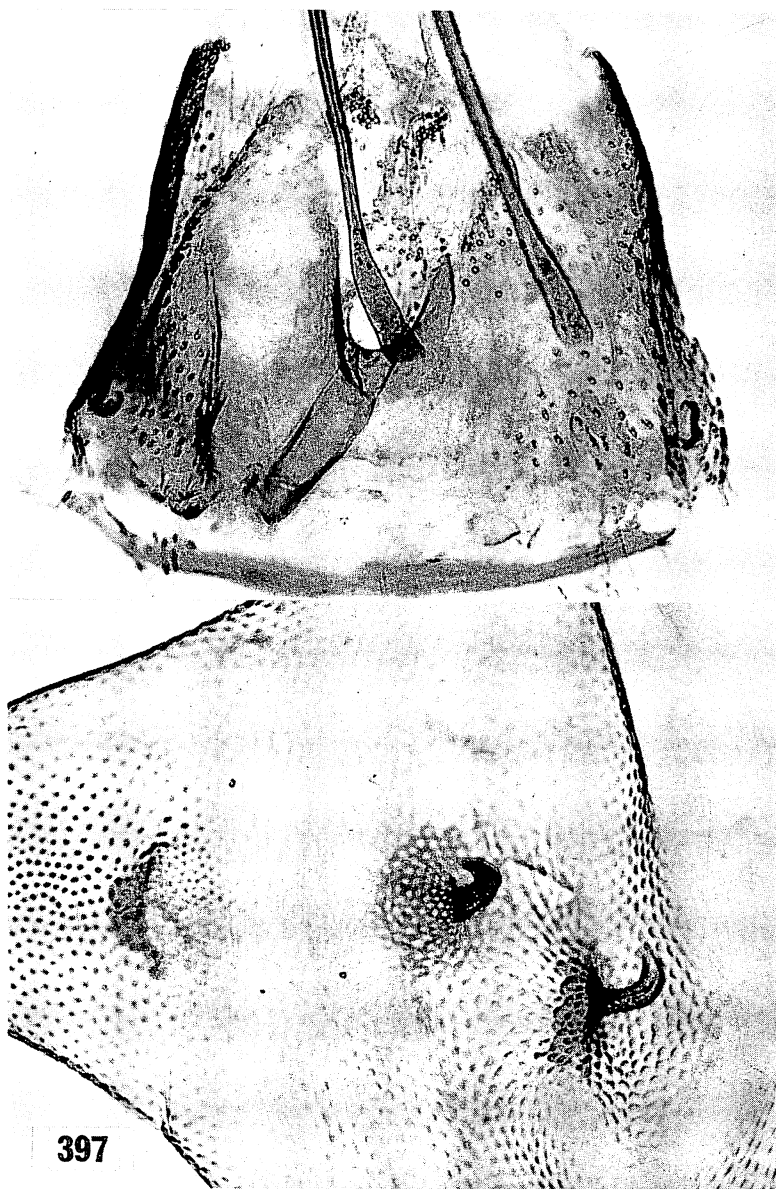


Figure 397—Female genital parts of *Cydia rufipennis* (Butler) from a specimen determined by Walsingham (BM slide 2057); Waianae Mts., Oahu. The ductus bursae (not shown here) is longer and more slender than normal and is somewhat longer than the length of the bursa.

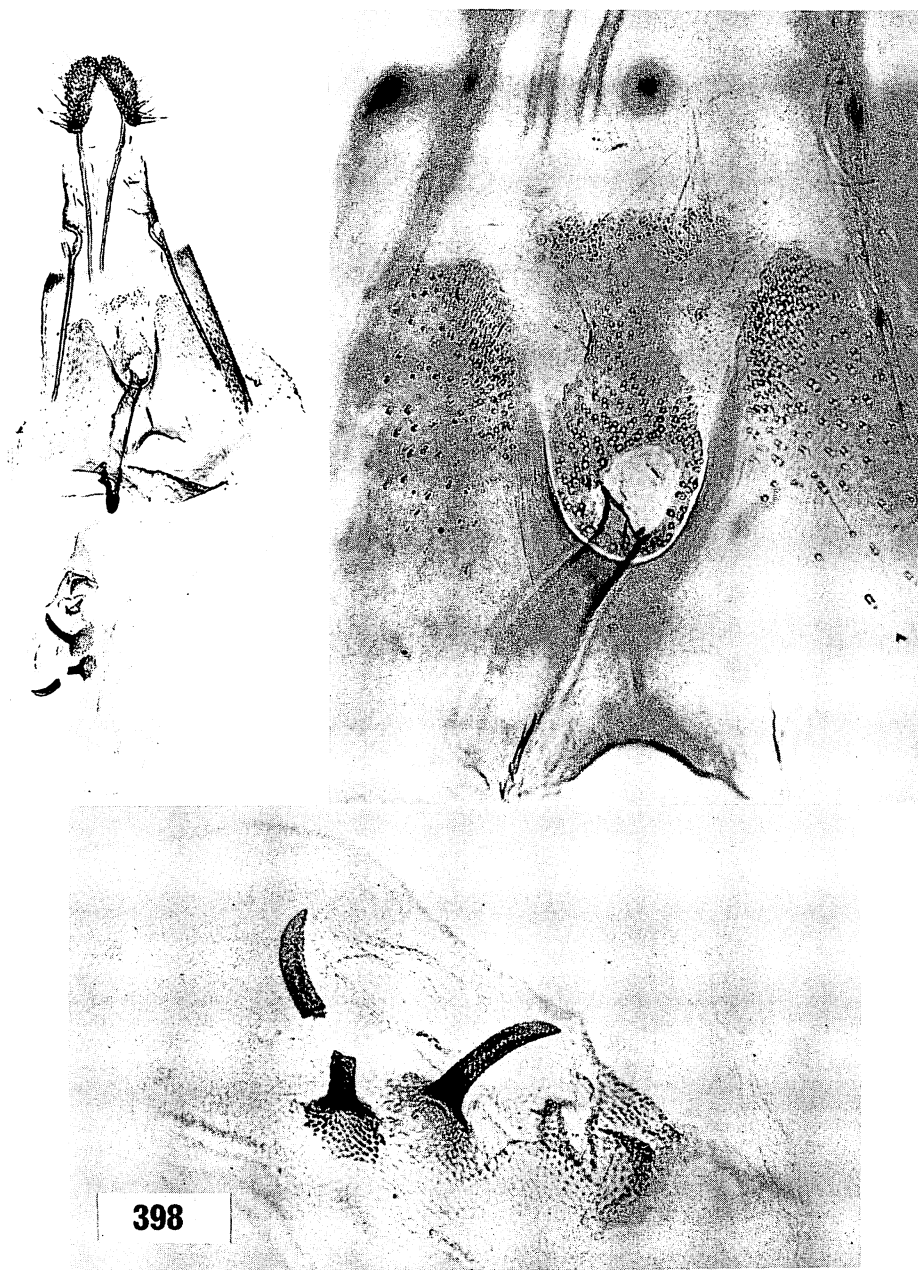


Figure 398—Female genitalia of *Cydia storeella* (Walsingham), holotype (BM slide 1881); Haleakala, 5,000 feet, Maui. Note the close approximation of the signa and compare *conspicua* (figure 390) and *plicata* (figure 396).

**Cydia obliqua** (Walsingham), **new combination** (figs. 381, moth; 394, female genitalia).

*Enarmonia* (?) *obliqua* Walsingham, 1907b:686, pl. 11, fig. 4.

*Adenoneura obliqua* (Walsingham) Meyrick, 1932:222.

Endemic. Hawaii (type locality: Hualalai, 5,000 feet).

Hostplant: unknown.

**Cydia parapteryx** (Meyrick), **new combination** (figs. 374, wing venation; 381, moth; 386, male genitalia; 395, female genitalia).

*Adenoneura parapteryx* Meyrick, 1932:222.

Endemic. Oahu (type locality: Honolulu).

Hostplants: *Canavalia galeata*, *Strongylodon lucidus*.

Parasite: *Trathala flavo-orbitalis* (Cameron).

This species was confused with the closely similar *falsifalcella* until it was described in 1932, and the life history data applied to *falsifalcella* prior to 1932 belong to this species. This moth has the outer edge of the dark fascia near the middle of the forewing less acutely angled than it is in *falsifalcella*, and the contour of the uncus and the aedeagus are different. The illustrations demonstrate these and other distinctive features.

Dr. Swezey (1908c:15-16) made the following observations on the larvae of this species which he then called an "*Enarmonia* sp." found attacking *Canavalia* beans:

In July, 1907, I found a few larvae of this moth eating the growing seeds of *Canavalia galeata*, a native species of bean with a woody twining vine and very large pods containing 2 to 4 black beans about  $\frac{3}{4}$  inch long. The vine had been planted by a fence in Honolulu and had gotten considerable of a growth, and a few pods had already formed. As the vine continued to grow and produce pods these larvae increased in abundance so that finally nearly every pod was attacked by them. They did not confine their attacks to the pods, however; besides feeding in the fleshy walls of the green pod and eating the growing beans within, they also bored the peduncles of the flower clusters, the petioles of the leaves, and the branches of the vine itself; practically attacking all parts of the plant.

Quite a series of this moth was bred from the vine during January and February, 1908. There is some little variation in coloration as shown by the specimens exhibited. . . .

The eggs are laid on the surface of the bean pod, singly or one or two together in slight unevennesses of the surface. They are irregularly oval, about half a mm. long; flattened below, slightly convex above and finely reticulate; whitish in color, sometimes iridescent, becoming pinkish a little before hatching.

On hatching, the larva bores into the pod, feeding for awhile in its fleshy walls, but when it gets larger, attacks the seeds. One larva may eat several of the large seeds before reaching its full growth. When full-grown, the larva is 18 to 20 mm., plump, yellowish white; head medium brown, strongly bilobed; cervical shield slightly infuscated; tubercles faintly infuscated; hairs pale, short; spiracles pale brown.

Before pupating the larva constructs a silken gallery where it has been feeding, extending often through one or more beans, and it finally extends this to the outer wall of the pod, through which it eats a circular hole, except a thin layer on the outside, which can easily be broken through when the moth emerges; then the larva recedes back into the gallery, spins a silken partition across about a quarter of an inch from the outer end, and in this place of security pupates.

The pupa is 10 mm.; light brown; head, thorax and wing-cases darker; the latter and antenna-cases extend to apex of 3rd abdominal segment, a free tip extends a little farther. Abdominal segments 3 to 7 have on dorsal side two transverse rows of numerous tiny, very short, conical spines, those of the anterior row larger than those of posterior row; segment 2 has one row of very tiny spines near posterior margin; segment 8 has but one row of few large spines; segment 9 has but two large dorsal spines and a terminal row of 7, there are also several slender hooked bristles at apex of abdomen.

Dr. Perkins (1913:clxviii) also observed the larva which he said "feeds on the beans in the pods of leguminous plants and also bores in the stems, sometimes destroying the plant."

**Cydia plicata** (Walsingham), **new combination** (figs. 374, wing venation; 382, moth; 387, male genitalia; 396, female genitalia).

*Adenoneura plicatum* Walsingham, 1907b:678, pl. 10, fig. 19.

Endemic. Maui, Hawaii (type locality: Kona, 4,000 feet, male; Kona, 6,000 feet, female).

Hostplant: *Sophora chrysophylla*.

Parasites: *Eupelmus pelodes* Perkins?, *Pristomerus hawaiiensis* Perkins.

One would imply from Perkins' field note, as recorded under this species in Walsingham's original description, "Larvae in seeds of native *Acacias* . . .", that the species feeds upon *Acacia koa*, but discoveries of the species since it was collected by Perkins indicate that it is a *Sophora*-eater. Dr. Swezey told me that he found as many as 70 percent of the seeds in green *Sophora* pods eaten by this moth. I have compared material reared from *Sophora* with the holotype.

**Cydia rufipennis** (Butler), **new combination** (figs. 375, wing venation; 382, moth; 388, male genitalia; 397, female genitalia; col. pl. 2:8).

*Phoxopteris rufipennis* Butler, 1881:395.

*Adenoneura rufipennis* (Butler) Walsingham, 1907b:680, pl. 10, fig. 22.

Endemic. Kauai, Oahu (type locality: no specific locality given, and the female holotype bears only the Blackburn code "Hawaiian Islands, 81.7 109"; the same code number has been used for specimens coming from "the mountains of Oahu", and I presume that the type came from the mountains behind Honolulu).

Hostplant: *Acacia koa*.

The larvae feed upon the developing seeds within the pods, but they are at times to be found feeding in the flowers and buds. The larvae were reported by Bridwell (1919:24) to emerge from the pods and to pupate elsewhere. *Cryptophlebia illepida* also feeds in the koa pods. See the quotation from Swezey under that species name for additional data.

Superficially, specimens of *rufipennis* may appear to be diminutive *plicata*, but an examination of their genitalia will reveal their distinctiveness.

**Cydia storeella** (Walsingham), **new combination** (figs. 383, moth; 398, female genitalia).

*Enarmonia* (?) *storeella* Walsingham, 1907b:686, pl. 11, fig. 3.

*Adenoneura storeella* (Walsingham), Meyrick, 1932:222.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

This species was described from one female, and I have no further information regarding it.



**Cydia walsinghamii** (Butler), **new combination** (figs. 375, wing venation; 383, moth; 388, male, female genitalia).

*Proteopteryx walsinghamii* Butler, 1882 : 43.

*Enarmonia walsinghamii* (Butler) Walsingham, 1907b : 684, 736, pl. 11, fig. 1.

Endemic. Kauai, Oahu (type locality: "In the neighbourhood of Honolulu"; the type bears the Blackburn collecting code "Hawaiian Isld. 82.9 161"), Maui, Hawaii.

Hostplant: *Acacia koa*.

Parasite: *Pristomerus hawaiiensis* Perkins.

I am not positive that the species has such a wide distribution as the literature indicates, although this may be true. I have seen specimens reared from *Acacia* and determined as this species but which represent new species.

The female holotype bears a Walsingham label stating incorrectly that it is a male.

Dr. Swezey (1954:5, fig. 2) said that "the caterpillars live in dead twigs of koa and also bore into tips of living twigs. They have been found most abundantly in the enlarged phyllodes and twigs which have been infected and malformed by the rust, *Uromyces koae* Arthur. Sometimes such malformed twigs grow into branches of an inch or more in diameter, within which the caterpillars of this moth are found in the bark or in the living wood."

See the quotation from Swezey under *Cryptophlebia illepida* for additional information. Although this species has been reported to be a koa seed eater, Dr. Swezey did not mention koa seeds in his 1954 report on this species. It is possible that there has been some confusion in the records, and some of the details credited to *walsinghamii* may really belong either to a new species from Hawaii which I list below or to other new species.

The males of this species and of *crassicornis* lack the sex pouch beneath the hindwing.

**Cydia new species 1** (figs. 377, larvae damage; 386, male genitalia).

*Enarmonia* species confused with *walsinghamii* by some workers in Hawaii.

Endemic. Hawaii (Kawaihae Uka and Kohala Road, 3,500 feet).

Hostplant: *Acacia koa*ia.

This species has been confused with *walsinghamii*, and it is possible that some of the published information concerning *walsinghamii* belongs to this species. As is demonstrated by my illustrations of the male genitalia, two species are involved. The specimen whose male genitalia are illustrated on figure 386 has sex pouches on the hindwings which are absent from *walsinghamii*.

I am indebted to C. J. Davis for information and specimens of this species. Further details are included with figure 377.

Genus **STREPSICRATES** Meyrick

*Strepsiceros* Meyrick, 1881c:678. Type-species: *Sciaphila ejectana* Walker by subsequent designation by T. B. Fletcher, 1929:211. A homonym of *Strepsiceros* Rafinesque, 1815, Mammalia.

*Strepsicrates* Meyrick, 1888a:73, a replacement name for *Strepsiceros*.

*Phthinolophus* Dyar, 1903b:307. Type-species: *Phthinolophus indentanus* Dyar, monotypic.

The species assigned to this generic name are in need of study, and the status of the group in relation to its allies requires revision. At present, the group supposedly includes species from Ceylon, Australia, New Zealand, New Hebrides, Fiji, Samoa, Austral Islands, and two from America. A supposedly widespread American species has been introduced to Hawaii. Meyrick originally placed the genus in the "Grapholithidae", and he later assigned some of the species to *Spilonota*. T. B. Fletcher (1929:208) wrongly listed *Strepsicrates* as a synonym of *Spilonota* Stephens, 1834 (see Stephens, 1829–1834), but he probably only followed Meyrick.

***Strepsicrates smithiana*** Walsingham (figs. 399, head, wing venation, antennal base; 400, moths; 401, male, female genitalia; 402, larva; 417–A, d–f, pupa).

*Strepsicrates smithiana* Walsingham, 1892(1891):506 (type locality: St. Vincent, West Indies).

*Phthinolophus indentanus* Dyar, 1903b:307 (type locality: Florida, U.S.A.).

*Spilonota imminens* Meyrick, 1917a:15 (type locality: British Guiana). Synonymy by Clarke, 1958:600, pl. 297, figs. 3, 3a.

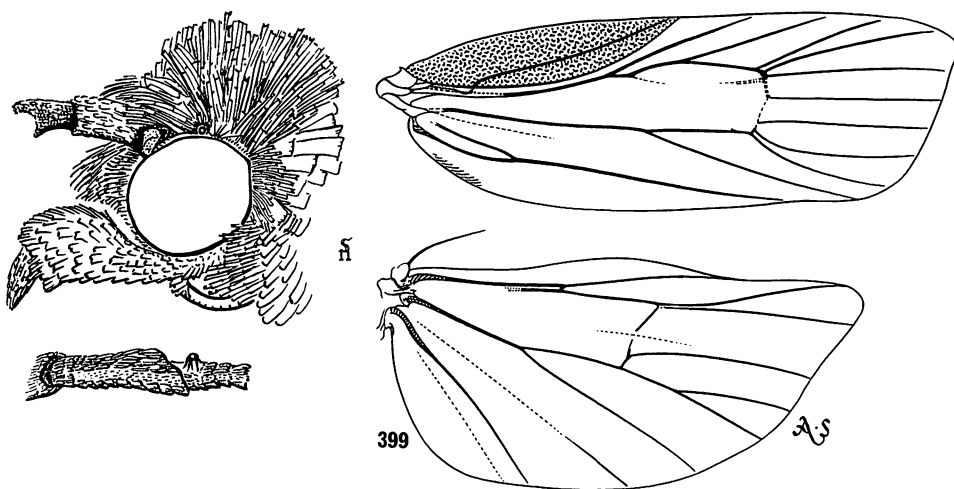


Figure 399—Head and wing venation of *Strepsicrates smithiana* Walsingham (BM slide 14186); Constant Springs, Jamaica. The figure below the head is a frontal view of the basal part of the male antenna to the same scale as the head.

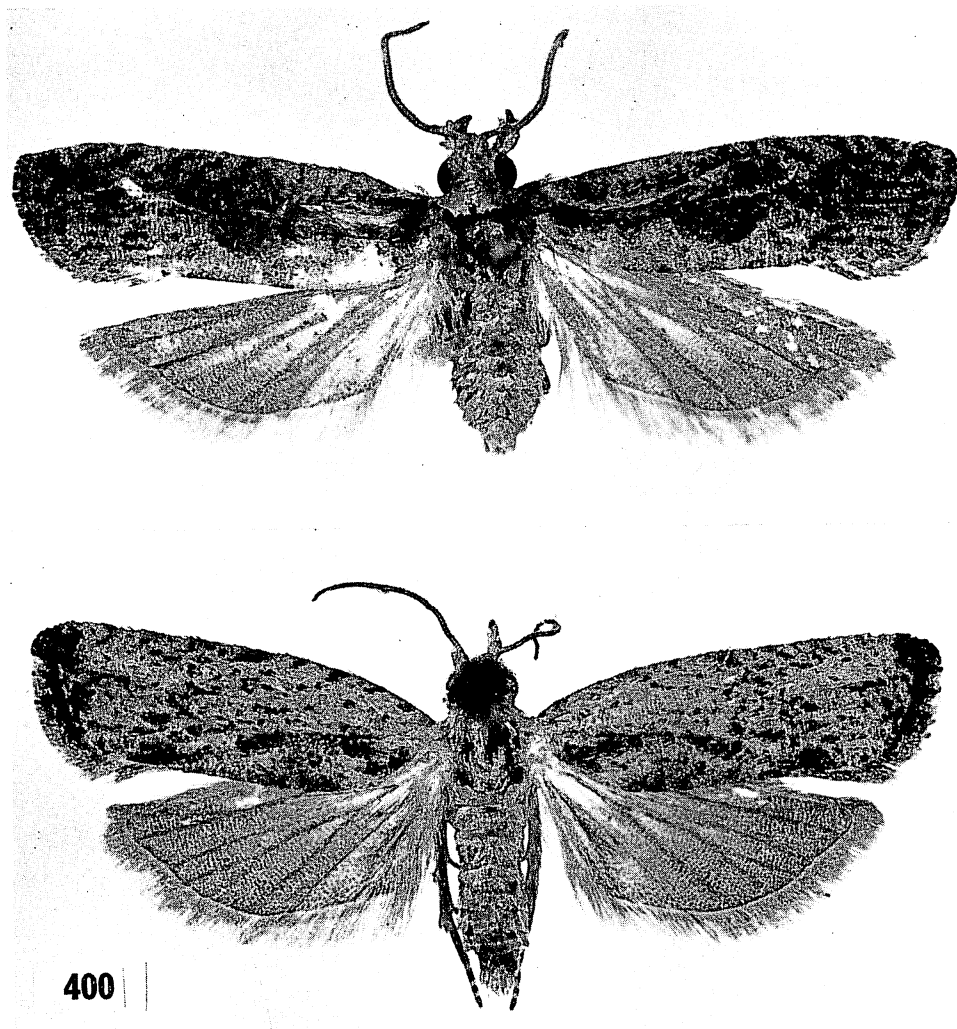


Figure 400—*Strepsicrates smithiana* Walsingham. Top, a male from Cape Henry, Virginia. Bottom, a female from Everglade, Florida. Expanse about 13 to 14 mm. (USNM photographs.)

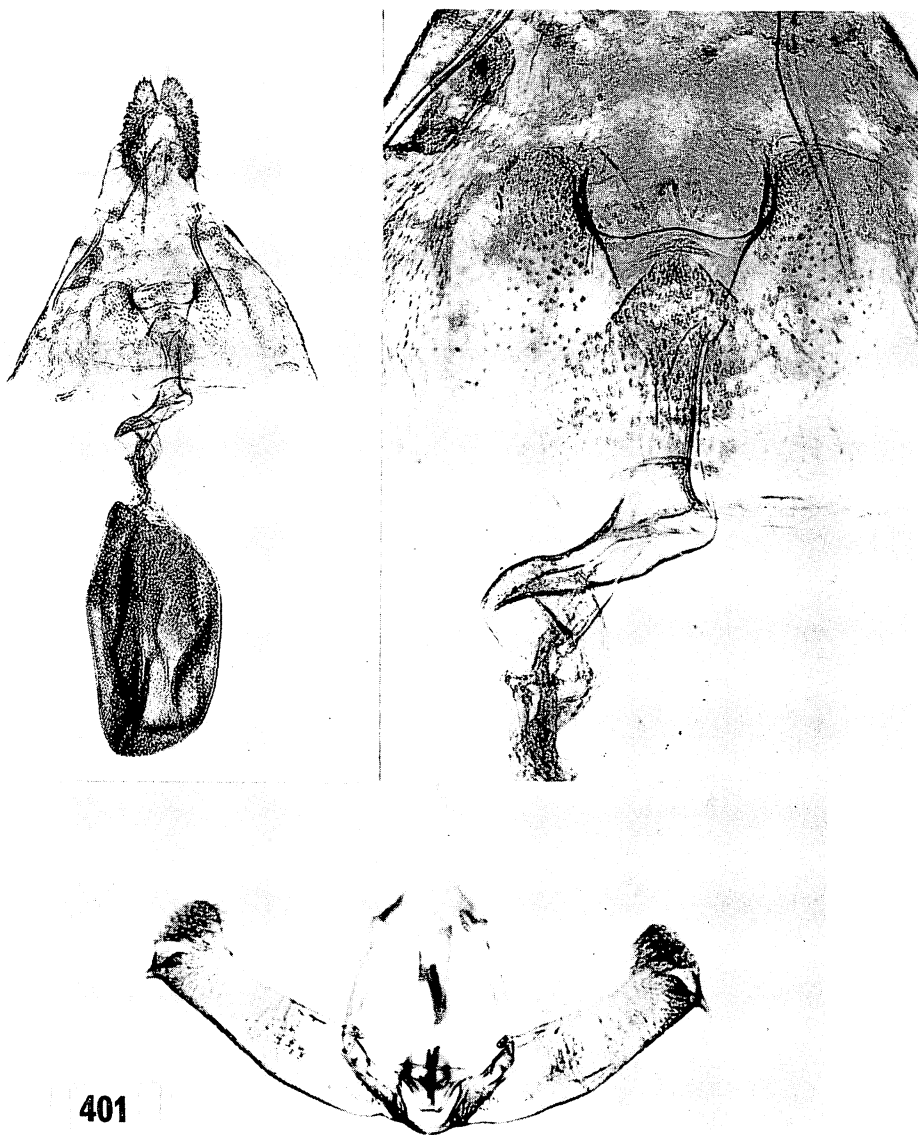


Figure 401—*Strepsicrates smithiana* Walsingham. Top, female genitalia of the holotype (BM slide 11780); St. Vincent, West Indies. Bottom, male genitalia from the lectotype of the synonymous "*Spilota imminens*" Meyrick (BM slide 6260); Guyana.

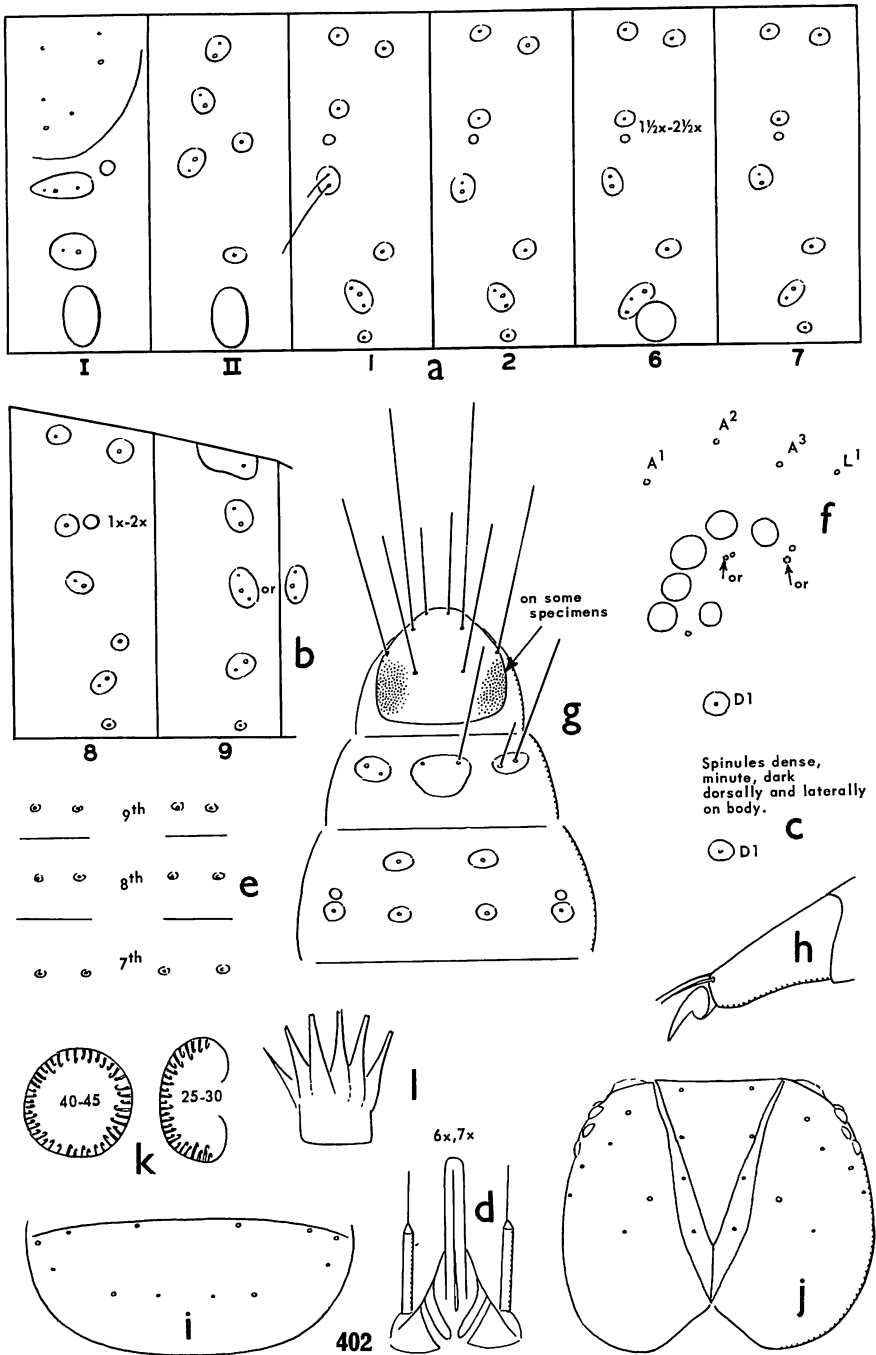


Figure 402—Details of the larva of *Strepsicrates smithiana indentana* Dyar. *a*, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; *b*, same of abdominal segments 8 and 9; *c*, dorsal seta, pinacula and dermal spinules of an anterior abdominal segment; *d*, spinneret and labial palpi; *e*, V1 setae of abdominal sternites 7, 8, and 9; *f*, ocellar area of the left side of the head; *g*, dorsal aspect of abdominal segments 8, 9, and 10; *h*, lateral aspect of a thoracic leg; *i*, prothoracic shield; *j*, frontal aspect of head; *k*, crochets of 6th ventral and anal prolegs of left side; *l*, anal fork. (Drawing loaned by Margaret MacKay.)

Oahu.

Introduced purposely from Florida and Georgia, U.S.A., in 1955, by the Hawaiian State Department of Agriculture to aid in the control of the pasture weed pest *Myrica faya*, or firebush. It was found to be established on Oahu in 1960. The species is reported to be widely distributed in North and South America.

Hostplants: *Myrica cerifera* (wax myrtle), *Myrica faya* (firebush). I have seen specimens reared from *Psidium guajava* (guava) in the West Indies. The larvae roll the leaves of the hostplants.

The forewing of both sexes has a conspicuous patch of raised scales posterior to the fold at about the basal one-fourth of the wing. The antenna of the male has a dorsal "notch" on the shaft at about the length of an eye beyond the basal antennal segment. In Hawaii, *Eccoptocera* also has "notched" antennae but, on that genus, the "notch" is more basal. The forewings of the males have strong costal folds enclosing hair tufts.

#### Genus **CROCIDOSEMA** Zeller

*Crocidosema* Zeller, 1847b:721. Type-species: *Crocidosema plebejana* Zeller, 1847b:721. (figs. 403, head, wing venation; 415, larva; 407, 409, 411, male genitalia.)

Heinrich, 1923:189, figures.

Confusion exists regarding the taxonomic positions of the species of *Crocidosema*. It is not known how many of the names that have been proposed represent species, nor is it known how much of the supposed synonymy is correct. A number of names have been proposed for supposed species in Eurasia, Africa, America, and various Pacific islands. The genus may include only a few species or it may include series of closely similar forms whose specifically diagnostic characters remain to be ascertained and described. There is no doubt that this group has greatly confused taxonomists, and little more can be said here than to call attention to our great ignorance of *Crocidosema*. *Crocidosema* and *Epinotia* are closely allied.

*Crocidosema* appears to be widely spread over the warmer parts of the world, but we do not know to what extent man has contributed to this distribution. There is no doubt, however, that he has aided in the wide dispersal of some forms, and the genus is extraordinarily widespread even to remote islands. It does seem evident, however, that, although these moths are confusingly variable in color and pattern, several species do exist in the genus. Perhaps *Crocidosema* is a group in a highly plastic state of early evolution with a marked tendency to variation.

I have not seen what I consider to be typical *Crocidosema plebejana* Zeller from Hawaii, although many Hawaiian specimens have been named *plebejana* and the bulk of Perkins' Hawaiian collection (26 of 29 specimens) were named *plebejana* by Walsingham in *Fauna Hawaiiensis*.

The first record for the group in Hawaii is that of Butler who, in 1881, described "*Proteropteryx*" *blackburnii* from two specimens collected by the Reverend Blackburn on Maui. Walsingham (or Durrant for Walsingham) determined one of these as a male (holotype) and the other as a female (paratype), but they are both females (each has lost its abdomen). Walsingham placed the name *blackburnii* (Butler) as a synonym of *plebejana* in *Fauna Hawaiiensis*, but it is not *plebejana*. Walsingham described a large female specimen as *Adenoneura? marcidellum*, and he described a third Hawaiian form (*leprarum*) from a small, pale specimen which he assigned to a third genus, *Gypsonoma*. It is obvious that Walsingham was confused by these moths, as were all other workers. The entire genus requires long and careful study, but, because I do not now have the time or the opportunity to engage in such work, I can only call attention to some of the problems. I have found what appear to be constant differences in the Hawaiian material I have studied, and I propose to recognize three species in Hawaii: *blackburnii* (Butler), *leprara* (Walsingham), and *marcidella* (Walsingham). It is possible that these forms are geologically recent additions to the Hawaiian fauna, and perhaps their immediate ancestors were introduced by the Polynesians. More sibling species may be involved than the three species presently recognized. I shall temporarily consider these *Crocidosema* to be endemics, although it may later be demonstrated that one or more of them occurs elsewhere.

The males of most of the forms of *Crocidosema* that I have seen have a much heavier mass of erect hairs (cubital pecten) along the basal section of the posterior margin of the cell on the hindwings than do the females. On *leprara*, however, the cubital pecten is only slightly more developed on the male than on the female. The recognition of this character enables easy sexing of specimens.

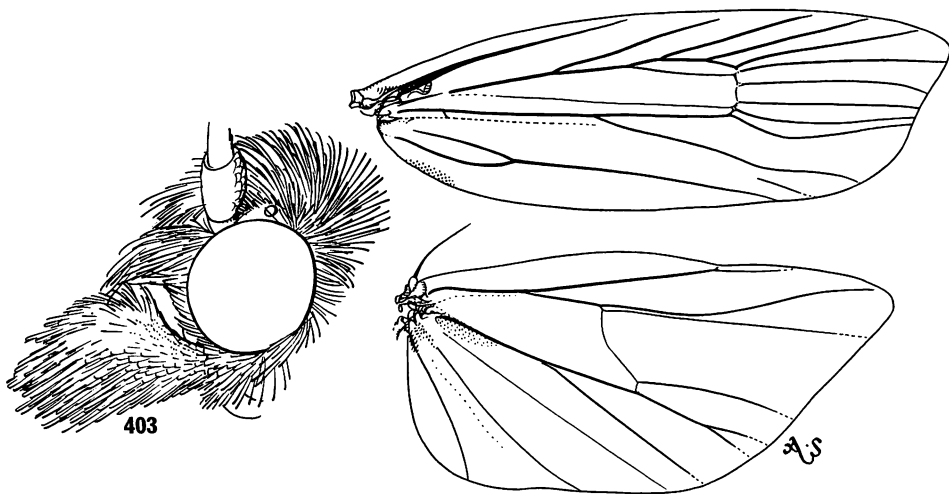


Figure 403—Head and wing venation of *Crocidosema plebejana* (Zeller), the type-species of *Crocidosema*, holotype male (BM slide 1838); Sicily.

Insofar as is known, the larvae of Hawaiian *Crocidosema* feed on Malvaceae and attack mostly the flowers, fruits, and seeds, but occasionally they may bore in leaf petioles. Bovey, in Balachowsky et al. (1966:848–850), quotes details of *Crocidosema plebejana* feeding on cotton; but Pearson and Darling, in their detailed study of cotton pests in tropical Africa (1958), did not find that *C. plebejana* attacked cotton, although it was found in cotton fields. I have no records of any *Crocidosema* from cotton in Hawaii, and perhaps elsewhere an error has been made in recording the genus from *Gossypium*.

As previously stated, I have not seen any typical *Crocidosema plebejana* from Hawaii. I have illustrated the male genitalia of the holotype of *plebejana*; note that the “rib” of the valva is comparatively close to the ventral margin of the valva. The “rib” of all of the specimens of *Crocidosema* examined from Europe and North America is similarly formed. In the Hawaiian specimens, however, the “rib” is placed distinctly farther from the ventral margin of the valva—it is more medial in position. This feature may be appreciated better by examining figure 410 of *plebejana* and *marcidella*, for example.

The larvae of *Crocidosema* may be distinguished from those of *Epinotia* because the outer seta of the dorsal, apical pair of setae on the claw-bearing segment of the thoracic legs is obviously longer than the inner one, whereas the setae are subequal on *Epinotia*. See figures 415 and 420.

#### KEY TO THE HAWAIIAN SPECIES OF CROCIDOSEMA

1. Palpi and head clothed with mostly pale, straw-colored vestiture, and the moth is a comparatively pale colored species, as in figure 405, with variations; hindwing of male with the cubital pecten (fringe of hair along posterior margin of cell near its base) only moderately more strongly developed than that of the female and without an extensive area of erect hair between the pecten and inner posterior corner of wing; male genitalia as in figures 408–410, ectal “rib” of valva without any stout, conspicuously differentiated subterminal, spurlike setae; female genitalia as in figure 413, the signa broad; a lowland and coastal species. . . . . **leprara** (Walsingham).

Much darker species, palpi and head extensively clothed with dark vestiture; male hindwing with the cubital pecten very strongly developed as a comparatively huge mass of dense hair, conspicuously more strongly developed than that of female, and the area between vein 1b and posterior inner corner of wing densely clothed with erect hair; valvae of male genitalia with one to three distinctly differentiated, long, heavy, subterminal, spurlike setae, as at the bottoms of figures 410 and 411, of *marcidella* and *blackburnii*; female genitalia as in figures 412, 414, the signa sharply pointed. . . . . 2



2. Forewings with outer margin of the broad subbasal dark fascia strongly angled distad, often externally subacute, as in figure 406; eighth abdominal tergum and sides of tergum of female (the penultimate segment of the ovipositor to which are attached the anterior apophyses) with a complete, transverse, submedial, mostly double but partly triple row of more than 35 long setae extending continuously across the disc (figure 404); expanse 15–20 mm. . . . . **marcidella** (Walsingham).

Forewings with outer margin of the broad subbasal dark fascia rather moderately convex, as in figure 405, or less convex; eighth abdominal tergum and sides of tergum of female with about 10 or fewer long setae on each side and none in middle of disc (figure 404); expanse about 10–12.5 mm. . . . . **blackburnii** (Butler).



Figure 404—Caudal parts of the dorsal surfaces of the penultimate sections of the ovipositors of *Crocidosema marcidella* (Walsingham), left, and *blackburnii* (Butler), right, to illustrate the differences in chaetotaxy.

**Crocidosema blackburnii** (Butler) (figs. 404, ovipositor; 405, moth; 411, male genitalia; 412, female genitalia).

*Proteopteryx Blackburnii* Butler, 1881:393.

*Proteopteryx Blackburnii* variety Butler, 1881:393.

Incorrectly synonymized with *Crocidosema plebejana* Zeller, by Walsingham, 1907b:675, 736.

Endemic? Nihoa, Kauai, Oahu, Molokai, Maui (type locality: “flying about low plants at Makawao, Maui”; the Blackburn code is “81.7” over “132”), Lanai, Hawaii.

Hostplants: *Abutilon* (= *Abortopetalum*) *eremitopetalum*, *A. menziesii*, *A. molle*, *A. sandwicense*, *Sida fallax*, *Sida* species. The larvae feed in flower buds, fruits, and seeds.

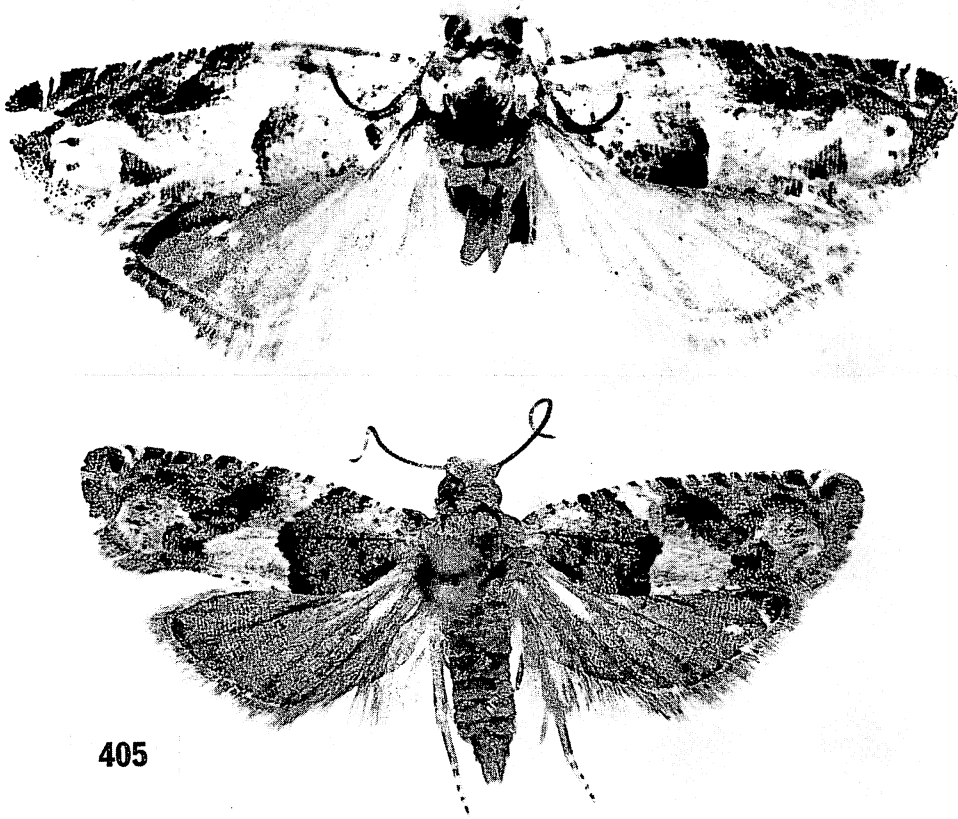
Parasites: *Bracon mellitor* (Say), *Brachymeria obscurata* (Walker), *Trathala flavo-orbitalis* (Cameron), *Pristomerus hawaiiensis* Perkins.

Predators: *Nesodynerus rudolphi* (Dalla Torre), *Odynerus montana* Smith.

This moth was described from two females (although the holotype was incorrectly considered a male), both of which now lack abdomens. It has long been masquerading under the name *Crocidosema plebejana* Zeller. This moth is the most common and widely spread species of *Crocidosema* in Hawaii, and appears to be mostly a lowland species. About the size of *leprara*, but smaller

than *marcidella*, *blackburnii* averages about 10 to 12 mm in expanse. It is highly variable in color and pattern, and some forms are so distinctive in appearance that one wonders if it is possible that several sibling species may be involved.

Perkins (1913:clxvii), following Walsingham in considering it to be *plebejana*, said that it is "a natural immigrant, attached to the immigrant plant *Sida*, in the buds of which the caterpillar lives. It is an important food-supply of the larvae of many of the endemic wasps, that frequent the lowlands and lower mountain slopes, since it is excessively numerous and ubiquitous, wherever its food-plant flourishes. Near Honolulu, *Nesodynerus rudolphi*, *Odynerus montanus*, and other wasps are always to be seen searching the 'Ilima' buds in their season for these small caterpillars."



405

Figure 405—*Crocidosema*. Top, *leprara* (Walsingham), holotype female (BM slide 1878); Molokai, sea level; expanse 12.5 mm. Bottom, *blackburnii* (Butler), female; Kamehameha Schools, Honolulu; reared from seeds of *Abutilon eremitopetalum*; forewing 5.8 mm.

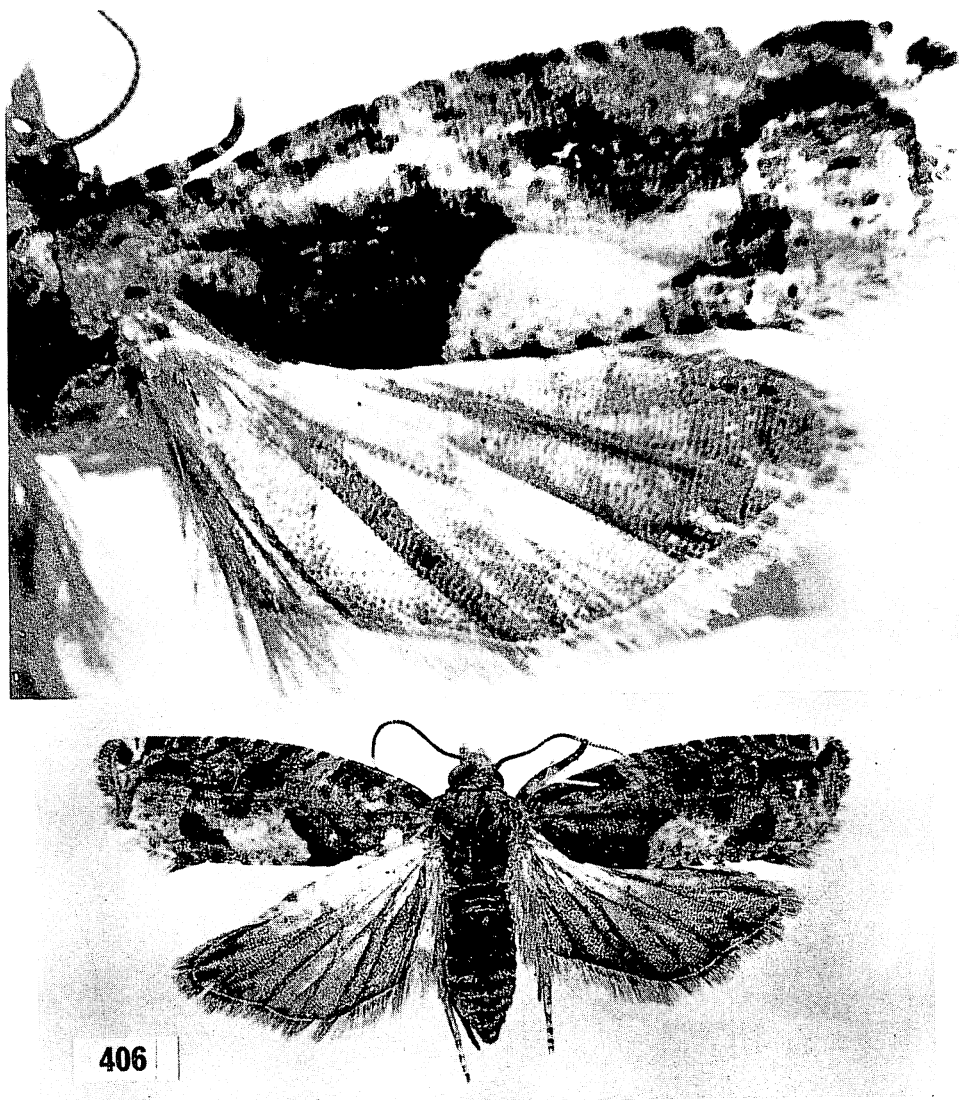


Figure 406—*Crocidosema marcidella* (Walsingham). Top, holotype female (BM slide 1875); Waianae Mts., Oahu; forewing 8.5 mm. Bottom, a specimen reared from *Hibiscus* on Mt. Tantalus, Oahu; forewing 7.5 mm.

***Crocidosema leprara*** (Walsingham), **new combination** (figs. 405, moth; 408–410, male genitalia; 413, female genitalia).

*Gypsonoma leprarum* Walsingham, 1907b:676, 736, pl. 10, fig. 16.

Endemic? Oahu, Molokai (type locality: sea level), Nihoa, Necker, French Frigate Shoal?, Laysan?

Hostplants: undetermined, but probably *Abutilon* and *Sida*.

Parasites: undetermined, but probably the same as for *blackburnii*.

This moth has been confused with *plebejana* in Hawaii, and it has not been recognized since the publication of *Fauna Hawaiiensis*. It is the palest of the Hawaiian *Crocidosema*, and it is undoubtedly more widely distributed in the islands than the records indicate. It was described from one pair collected by Perkins in May, 1893. In addition to the type pair, there are two other males (although one of these was labeled as a female) determined as this species by Durrant in the *Fauna Hawaiiensis* collection in the British Museum. They were collected by Perkins in 1901—one from the northwest Koolau Mountains,

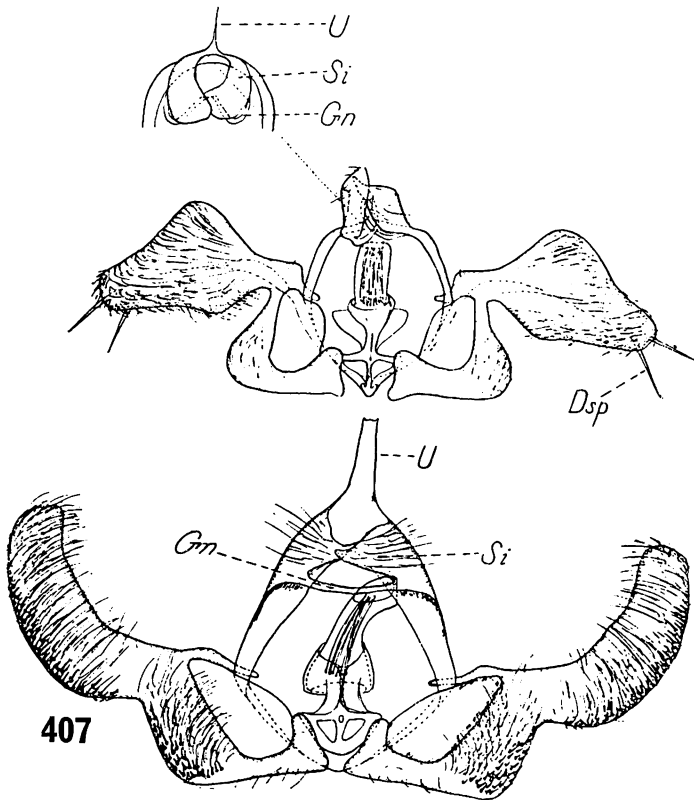


Figure 407—Top, male genitalia of *Crocidosema plebejana* Zeller. Bottom, male genitalia of *Epinotia similana* (Hübner), the type-species of *Epinotia*. (After Heinrich, 1923.) *Dsp*, distal spines; *Gn*, gnathus; *Si*, socii; *U*, uncus.

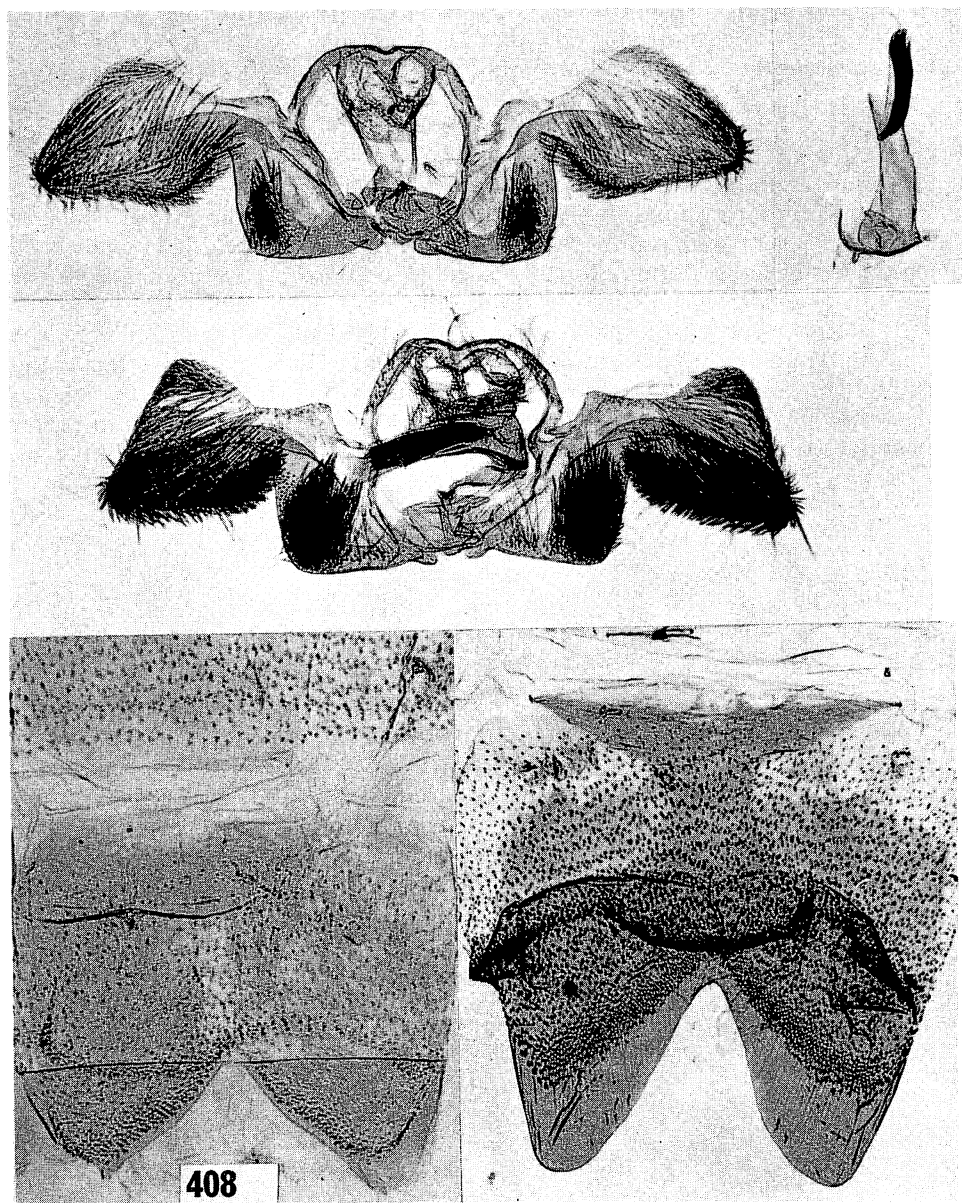


Figure 408—Male genitalia and caudal abdominal processes of *Crocidosema*. Top and bottom left, *leprara* (Walsingham); Niihoa Island (slide Z-I-14-65-B); see also the holotype on figure 409. Middle and bottom right, *marcidella* (Walsingham); Mt Tantalus, Oahu (slide Z-I-15-65-A). Compare figure 410.

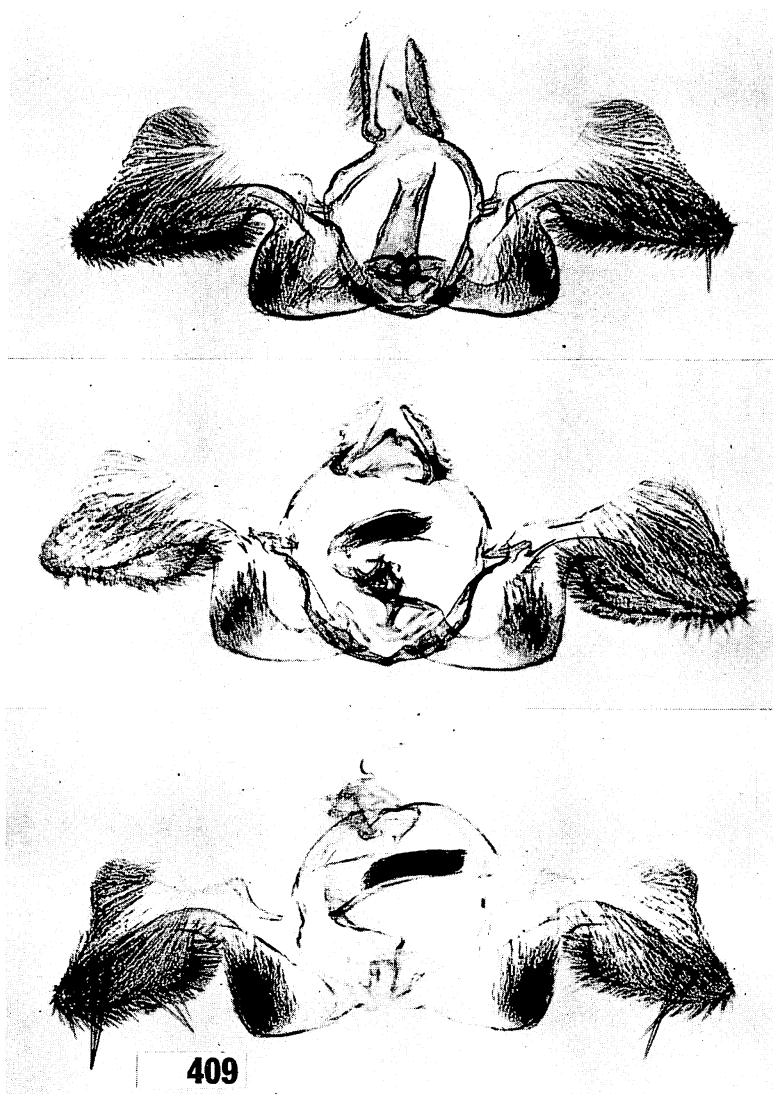


Figure 409—Male genitalia of *Crocidosema*. Top, *plebejana* Zeller, holotype (BM slide 1838); Sicily. One or two long spines have been broken off the left valva, and the cornuti of the internal sac of the aedeagus have been shed. Middle, *leprara* (Walsingham), holotype (BM slide 1877); Molokai, sea level. Bottom, *marcidella* (Walsingham); Kauai (Busck slide 224). Compare the enlargements in figures 410 and 411.

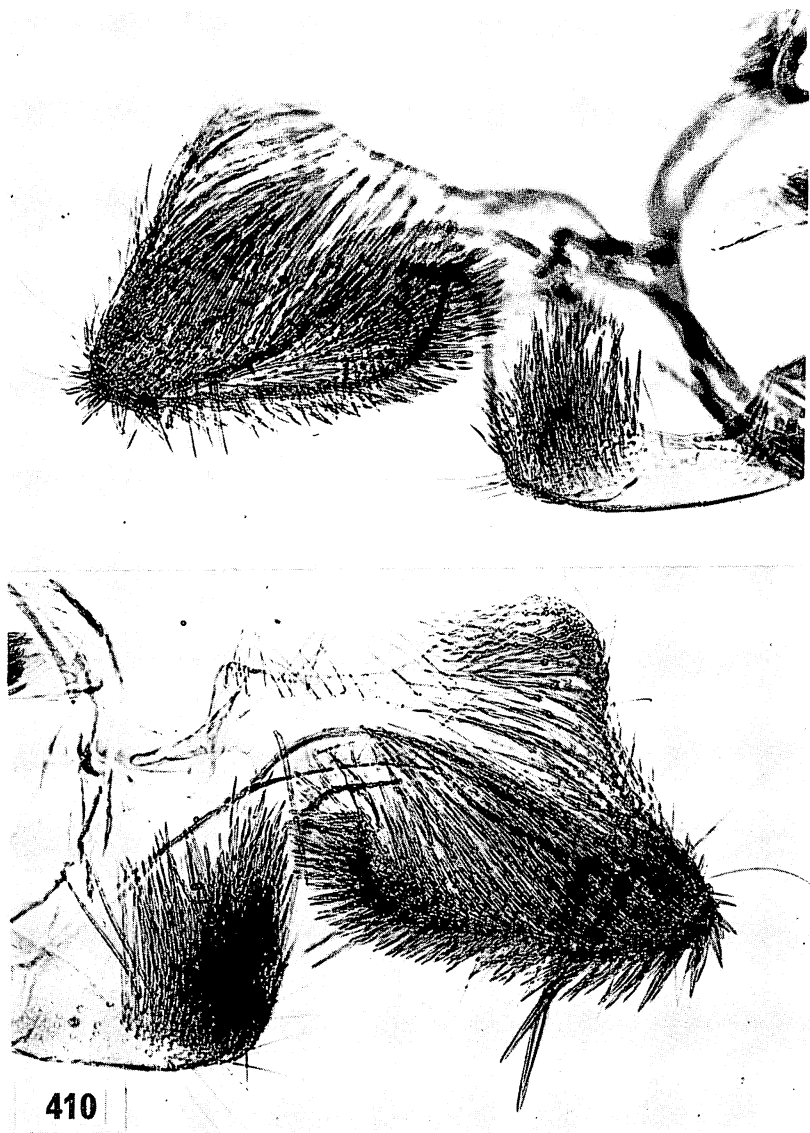


Figure 410—Male genitalia of *Crocidosema*. Top, ectal aspect of the right valva of *leprara* (Walsingham), holotype (BM slide 1877). Bottom, ental aspect of the right valva of a specimen of *marcidella* (Walsingham) from Kauai (Busck slide 224). Compare figures 408 and 409.

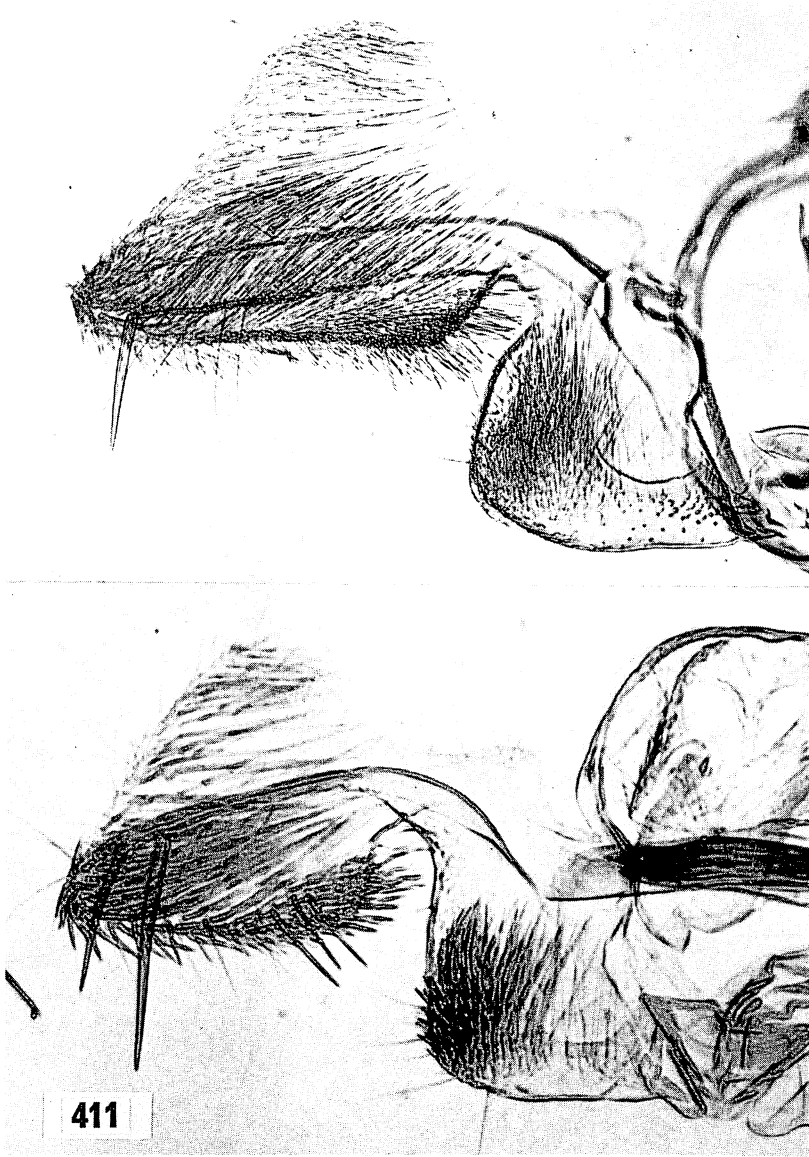


Figure 411—Male genitalia of *Crocidosema*. Top, ectal aspect of the right valva of the holotype of *plebejana* Zeller (BM slide 1838); Sicily. Bottom, the same view of a specimen of *blackburnii* (Butler); Lanai (Busck slide 104).



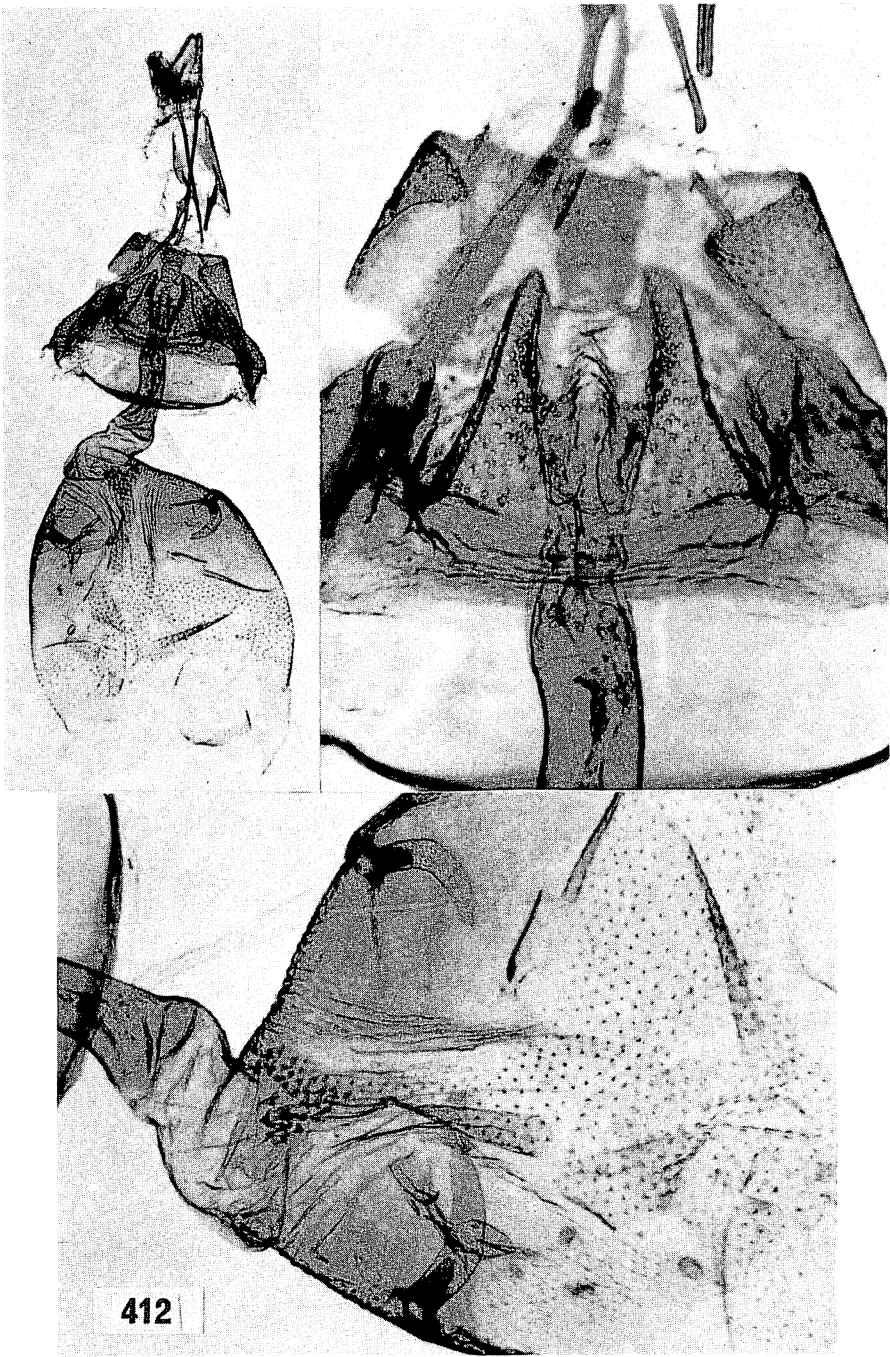


Figure 412—*Crocidosema blackburnii* (Butler), female genitalia (BM slide 7551); Waianae Mts., Oahu.

Oahu, and the other from Honolulu. They were mentioned by Walsingham in his supplementary remarks on page 736 of his *Fauna Hawaiiensis* monograph. Perkins said (1913:clxvii): "*Gypsonoma leprorum* is less abundant [than *blackburnii*] and may be an introduction. If not, it is probably a natural immigrant and will be found elsewhere."

I have examined several specimens, and they all agree in the characters of the male and female genitalia as illustrated and as described in the key.

***Crocidosema marcidella*** (Walsingham) (figs. 404, ovipositor; 406, moths; 408–410, male genitalia; 414, female genitalia).

*Adenoneura? marcidellum* Walsingham, 1907b:678, pl. 10, fig. 18.

*Crocidosema marcidellum* (Walsingham) Swezey, 1915b:61. Heinrich, 1923:190. Meyrick, 1932:222.

Endemic? Kauai, Oahu (type locality: Waianae Mountains).

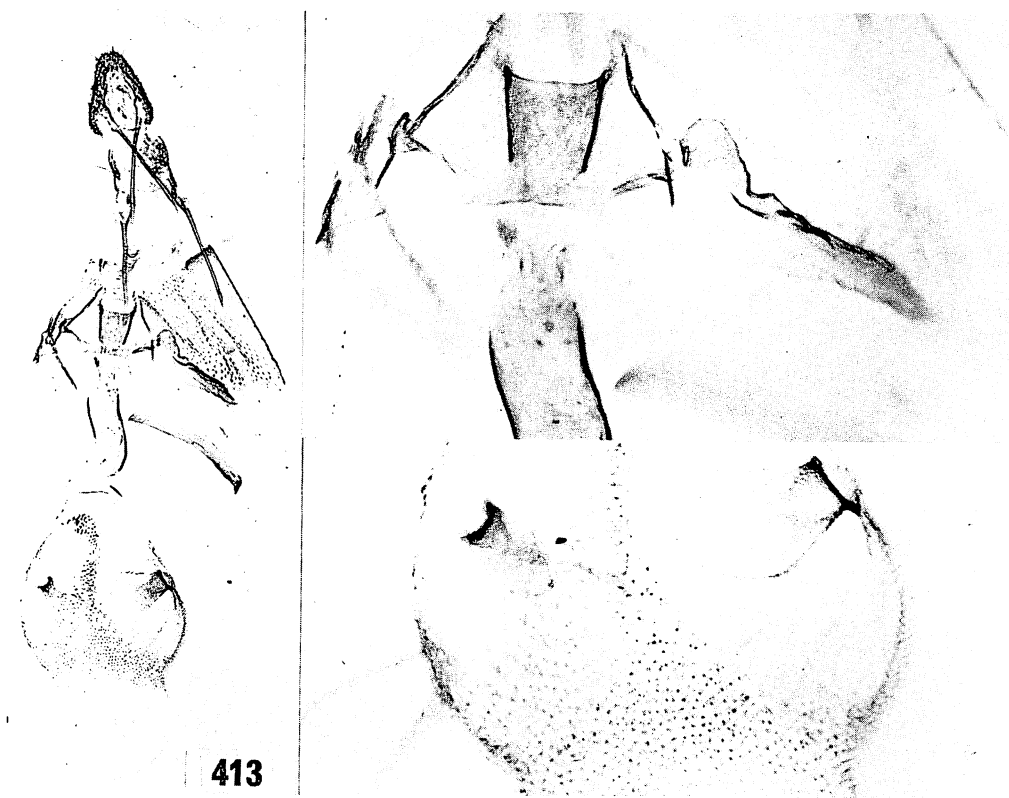
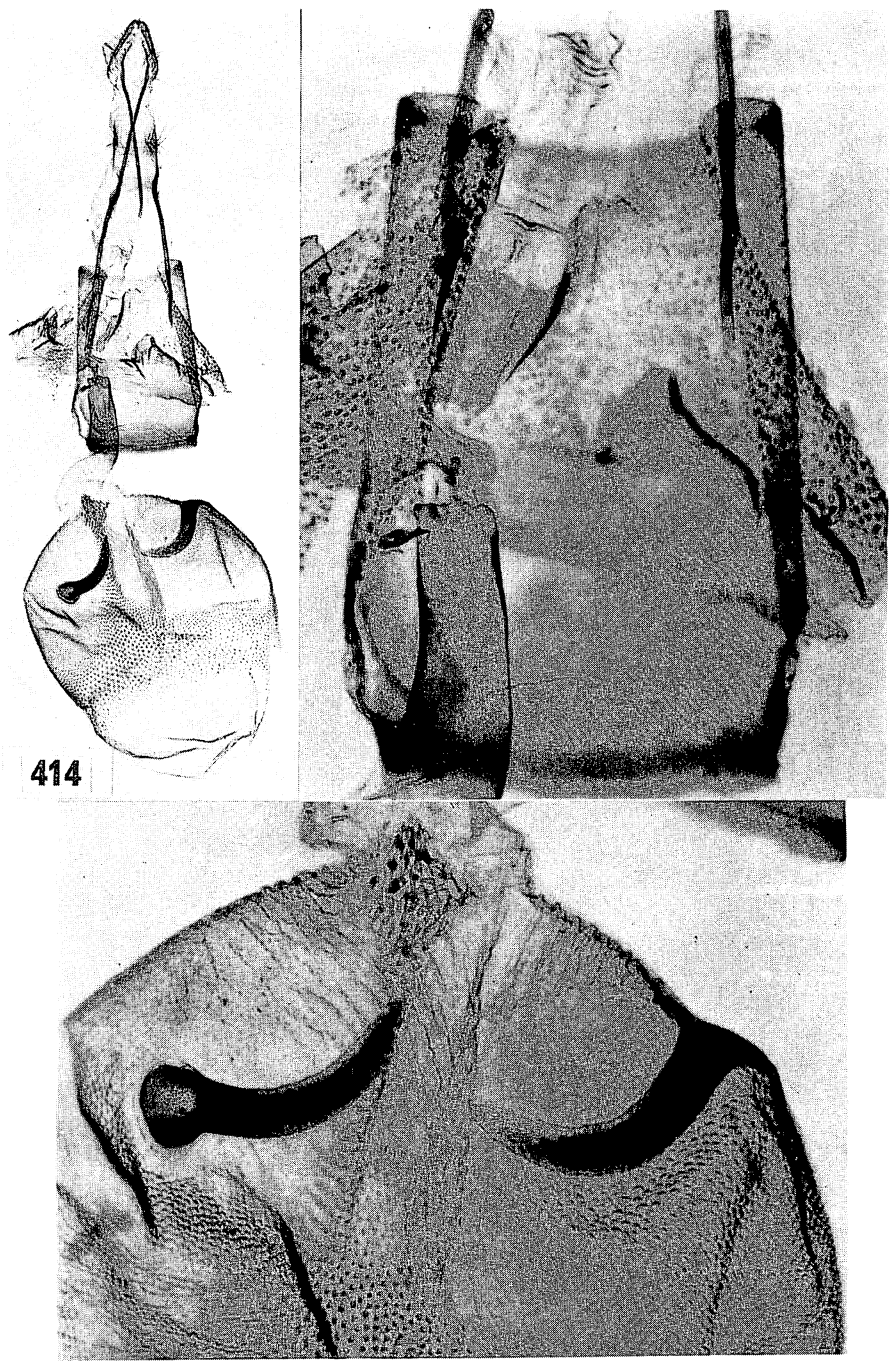


Figure 413—Female genitalia of *Crocidosema leprara* (Walsingham), holotype (BM slide 1878); sea level, Molokai. A specimen from Nihoa Island is exactly like this specimen, including details of the ostium and signa.



414

Figure 414—Female genitalia of *Crocidosema marcidella* (Walsingham), holotype (BM slide 1873); Waianae Mts., Oahu. Another specimen reared from *Hibiscus* on Mt. Tantalus, Oahu, has closely similar genitalia.

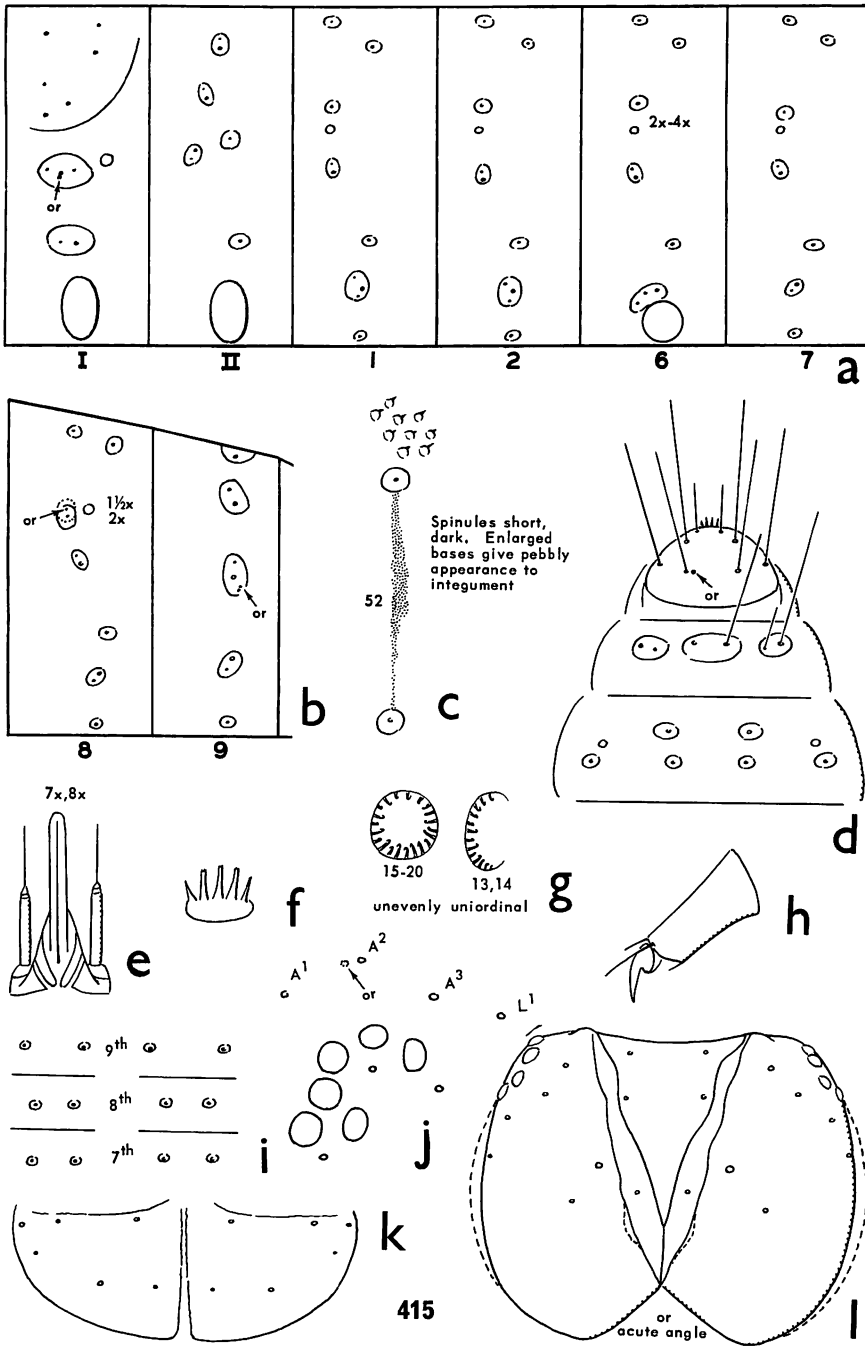


Figure 415—Details of the larva of *Crocidosema plebejana* Zeller, American specimen. *a*, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; *b*, the same of abdominal segments 8 and 9; *c*, dorsal setae, pinacula, and dermal spinules of an anterior abdominal segment; *d*, dorsal aspect of abdominal segments 8, 9, and 10; *e*, spinneret and labial palpi; *f*, anal fork; *g*, crochets of a mid-abdominal and an anal proleg; *h*, lateral aspect of a thoracic tarsus; *i*, the VI setae of abdominal sternites 7, 8, and 9 of two specimens to show variation; *j*, ocellar area of the left side of the head; *k*, prothoracic shield; *l*, frontal aspect of head. (Plate loaned by Margaret MacKay.)

Hostplants: *Abutilon* (= *Abortopetalum*) *sandwicense*, *Hibiscus arnottianus*.

Parasites: *Pristomerus hawaiiensis* Perkins, *Trathala flavo-orbitalis* (Cameron).

This species was described from one female collected by Perkins in April, 1892, but it has since been found also in the Koolau Mountains of Oahu and in the highlands of Kauai. In contrast to the lowland species *blackburnii* and *leprara*, *marcidella* is an upland form. It is distinctly larger than either *blackburnii* or *leprara*; some specimens may have a wing expanse of 20 mm.

Most of what is known regarding the distribution and habits of this moth is the result of the work of Dr. Swezey. In 1915*b*:61–62, he published a paper

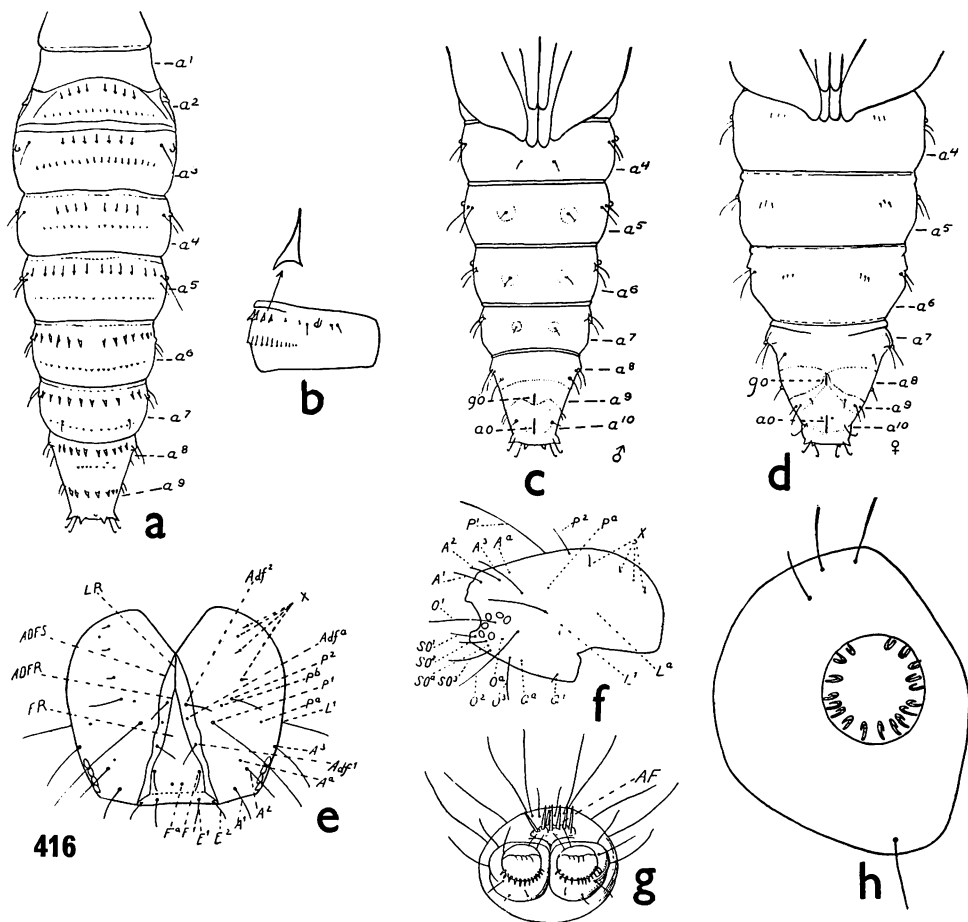


Figure 416—Details of the larva and pupa of *Crocidosema* (supposedly *plebiana* Zeller); American specimens (rearranged from Heinrich, 1921). *a*, dorsal aspect of the abdomen of a pupa; *b*, lateral aspect of an abdominal tergite to show the dorsal denticles; *c*, *d*, ventral aspects of male and female pupal abdomens; *e*, *f*, frontal and left lateral aspects of the larval head capsule; *g*, caudal aspect of the abdomen of a larva showing the anal fork at *AF*; *h*, ventral aspect of a ventral abdominal proleg of a larva showing the *SV* and *V* setae. The nomenclature of the chaetotaxy is that of Heinrich. *ao*, anal opening; *go*, genital opening.

"Notes on '*Crocidosema marcidellum*' (Walsm.)", in which he reported upon his having reared 34 specimens, including many which "exactly match the figure given by Walsingham. . . ." He stated that:

My series of specimens were all reared from larvae in fruits of the native Hibiscus (*H. arnottianus*) collected from a tree along the Manoa Cliffs Trail of Mt. Tantalus, March 15th, 1914. It was the first time that I ever found fruits on a tree of the native Hibiscus, and I noticed that they were much eaten, so took along about two dozen of them (about all that I could conveniently obtain) to rear the moth from the numerous larvae infesting them. My 34 specimens emerged April 3rd to the 16th.

Mr. J. F. Rock told me once that he had found the fruits of this Hibiscus and other related trees in the mountains of Hawaii badly eaten by insects. I have no doubt [that] they were the larvae of this moth.

The eggs of the moth are laid on the outside of the enclosing calyx. On hatching the young larva eats through this, and feeds for a time between it and the fruit, finally eating inside of the fruit and destroying all of the seeds. In the lot of fruits that I collected were but three seeds remaining uninjured when the larvae had finished with them.

The young larvae have the head and cervical shield black. The full-grown larva is about 12 mm. in length, dirty whitish or yellowish with a rosy tinge; head very pale testaceous, eyes black, a black streak behind eyes and above this the posterior margin of the head is black; cervical shield concolorous, two submedian blackish spots at posterior margin; spiracles circular, black margined; surface of body minutely roughened except circular areas at base of setae.

The pupa is about 7 mm. in length; yellowish brown; wing-sheaths and posterior leg-sheaths extend to apex of 4th abdominal segment, antenna-sheaths a little shorter; two transverse rows of small backwardly-directed spines on dorsum of abdominal segments 2-7, those of the anterior row the larger, one row on segments 8 and 9; cremaster blunt, with two lateral and two dorsal spines.

In 1933b:302, Dr. Swezey reported: "One specimen . . . was reared from a larva found boring in a petiole of leaf of *Abortopetalum sandwicense* in Makaha Valley, 1850 ft. elevation, March 30, 1933, by Mr. Glenn Russ. Five specimens were reared from the same plant in Kamokuiki Valley, about 2000 ft. elevation, Waianae Mts., April 13, 1933 (Swezey and Williams). The petioles in which larvae are boring become considerably swollen. The only previous rearing of this moth was from fruits of *Hibiscus arnottianus* on Mt. Tantalus, 1914 and 1924 (Swezey)."

Although this form appears to be very close to *blackburnii*, it does appear to be a distinct species with different habits. I have been able to separate the moths I have seen from those of *blackburnii* by external appearance and by the structure of the female genitalia as noted in the key. I have, however, been surprised to have been unable to find any reliable differences in the male genitalia.

### Genus **EPINOTIA** Hübner

*Epinotia* Hübner, 1825:377. Type-species: *Tortrix similana* Hübner. Heinrich, 1923, figs. 38, 358 male genitalia.

See Heinrich, 1923: 194, for redescription, discussion and extensive synonymy.

*Epinotia* is a large, widespread genus whose only representative in Hawaii has been purposely introduced to assist in the biological control of *Lantana*. It is closely similar to *Crocidosema*, and one can only wonder whether the species in Hawaii is really generically distinct from *Crocidosema*. The females are closely similar, but the male genital valvae of *Crocidosema* each has a conspicuous longitudinal "rib" on the ectal surface which is distinctive.

***Epinotia lantana*** (Busck) (figs. 417, head, wing venation; 417-A, *g-i*, pupa; 418, moth, male genitalia; 419, female genitalia; 420, larva).

*Crocidosema lantana* Busck, 1910*b*:132. Swezey, 1924:76, fig. 3.

*Epinotia lantana* (Busck) Heinrich, 1923:190.

*Eucosma polyphaea* Turner, 1926:138. Synonymy by Common, 1957:230.

*Eucosma tornocosma* Turner, 1946:205. Synonymy by Common, 1957:230.

*Eucosma phaedropa* Turner, 1946:209. Synonymy by Common, 1957:230.

The lantana flower-cluster moth (lantana tortricid moth).

Kauai, Oahu (type locality: Mt. Tantalus, Honolulu; type 13149 in U.S. National Museum), Molokai, Maui, Hawaii.

Purposely introduced by Koebele from Mexico in 1902 to aid in the control of the *Lantana* weed pest.

Hostplants: *Bignonia chrysantha* (in pods), *Lantana* (in flower heads, feeds on berries and bores in tender twigs), litchi (in stem), *Tecoma stans* (in terminal twigs).

Parasites: *Bracon mellitor* Say, *Perisierola emigrata* Rohwer, *Pristomerus hawaiiensis* Perkins.

Predator: *Pachodynerus nasidens* (Latreille).

In 1924, Dr. Swezey reported that the

... larvae bore in the tender, growing shoots of lantana, and also feed in the flower heads, eating the flowers and hollowing out the receptacle, thus preventing the growth of the fruit, and they also feed to some extent on the fruit as well, boring into and consuming the pulp. In a count made of fruits of lantana collected in Manoa Valley, 30% were found to have been attacked by the larvae of this moth. At another time a

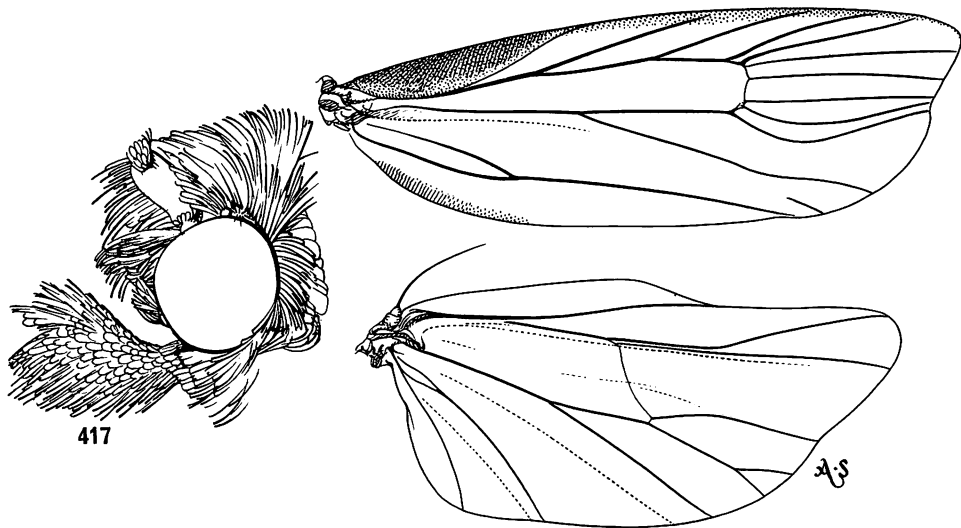


Figure 417—Head and wing venation of *Epinotia lantana* (Busck); Honolulu specimens. The head is that of a female. The male wings are on slide BM 5431; note the strong costal fold.

count made of the flower clusters on some lantana bushes, showed that 73% of them were infested by these larvae and a few of the larvae of the plume moth. On the same bushes the older flower heads showed a 65% destruction by the Tortricid larvae. Of this 65%, 26% had been destroyed by the larvae boring in the peduncle or flower stem and thus killing it before the flowers were developed; 39% of them had flowered, but the flowers had been eaten off or sufficiently injured so that no fruits had been produced. Of the remaining 35% of flower clusters that had produced fruits, there was an average of but 4.17 fruits per cluster as compared with 37.2 the normal average of flowers per cluster. This enormous reduction was largely due to the moth larvae, though the butterfly larvae and also the Tingid bug may have had a share in it.

In many places the general appearances indicated almost an entire destruction of flower clusters by the Tortricid and plume moth larvae, though no actual count was made for comparison.

The eggs are laid in the flower heads, often before the blossoms open, and are attached to the surface of a bract or other part of the flower. Length about .5 mm., flattish, nearly circular, upper surface evenly convex, covered with a fine reticulation, pale yellowish and slightly iridescent.

The full grown larva is about 6 mm. long, fuscous colored, with a slight reddish tinge, the head black, and a black spot on dorsum of first thoracic segment. Pupation takes place within the place where the larva fed, either in the receptacle of the flower cluster or webbed-together remains of the flowers or fruits. The pupa is brown, about 5 mm. long, and has transverse rows of short spines on the abdominal segments.

In some districts of the Islands and at certain times, this insect accomplishes more than any other in the prevention of lantana seed formation. (Swezey in Perkins and Swezey, 1924).

About 1914, this moth was purposely introduced from Hawaii into Australia where it has become widespread along the east coast where *Lantana* grows. Turner failed to recognize it as the introduced species, and he described three of its color forms as supposedly new Queensland endemics. For details concerning these facts, see Common, 1957:230. In 1948 and 1949, the moth was sent by Pemberton from Honolulu to Ponape in the Caroline Islands where it became established on the *Lantana* pest.

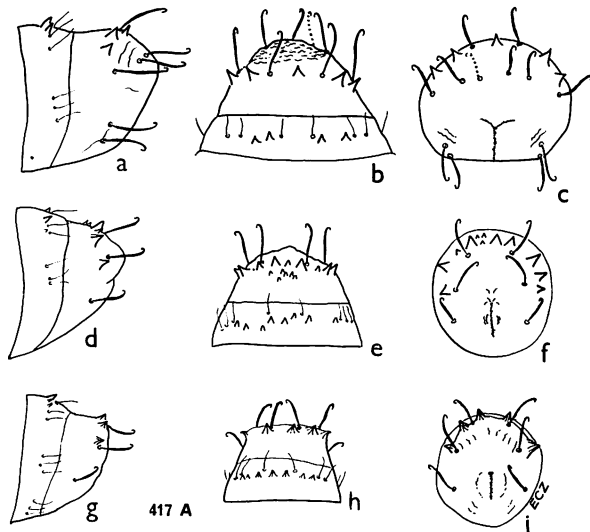


Figure 417-A—Details of the caudae of some tortricid pupae. *a, b, c*, lateral, dorsal, and caudal aspects of *Eccoptocera* species; Olinda, Maui, ex *Metrosideros*; length 7 mm. *d, e, f*, the same of *Strepsicrates smithiana* Walsingham; Panacwa Forest, Hilo, Hawaii; ex *Myrica cerifera*; length 7.5 mm. *g, h, i*, the same of *Epinotia lantana* (Busck); Honolulu; ex *Tecoma stans*; length 5.5 mm.



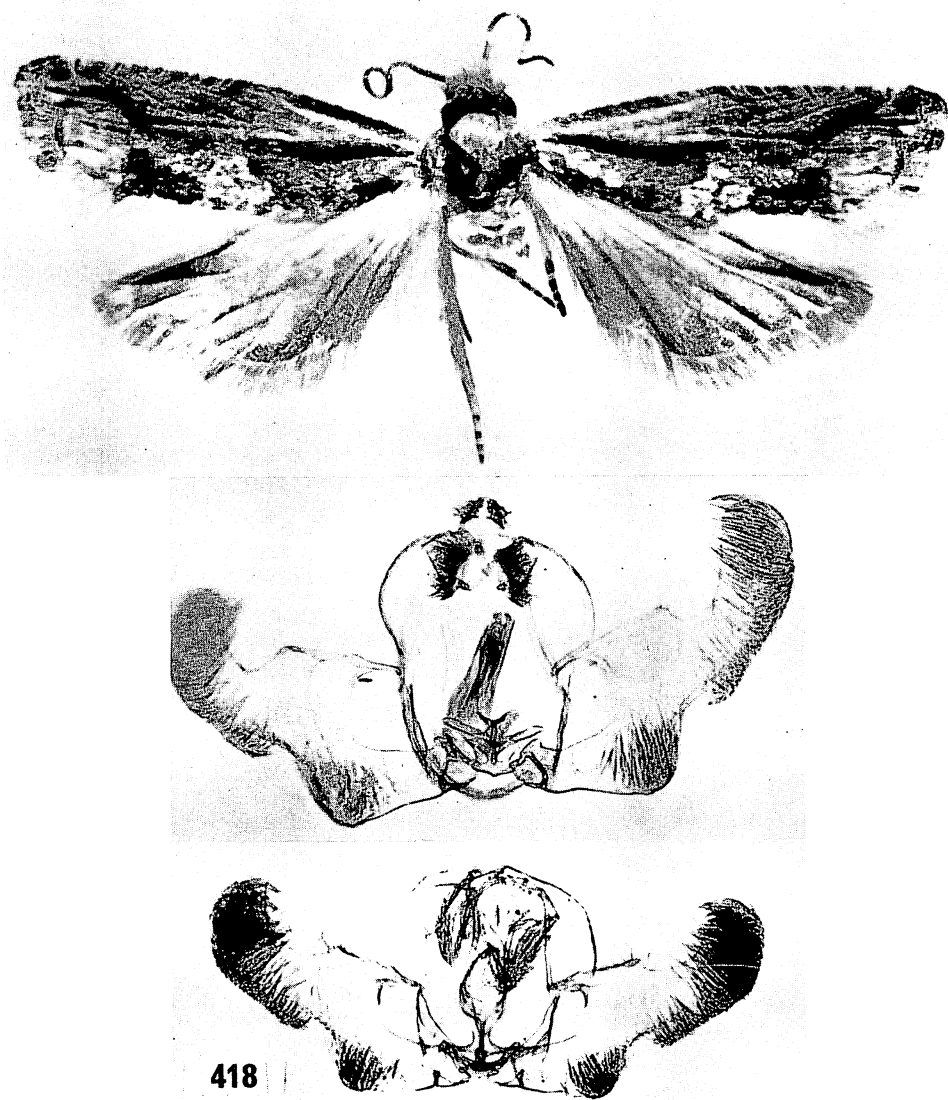


Figure 418—*Epinotia lantana* (Busck). Top, a moth from Manoa, Oahu; expanse 13 mm. Middle, male genitalia from a paratype from Mt Tantalus, Oahu (BM slide 1876). Bottom, a specimen from Honolulu (BM slide 5431).



Figure 419—Female genitalia of *Epinotia lantana* (Busck). Top, from a specimen from Manoa, Oahu (Busck slide 226). Bottom, the area of the ostium from another Honolulu specimen (BM slide 5400).

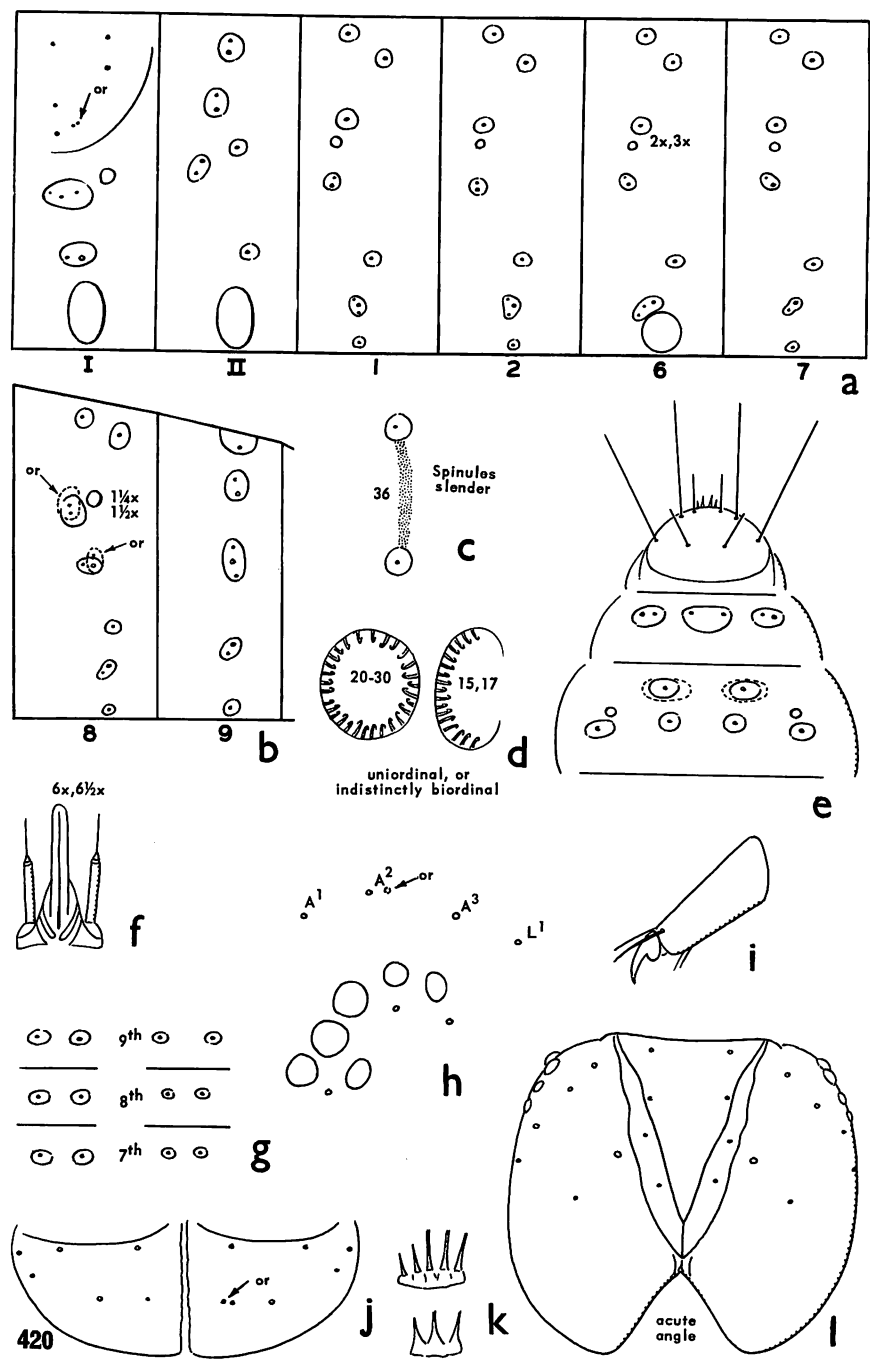


Figure 420—See legend on page 637.

Genus **EPISIMUS** Walsingham

*Episimus* Walsingham, 1892 (1891):501; 1897b:122. Type-species: *Carpocapsa transferrana* Walker.

Heinrich, 1926:78, redescription and illustrations.

*Episimus* is American, and, although some of the species range as far north as southern Canada, the genus is predominantly tropical. A purposely introduced species represents the genus in Hawaii.

***Episimus utilis* Zimmerman, new species** (figs. 421, head and wing venation; 422, moths; 423, male, female genitalia; 425, larva and pupa; 426, pupa).

*Episimus argutanus*, as a misidentification, not of Clemens, 1860b:358.

Closely similar in color pattern to *argutanus*, variable, but usually paler, especially in the male, that sex having a pale area containing many white

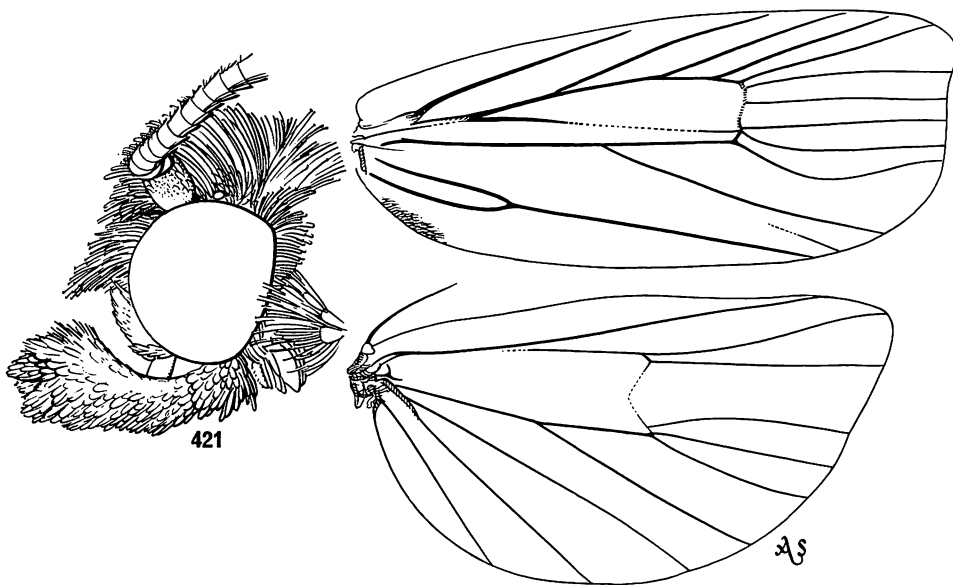


Figure 421—Head and wing venation of *Episimus utilis* Zimmerman; Wailupe, Oahu (BM slide 6201).

Figure 420—Details of the larva of *Epinotia lantana* Busck. *a*, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; *b*, setal map of abdominal segments 8, 9, and 10; *c*, the D1 setae, pinacula, and dermal spinules of an anterior abdominal segment; *d*, crochets of a mid-abdominal and an anal proleg; *e*, dorsal aspect of abdominal segments 8, 9, and 10; *f*, spinneret and labial palpi; *g*, the V1 setae of abdominal ventrites 7, 8, and 9 of two specimens to show variation; *h*, ocellar area of the left side of the head; *i*, a thoracic leg tarsus; *j*, prothoracic shield; *k*, anal fork; *l*, frontal aspect of head. (Plate loaned by Margaret MacKay.)

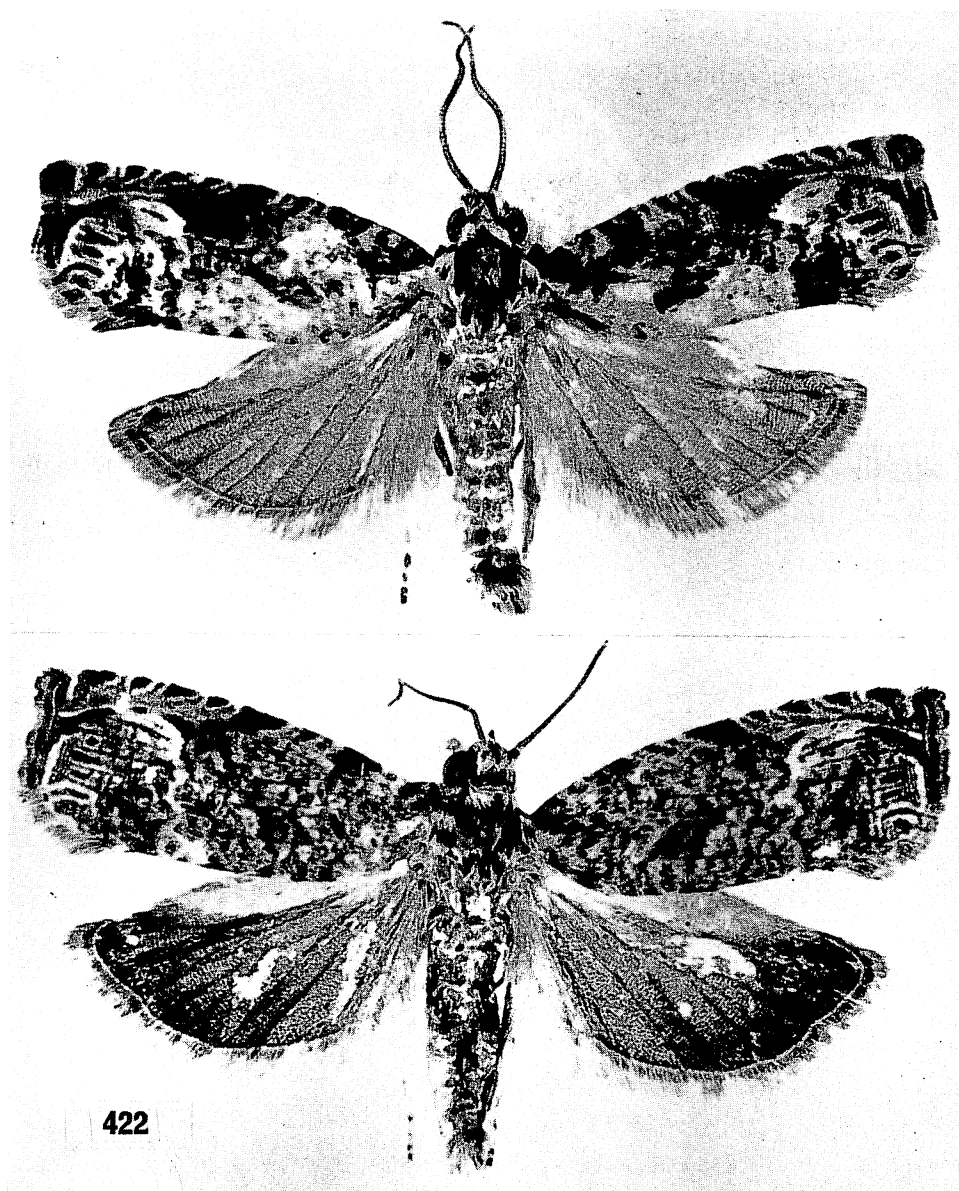


Figure 422—Male, top, and female *Episimus utilis* Zimmerman; Mapulehu, Molokai; reared from *Schinus* by J. W. Beardsley; expanse about 14 mm.

squamae extending from near base to about the distal two-thirds of the posterior margin of the forewing and expanded moderately costad at midwing, but this pale area obscured by more contained dark maculation in the female (see figure 422). Sides of metanotum (metascutum) clothed with mostly long, slender squamae with a cluster of long hairs on ectal edges (in *argutanus*, clothed entirely with broad or very broad, apically broadly truncate or subtruncate squamae). Male genitalia with uncus slender and needlelike (dorsoventrally broader and more bladelike in *argutanus*), with the ectal angle between the ventral margin of the valva and the ventral process of the margin of the valva much broader in *utilis* and approximating  $130^\circ$  (instead of about  $90^\circ$ – $100^\circ$  in *argutanus*), and the aedeagus appears comparatively shorter and apically broader in *utilis*. Female genitalia evidently closely similar to *argutanus*. Larvae and pupae differing from *argutanus* as described below.

Holotype: male, from Waiupe Valley, Oahu, Hawaii; taken in a light trap by J. W. Beardsley in December, 1958. Allotype: female, from Ewa, Oahu, taken in a light trap by J. W. Beardsley, December 2, 1958. One male paratype with the same data as the holotype but collected on February 15, 1959 (wings on BM slide 6201); one male paratype with the same data as the allotype (male genitalia on slide BM 6211); one male paratype bred on *Schinus* in the laboratory in Honolulu, January, 1960 (genitalia on slide BM 6213); one female paratype with the same data (genitalia on slide BM 6114), and three male paratypes with the same data. All of these specimens are in the British Museum (Natural History).

Kauai, Oahu, Molokai, Maui, Hawaii.

Purposely introduced from Rio de Janeiro and Salvador, Bahia, Brazil in 1954, by the Hawaiian Department of Agriculture.

Hostplant: *Schinus terebinthifolius* (Christmas berry, Brazilian peppertree).

Parasite: *Bracon omiodivorum* (Terry).

The original stock for the importation of this species to Hawaii was collected in Brazil by Noel Krauss, and it was introduced to assist in the biological control of the Christmas berry, a pasture and range pest in Hawaii. The larvae web together and feed upon the leaves of the hostplant. The first Hawaiian liberation consisted of 200 adults which were released at Naalehu, Hawaii in December, 1954 (see Krauss, 1963:281). J. W. Beardsley first recorded it in the literature in 1959 as being established in the Hawaiian Islands (*Proc. Hawaiian Ent. Soc.* 17:28), after he had found the species on Molokai in 1958. He noted that the moth had been found to be established on Kauai, Oahu, Maui, and Hawaii by 1957 or earlier.

I am indebted to J. D. Bradley, J. F. G. Clarke, and Margaret MacKay for comments regarding this species. Miss MacKay most kindly illustrated the larva and pupa and provided some descriptive notes which I have rearranged as follows:

**LARVA:** Length of largest larvae is about 15 mm. Length and width, respectively, of the heads of two specimens: 1.08 mm. and 1.22 mm.; 1.05 mm. and 1.13 mm. Head pale, sometimes tinged with reddish, with a distinct blackish

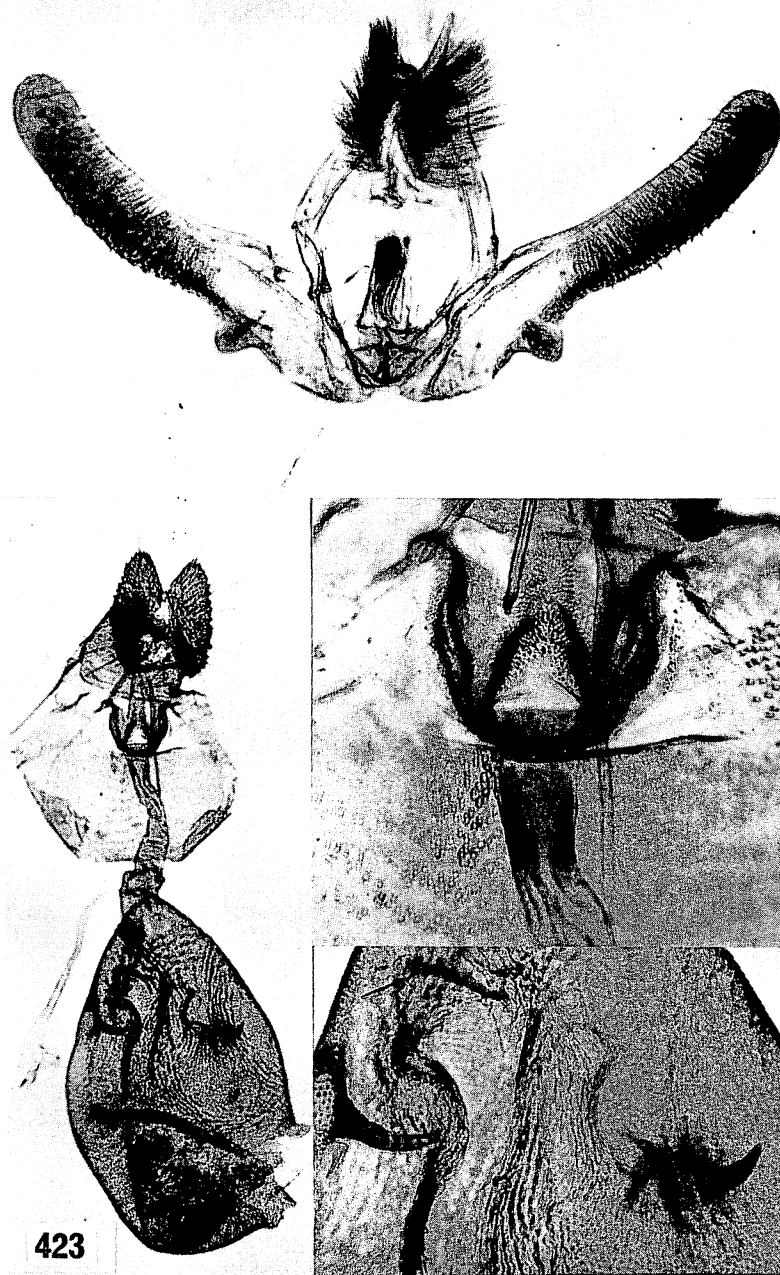
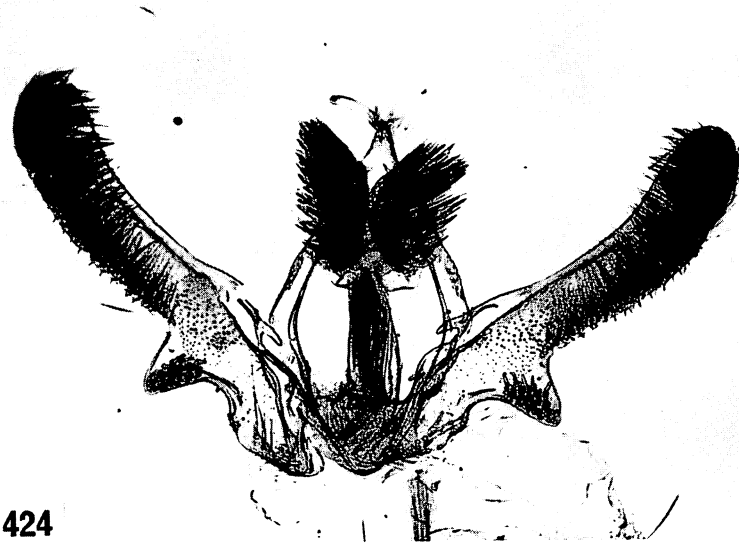


Figure 423—*Episimus utilis* Zimmerman. Male genitalia (BM slide 6211); Ewa, Oahu. Female genitalia (BM slide 6114); Honolulu.



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Figure 424—Male genitalia of *Episimus argutatus* Clemens; New Brighton, Pennsylvania (BM slide 6208).

ocellar area and bar extending anteriorly from postgenal juncture almost to the ocellar area. Thoracic shield pale, edged laterally with a narrow area of brown. Lateral pinaculum on prothorax with some brown pigment. Thoracic legs pale. Body color pale, sometimes tinged with reddish, or bright red. Pinacula of body color or slightly darker, easily observed. Spinules slender, dark, easily observed. Other characters as illustrated.

**DISTINCTIVE SPECIFIC CHARACTERS:** A distinct dark lateral bar is present on head; thoracic shield narrowly edged laterally with brown, and prothoracic lateral pinaculum with some brown pigment; each D1 seta on abdominal segment 9 on its own pinaculum which is equidistant from those of SD1 and D2 or occasionally fused with that of D2; D1 on anal shield as long as SD1 or almost so.

**PUPA:** with specific characters as compared with *Episimus argutatus*—proboscis extending posteriorly to caudal tip of prothoracic femur; caudal row of spines on abdominal tergite 8 present in both sexes and distinct; with a considerably greater number of spines on abdominal segments 9 and 10 than on *argutatus*; length of pupa: 6.5–7.0 mm. (On *argutatus*, the proboscis distinctly does not extend to the caudal tip of the prothoracic femur; the caudal row of spines on the 8th abdominal tergite of the female is absent and on the male there are only four or five widely spaced spines; spines on abdominal tergites 9 and 10 sparse; length of pupa about 5.0 mm.)



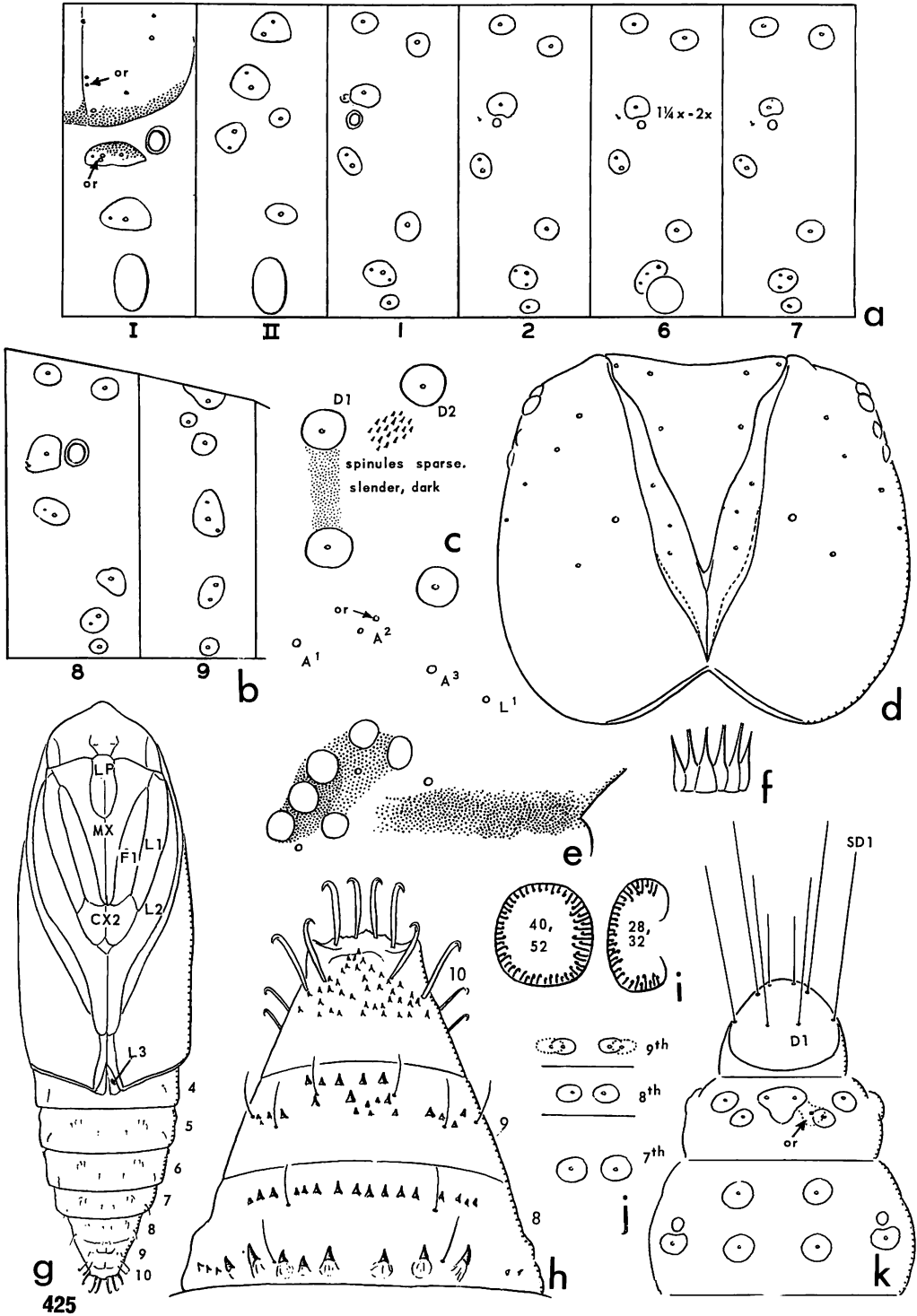


Figure 425—See legend on page 643.

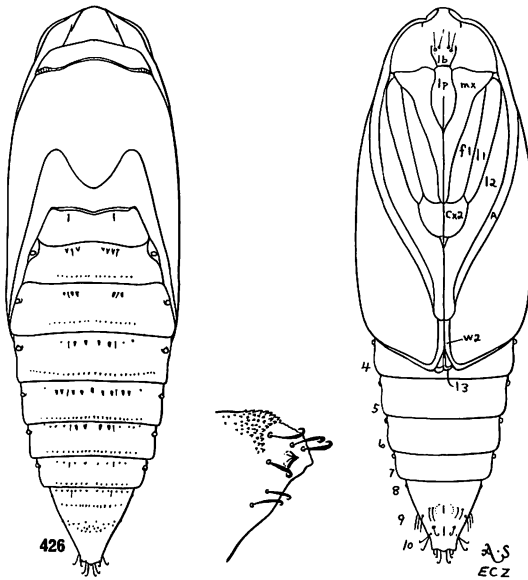


Figure 426—Pupa of *Episimus utilis* Zimmerman; female, length 12 mm.; Honolulu, laboratory reared. A sketch of the cauda in left lateral aspect is inset. *A*, antenna; *Cx2*, mesocoxa; *fl*, profemora; *l1*, *l2*, *l3*, legs; *mx*, galea of maxilla (proboscis); *W2*, hindwing.

Figure 425—Details of the larva and pupa of *Episimus utilis* Zimmerman, drawn especially for this text by Margaret MacKay. *a*, setal map of the pro- and mesothorax and abdominal segments 1,2,6,7; *b*, setal map of abdominal segments 8 and 9, in left aspect; *c*, dorsal setae and pinacula of an anterior abdominal segment together with an enlargement of the spinules of the derm; *d*, frontal aspect of head; *e*, ocellar area of the left side and the "lateral bar"; *f*, anal fork; *g*, ventral aspect of a male pupa; *h*, dorsal aspect of segments 8 to 10 of the male pupa; *i*, crochets of a mid-abdominal and a caudal proleg; *j*, the VI setae on the mid-ventral line of abdominal segments 7, 8, and 9; *k*, dorsal aspect of abdominal segments 8, 9, and 10.

## Superfamily **GRACILLARIOIDEA** (Stainton)

*Gracillarioidea*: Mosher, 1916:23, 31, 58.

### Family **GRACILLARIIDAE** Stainton

*Gracillariidae* Stainton, 1854:193. Anonymous, 1858:95. Sauveur and Fologne, 1863:109. Spuler, 1898a:33. Braun, 1908. Ely, 1917.

*Gracillarina*: Herrich-Schäffer, 1857:58.

*Gracillaridae*: Morris, 1870:153.

*Gracilaridae*: Staudinger and Wocke, 1871:310.

*Graciliarianae*: Walsingham, 1890:150.

*Gracillariadae*: Meyrick, 1912b:25; 1912c.

*Gracillariidae*: McDunnough, 1939:95.

*Ornichidae* Stainton, 1854:10 (used by error? in key; *nomen oblitum*).

*Lithocolletidae* Stainton, 1854:264. T. B. Fletcher, 1929:v. Vari, 1961 (detailed South African work).

*Phyllorxycteridae* Walsingham, 1914:336 (1909–1915) [*recte Phyllonorycteridae*].

*Eucestidae* Hampson, 1918b:387.

*Caloptiliadae* Fletcher, 1929:v.

*Caloptiliidae*, *auctorum*.

Much confusion exists regarding the spelling of the name *Gracillaria*. Haworth (1828:527) originally spelled it *Gracillaria*, but some of us believe that he misspelled the name which is derived from the Latin *gracilis*, “slender”, in reference to the slender appearance of the tiny moths. Haworth drew attention to this characteristic by calling them “the slenders”; he named them “the livid slender”, “the violaceous slender”, “the buff-blotched slender”, etc. In 1839, Zeller, who was evidently well-versed in the classics, corrected the spelling to *Gracilaria*. The classical scholars who assisted the Oxford and Cambridge entomological societies in the preparation of the useful work *An Accentuated List of the British Lepidoptera with Hints on the Derivation of the Names* (Anonymous, 1858) used the corrected spelling *Gracilaria*. Meyrick, a teacher of the classics, used *Gracilaria*, and many experienced and well-known authorities have accepted the emendation. The corrected spelling *Gracilaria* was used by Zeller, Herrich-Schäffer, Stainton, Heinemann, Meyrick, Walsingham, Butler, Hampson, Tutt, Chapman, Börner, Handlirsch, Mosher, Comstock, Clemens, Forbes, Fracker, Busck, Dyar, Ely, Braun, Costa Lima, Packard, Imms, Tillyard, Turner, Swezey, Brues, Melander and Carpenter, and many, many other authorities. To obtain stability in the use of the terms *Gracilaria* and *Gracillariidae*, N. D. Riley and I appealed to the International Commission on Zoological Nomenclature to have the names placed on the Official Lists of accepted names. See Zimmerman and Riley, 1966, 1967; Whalley et al., in Whalley, 1967; Common and Key, 1967.

Much to my astonishment and dismay, long after this text was completed and the form *Gracilaria* used scores of times throughout the work, the Commission voted to refuse our appeal and to revert to what I consider to be the erroneous spelling *Gracillaria*. I believe that they did so without independent

research into the questions involved. Supplementary evidence supplied by me emphasizing the overwhelming usage of the corrected form *Gracilaria* was not circulated to the members of the Commission (and evidently not shown to the Secretary until several months after I submitted it, and then only after a complaint by me). Before submitting our application for the preservation of the corrected form *Gracilaria*, detailed and prolonged examinations of a large number of books and articles were made by us, and we ascertained conclusively that, without question, the corrected form *Gracilaria* has been used by more than 75 percent, and possibly 90 percent, of those authors who have had occasion to use the name since 1839. With few exceptions, it has been only within the last comparatively few years that a few workers, including several of those who have opposed our application on the grounds that they believe it best to follow absolute priority, have used the erroneously formed but original spelling *Gracillaria*. In effect, most of the members of the Commission evidently listened to the opposition to our proposal without making an independent investigation or consulting us, and I consider this to be unfortunate.

The ruling on the Gracillaria problem is included as Opinion 912, *Bull. Zool. Nomenclature* 27(1):27, 1970. I was astounded to see Opinion 905 on page 6 of the same part of the same publication in which the Commission has approved the emendation of *Pollyxenus* to *Polyxenus*! One can only ask: how is it possible for a supposedly impartial Commission to approve the logical application of Dr. Kraus to correct *Pollyxenus* to *Polyxenus* but refuse to accept our plea for exactly the same kind of correction from an erroneously formed *Gracillaria* to *Gracilaria*? If Dr. Kraus was thought correct, then our application, being entirely comparable and having been accepted by the overwhelming majority of authors since 1839, should also have been accepted. How can the Commission have it both ways? Professor Bonnet's *A Plea Against the Re-Establishment of Incorrectly Spelt Names* [*Bull. Zool. Nomenclature* 23 (3/4): 160, 1969] is suggested reading in connection with this case.

Because of the Commission's ruling, I have been obliged to alter the spelling as I had used it many, many times in this text. I can only hope that all of the alterations have been made in the right places and that no further confusion has been introduced.

Vari included a key to the genera of Gracillariidae in his important, well-illustrated volume on the South African species (1961), but he overlooked the Hawaiian *Philodoria*, evidently because some workers had placed it incorrectly in the Glyphipterigidae. His illustrations of various characters of the type-species of most of the genera of the family are of great assistance. It is unfortunate that Vari wrongly chose to use the family name Lithocolletidae instead of Gracillariidae.

Stainton, in his work on British Microlepidoptera (1854:193), said that "the species of this family sit on their *tails*, having the head considerably raised from the surface on which they repose, the anterior pair of legs being put forward, the middle pair rather stretched out sideways, and the posterior pair placed close beside the abdomen; by this peculiarity any species of this family may be immediately recognized if seen at rest." Vari (1961:xi) observed that "the peculiar posture of most species of the imagines is characteristic for this family. The anterior part of the insect is elevated and the fore and middle legs

prominently displayed. In *Cuphodes* and *Lithocolletis*, however, the head is kept down, the abdomen lifted and supported by the hind legs, the fore and middle legs stretched forwards." I regret that I cannot record details regarding the postures of the Hawaiian endemics, but see the note under *Caloptilia*.

This is a group of mostly highly colored, beautiful little leaf miners that are now represented in Hawaii by three genera, one of which has been purposely introduced for biological control purposes, one accidentally imported, and one extensively speciated endemic group.

#### KEY TO THE GENERA OF GRACILLARIIDAE IN HAWAII

1. Head with scaling of front shaggily overlapping anterior parts of eyes, and crown with erect, bristling vestiture; labial palpi short and drooping; wing venation much reduced, as in figure 427 . . . . . **Cremastobombycia.**

Head all smooth-scaled; labial palpi long and sickle-shaped; wings with more complex venation as in figures 432–433 . . . . . 2

2. Middle tibiae thickened by heavy scaling and obviously thicker than posterior tibiae (figure 443); posterior tarsi very long, more than twice as long as posterior tibiae; wings as in figure 432 . . . . . **Caloptilia.**

Middle tibiae slender and clothed as posterior tibiae; posterior tibiae about three-fourths as long as posterior tarsi; wings as in figures 432–435 . . . . . **Philodoria.**



Figure 427—Head and wing venation of *Cremastobombycia lantanella* Busck; paratype, Honolulu (BM slide 5139).

Genus **CREMASTOBOMBYCIA** (Braun)

*Lithocolletis* subgenus *Cremastobombycia* Braun, 1908:349. Type-species: *Lithocolletis solidaginus* Frey and Boll, 1876.

Vari, 1961:205, redescription.

This is a small American genus, one species of which has been purposely introduced to Hawaii.

***Cremastobombycia lantanella*** Busck (figs. 427, head, venation; 428, moth, larva, pupa, cocoon; 429, moth, male and female genitalia).

"*Lithocolletis* sp." Kotinsky, 1906:124, fig. 6.

*Cremastobombycia lantanella* Busck, 1910*b*:133. Swezey, 1924:78, fig. 5.

The lantana leaf miner.

Niihau, Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Kahoolawe, Hawaii.

Introduced purposely from Mexico in 1902 to aid in the control of the *Lantana* weed pest.

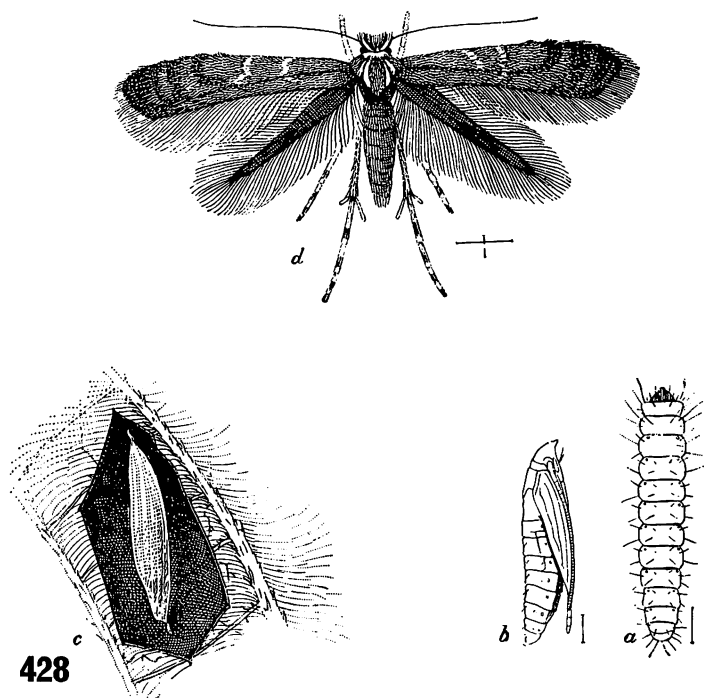


Figure 428—*Cremastobombycia lantanella* Busck. *a*, larva; *b*, lateral aspect of pupa; *c*, cocoon suspended within a larval mine in a lantana leaf; *d*, the moth. (After Kotinsky, 1906:123.)

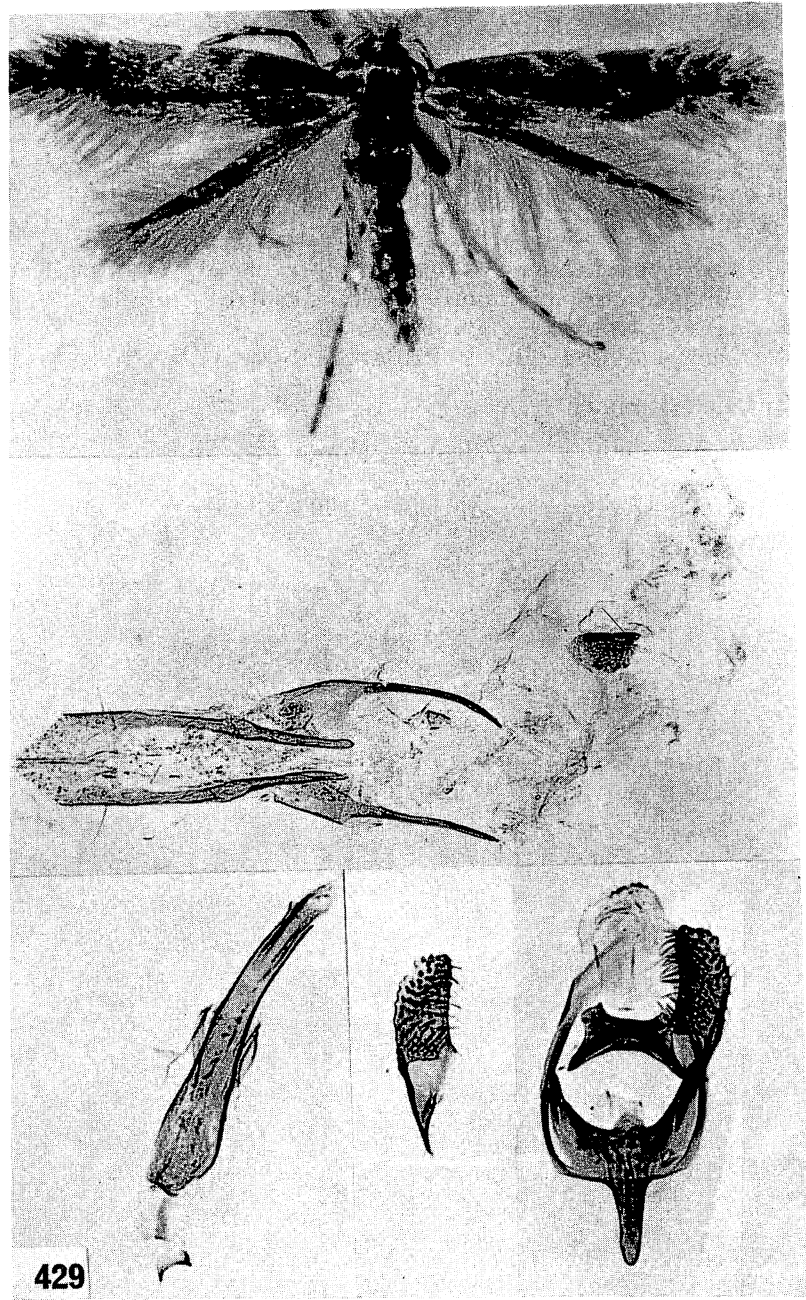


Figure 429—*Cremastobombycia lantanella* Busck. Top, a specimen from Palolo, Oahu; forewing=2.75 mm. Middle, female genitalia, Puu Kapele, Kauai (slide Z-VII-1-61-A). Bottom, male genitalia, Waipio, Oahu (slide Z-VII-1-61); the aedeagus is at the left and the left valva is in the middle.





Genus **CALOPTILIA** Hübner

- Caloptilia* Hübner, 1826:427. Type-species: *Tinea stigmatella* Fabricius, 1781:295 ( = *Caloptilia upupaepennella* Hübner, 1826:427). Vari, 1961:3.
- Poeciloptilia* Hübner, 1826:427. Type-species: *Tinea falconipennella* Hübner, 1816 (1796–1838): fig. 317.
- Gracillaria* Haworth, 1828:527 (1803–1828). Type-species: (*Gracillaria anastomosis* Haworth, 1803–1828 = ) *Tinea syringella* Fabricius, 1794:328 (1793–1794).
- Ornix* Treitschke, 1833:194. Type-species: *Tinea stigmatella* Fabricius, 1781:295.
- Gracilaria* (Haworth) Zeller, 1839:208, corrected spelling. Meyrick, 1907c:64, incorrectly designated *alchimella* Scopoli as type-species.
- Coriscium* Zeller, 1839:209. Type-species: (*Coriscium ligustrinellum* Zeller, 1839) = *Tinea cuculipennella* Hübner, 1796.
- Antiolopha* Meyrick, 1894:25. Type-species: *Antiolopha hemiconis* Meyrick, 1894:25.
- Xanthospilapteryx* Spuler, 1910:407 (1901–1910). Type-species: *Tinea syringella* Fabricius, 1793–1794:328.
- Vari, 1961:3–4, 27–28, redescription.

*Caloptilia* is a large and widespread genus. More than 50 species occur in America north of Mexico, and a larger number is known from Eurasia. The generic name *Caloptilia* has not appeared in Hawaiian literature heretofore, but I have found that one of the species previously assigned to *Parectopa* in Hawaii is really a *Caloptilia* and is not related to the endemic complex. The wing shape and venation (see figure 432) is like no other genus now known from Hawaii. The characters of the legs and wings, as noted in the generic key, make comparatively easy the identification of this genus among the other Gracillariidae known to be established in Hawaii.

For a recent, well-illustrated report on some of the Japanese species of *Caloptilia*, see Kumata, 1966.

Some authors consider *Gracillaria* to be a subgenus of *Caloptilia* instead of a synonym. See Vari, 1961:27, for example.

***Caloptilia mabaella*** (Swezey), **new combination** (figs. 431, male and female genitalia; 432, venation; 439, cocoon; 443, moth; col. pl. 3:1).

*Gracilaria mabaella* Swezey, 1910a:89, pl. 3, fig. 6.

*Parectopa mabaella* (Swezey) Swezey, 1928d:190.

The Hawaiian ebony leaf miner.

Oahu (type locality: Niu Ridge).

Immigrant. Although this species is not now recognized from any locality outside of Hawaii, I believe that it is an introduced insect. It appears similar to some Japanese and American *Caloptilia*, and it is probable that it has been introduced from Japan or from North America.

Hostplants: *Diospyros* ( = *Maba*) *Hillebrandii*, *Diospyros sandwicensis*.

Parasites: *Euderus metallicus* (Ashmead), *Sierola gracilariae* Fullaway.

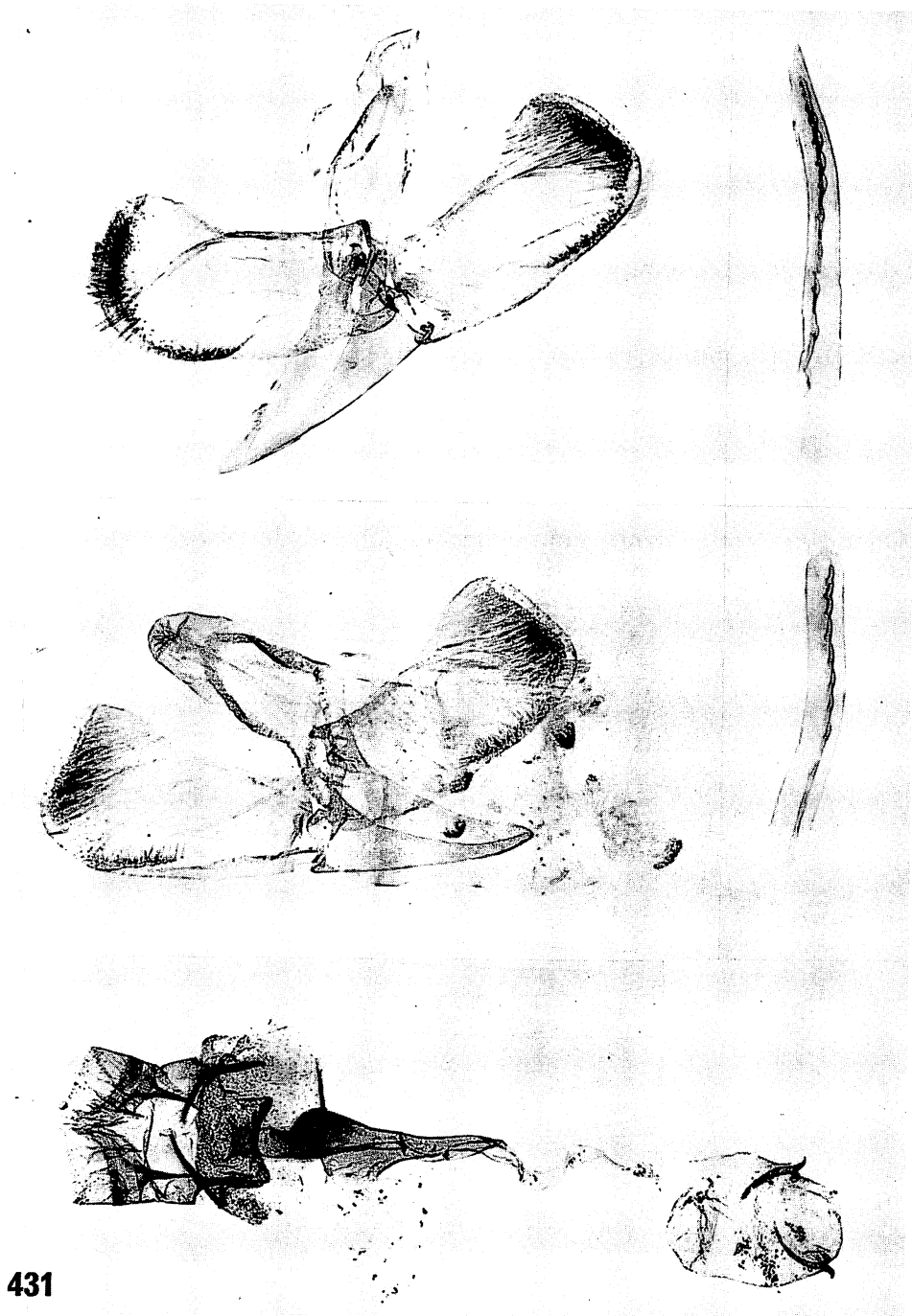


Figure 431—Male and female genitalia of *Caloptilia mabaella* (Swezey). Top, a specimen from Kuliouou, Oahu (slide Z-VI-15-61). Middle, a specimen from Makua, Oahu (slide Z-I-24-61-3). Bottom, female genitalia of a specimen from the same locality (slide Z-V-16-61).

The usual form of mine begins near margin of leaf towards base, approaches the margin, then follows it to near apex, thence to midrib which it follows downward, soon widening quite regularly to a broad blotch extending nearly or quite to the base of the leaf. On the old leaves these blotches are conspicuous by their having become blackened after the emergence of the larva.

The larva emerges from the mine to construct its cocoon, which is rounded-oval, white and parchment-like, about 7 mm. long by 4 mm. wide, and is made on the surface of the leaf in a depression, or a slight fold at the margin.

The resting position of the moth is with the anterior end of the body raised at an angle of  $45^{\circ}$ , supported by the fore and middle legs which are placed together, the hind legs being extended backward beneath the body and concealed by the wings, whose tips touch the surface of the leaf. The antennae are folded on the back. (Swezey, 1910a:89-90.)

The resting position, as described by Dr. Swezey, is characteristic of *Caloptilia* and has been noted by other authors elsewhere.

There is an error in the original description. In line 11 of the first paragraph, read "Fore and middle femora. . . ." instead of "Fore and hind femora. . . ."

### Genus **PHILODORIA** Walsingham

*Philodoria* Walsingham, 1907b:717. Type-species: *Philodoria succedanea* Walsingham, by original designation.

*Philodoria* is an endemic genus of beautiful, mostly highly colored, tiny leaf miners. Some of the species have the general facies of some species of the

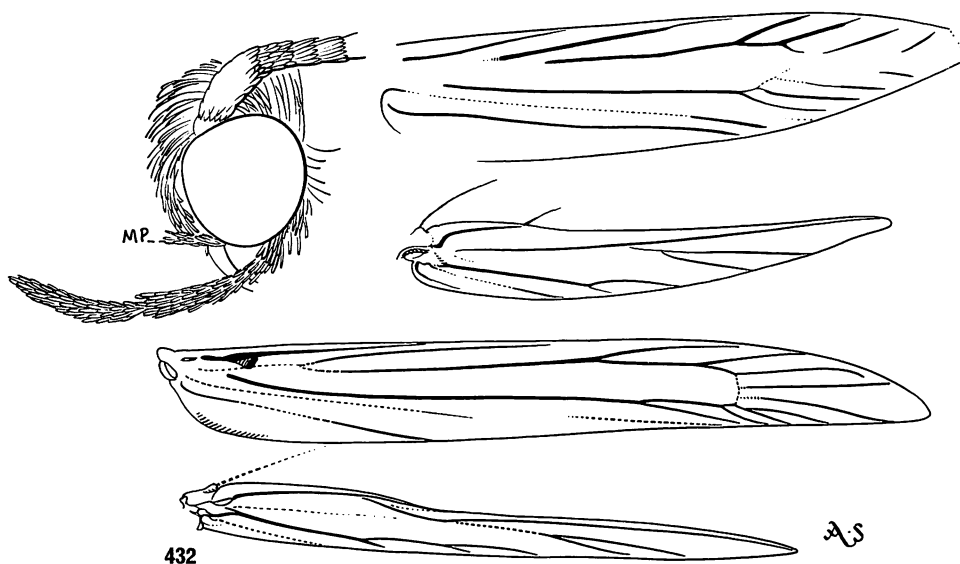


Figure 432—*Philodoria* and *Caloptilia*. Top, head and wing venation of *Philodoria* (*Eophilodoria*) *marginestrigata* (Walsingham), holotype male (slide BM 2866). Note the maxillary palpus at MP. Bottom, wing venation of a male *Caloptilia mabaella* (Swezey) (slide Z-V-20-61-3); Makua, Oahu, ex *Maba*.

widespread genus *Phyllonorycter* (= *Lithocolletis*), and the genitalia appear to be rather close to the type found in that genus. There are also similarities to some *Caloptilia* (= *Gracillaria*) (figures 435–436). These groups are distinct, however; the wing venation and other features are different. *Philodoria* was placed originally in the Tineidae by Walsingham, and Meyrick, (1912b:3, 1914d:25) assigned it incorrectly to the Glyphipterygidae.

The long antennae may be as long or longer than the wings, and the first segment lacks a pecten. The labial palpi are slender, smooth scaled, rather drooping, and as figured. The maxillary palpi are developed, reduced, or obsolete. The proboscis is developed. Ocelli are absent. The head and thorax are smooth scaled. The forewings are narrow, as illustrated, and have 11 or 12 veins with parts of veins 4 to 7 often faint or obsolescent and somewhat

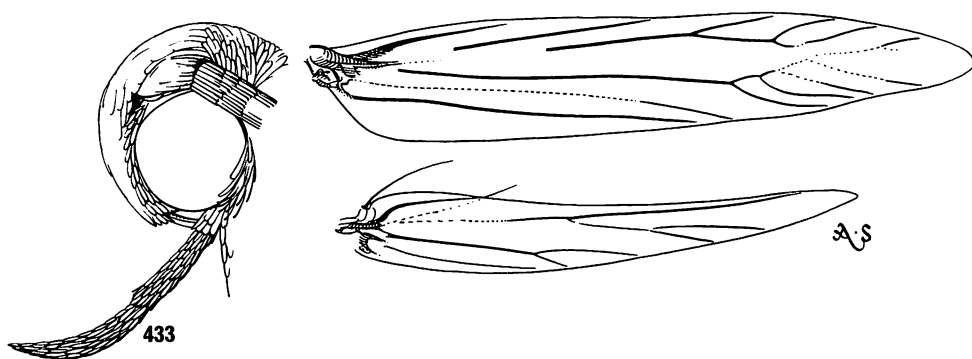


Figure 433—Head and wing venation of *Philodoria* (*Philodoria*) *succedanea* Walsingham, holotype male; Haleakala, 4,000 feet, Maui (BM slide 2755). The point where veins 6+7 begins varies in this genus, and vein 5 may share the same stem. Note the absence of maxillary palpi. Compare figure 432.

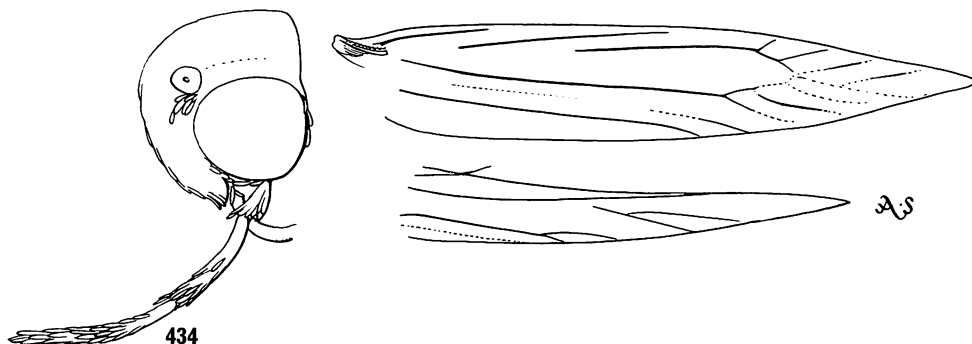


Figure 434—Head and wing venation of the female holotype of *Philodoria* (*Philodoria*) *spilota* (Walsingham) which was described erroneously as an "*Elachista*". The head is badly abraded. BM slide 2030. Compare figure 433.

confused; vein 6 is evidently subject to partial or entire loss. The hindwings are very narrow, with only 7 veins; vein 8 short, bearing bristles at apex on costa; vein 5 stalked with 6 which is out of 7; cell apex open between veins 3 + 4 and 5, and veins 2 and 3 + 4 are stalked. The legs are slender and the genitalia are as illustrated. The ovipositor is very short and the eggs are deposited on the leaf surfaces. In the pupa, the hindleg cases reach to the end of the abdomen, and the antennal cases extend distinctly beyond the apex of the abdomen.

Much confusion has existed concerning this genus. Walsingham said in the original description that ocelli are present, but that was a serious error. The group lacks ocelli.

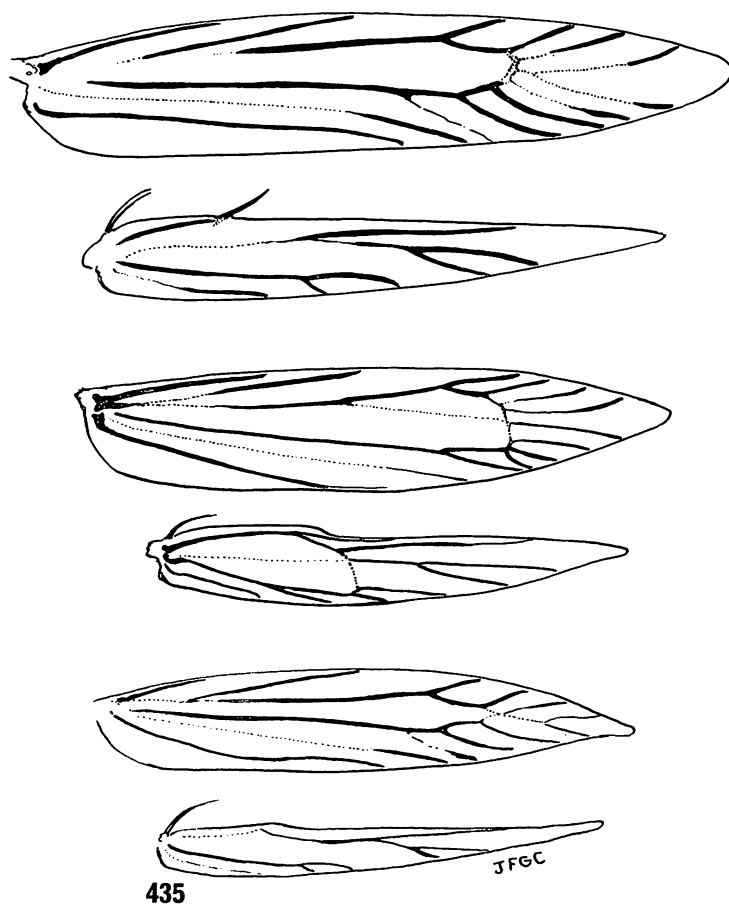


Figure 435—Wing venations of Gracillariidae. Top, *Philodoria succedanea* Walsingham; Hawaii. Middle, *Caloptilia* (*Gracillaria*) *syringella* (Fabricius), the type-species of *Gracillaria*; Europe. Bottom, *Parectopa lespedezaefoliella* Clemens, the type-species of *Parectopa*; North America.

When Walsingham (and Durrant) reported upon this group in *Fauna Hawaiiensis*, he listed seven species in *Philodoria* and two species in “*Gracilaria*”. Another species was erroneously placed in “*Elachista*”. Walsingham separated *Philodoria* from “*Gracilaria*” because of the presence of maxillary palpi in what he called “*Gracilaria*” and the apparent lack of these organs in *Philodoria*. However, one of the species (*nigrella*) which he placed in *Philodoria* has developed maxillary palpi which he apparently overlooked, so *nigrella* should have been placed in “*Gracilaria*” according to the Walsingham-Durrant plan.

Many years after the publication of Walsingham’s *Fauna Hawaiiensis* report, Meyrick (1928c: 104) said that “the Hawaiian species placed by Walsingham in *Gracilaria* belong properly to *Parectopa*, well represented in America.” He placed them in the Gracillariidae. Species supposedly belonging to *Parectopa* (type-species: the American *Parectopa lespedezaefoliella* Clemens, figures 435–436) have been described from many localities from America, through Europe, and out to Samoa. There are about 10 species listed for North America. When

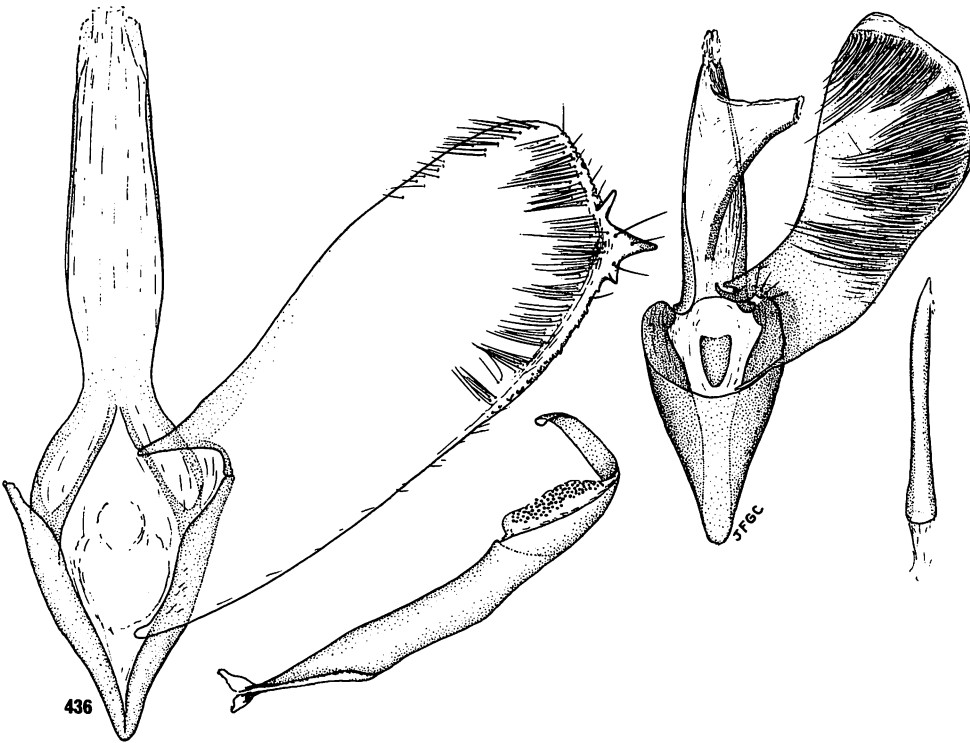


Figure 436—Male genitalia of the type-species of two non-Hawaiian genera of Gracillariidae. Various endemic Hawaiian species have been incorrectly assigned to these genera. Left, *Parectopa lespedezaefoliella* Clemens (USNM slide 3789 Clarke). Right, *Caloptilia (Gracilaria) syringella* (Fabricius) (USNM slide 3783 Clarke).



Figure 437—Top, larval mines of *Philodoria hibiscella* (Swezey) in a leaf of an endemic *Hibiscus*; Oahu. Bottom, mines of *Philodoria haucicola* (Swezey) in a leaf of *Hibiscus tiliaceus*; Oahu. (Photographs supplied by C. J. Davis.)

I began my study, I found generic differences between the Hawaiian species assigned to *Parectopa* and the type-species of the genus, including differences in the male and female genitalia. After considerable study and much thought, I have reached the surprising conclusion that the many species in Hawaii, heretofore assigned to *Parectopa* because they have maxillary palpi, and the many species placed in *Philodoria* because they are supposed to lack maxillary palpi, all belong to one genus; and, astonishing as it may appear, the presence or apparent absence of maxillary palpi in this group is subject to specific variation. The wing venation, genitalia, and other features of the two groups are identical. There are more differences in characters of the male genitalia between species assigned to *Philodoria* than there are between the genitalia of those here assigned to *Eophilodoria* and various species assigned to *Philodoria*. To include two groups of species in the same genus when one apparently lacks maxillary palpi and the other has them well-developed appears to be absurd and inadmissible "lumping". I am as astonished by this as will be most of my readers. However, we have here another example of the unusual features of the magnificent and astounding Hawaiian biota. Moreover, although the fact is not well known, many genera of Lepidoptera display such great differences in the development of the maxillary palpi. Sattler (1967, pl. 11), for example, has illustrated the palpi of *Ethmia*, and he demonstrated that the maxillary palpi vary from one to four segments and the labial palpi may have two or three segments within that one genus.

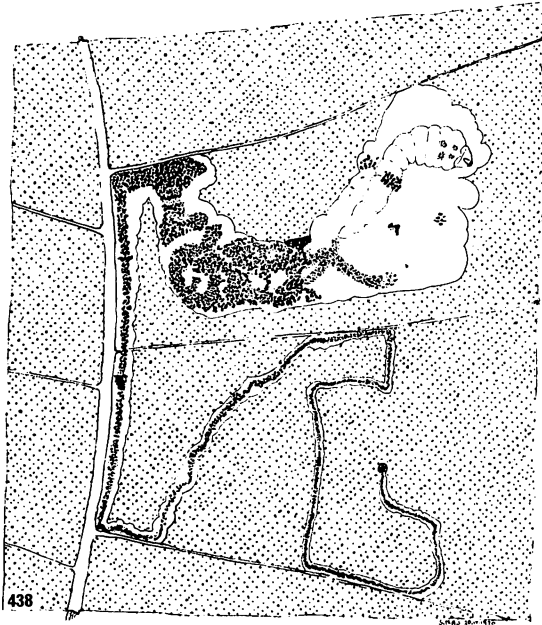


Figure 438—*Philodoria hauicola* (Swezey) larva in its mine in a leaf of *Hibiscus tiliaceus*; enlarged five times. (Drawn by S. N. A. Jacobs.)



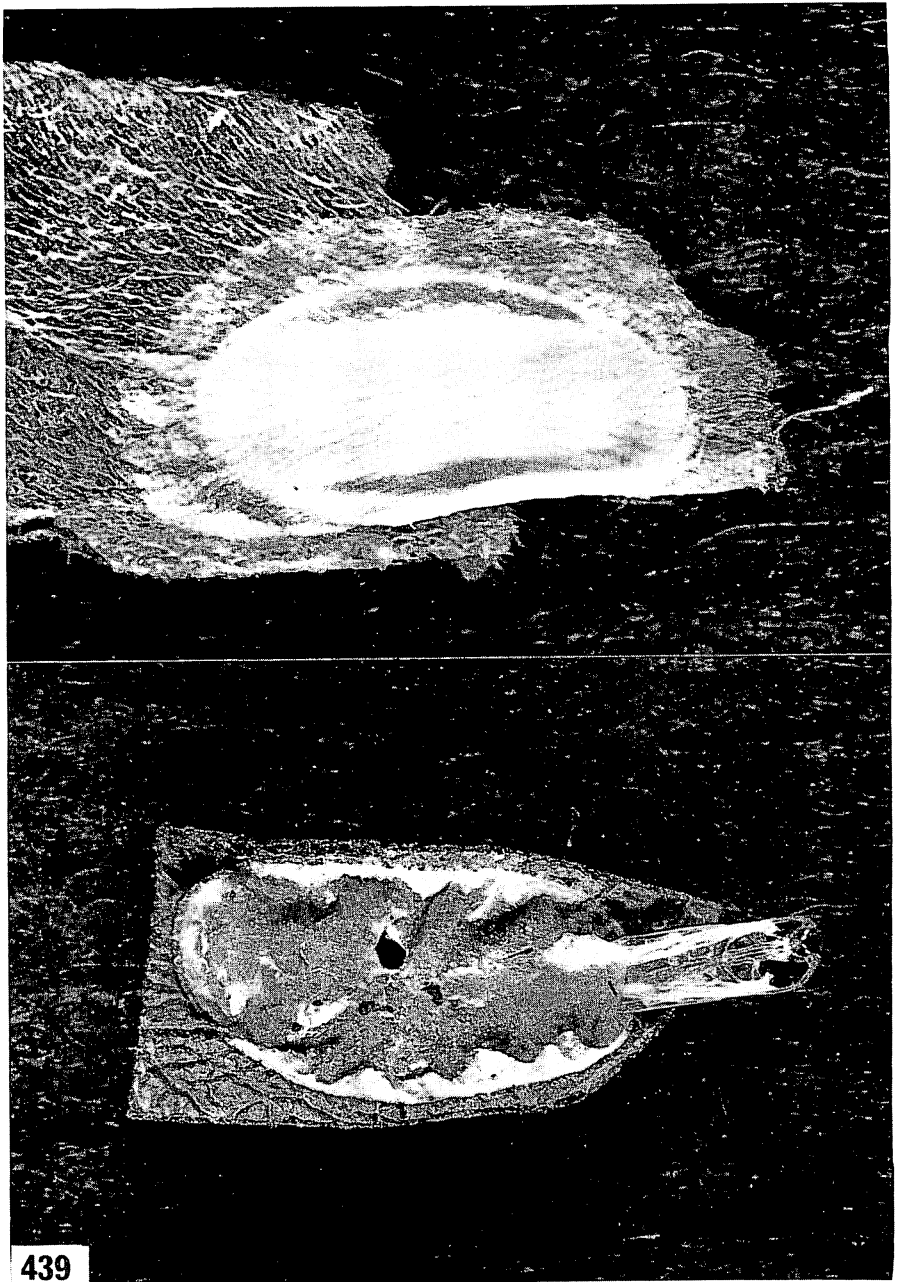


Figure 439—Top, cocoon of *Philodoria (Eophilodoria) lipochaetaella* (Swezey); length 5 mm. Bottom, cocoon of *Caloptilia mabaella* (Swezey); total length including the protruding pupal skin, 10.5 mm.

For the present, at least, it will be appropriate for reasons of convenience to use subgeneric or group names to separate the two sections. It appears that various species at various times have given rise to species or groups of species with greatly reduced or vestigial maxillary palpi and which now may be assigned to *Philodoria*, *sensu stricto*. *Philodoria*, *sensu stricto*, is not a monophyletic group. If one examines carefully some specimens of *Philodoria*, *sensu stricto*, it is possible to see rudiments of the obsolescent maxillary palpi, and other species have the maxillary palpi variously developed from very small to distinctly formed, although greatly reduced as compared with those of *Eophilodoria*. The development of these organs is probably controlled by a relatively simple genetic mechanism. The two groups may be defined as follows:

#### KEY TO THE SUBGENERA OF PHILODORIA

1. Maxillary palpi developed (figure 432) . . . . . **Eophilodoria**.
2. Maxillary palpi greatly reduced, vestigial or obsolete  
(figures 433–434) . . . . . **Philodoria**.

See color plate 3, figures 2–5.

The larvae mine the leaves of many kinds of broad-leaved plants. Some of the species pupate within the larval mines, but others emerge from their mines to pupate. No detailed, accurate, descriptive report has yet been prepared on the early stages. [For comparative studies of a related group, see Jayewickreme, 1940:74, who has described and illustrated some features of the European *Parectopa syringella* (Fabricius).]

We owe most of what we know about the biologies of these wonderful little leaf miners to Dr. Swezey who took special interest in rearing many of the

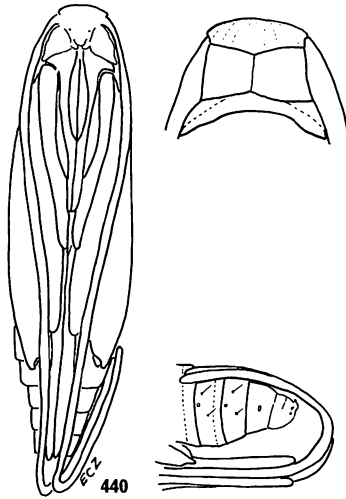


Figure 440—Details of the pupa of *Philodoria hibiscella* (Swezey) from a specimen from Honolulu; length 4.4 mm. Left, ventral aspect. Top right, dorsal aspect of head and pronotum, further enlarged. Bottom right, left aspect of caudal parts of abdomen and appendages.

species. Our knowledge is, however, widely incomplete, and much confusion exists in the published record and in collections. A large amount of work remains to be done on the group, and there are many new species to be recorded.

The hostplant relationships of the species are most interesting, and the known hostplants are given in summary in the following list. It is obvious from a study of this list that there must be a large number of unrecorded species of *Philodoria*. It will be noted that *Eophilodoria nanaeiella* (on two genera of Compositae), *Philodoria neraudicola* (on two genera of Urticaceae), and *Eophilodoria marginestrigata* (on four genera in the Compositae, Malvaceae, and Ambrosiaceae) have each been recorded from more than one host genus, whereas all of the other species known appear to be restricted to single plant genera. *Eophilodoria marginestrigata* attacks several species of introduced weeds, a most unusual habit for an autochthonous insect. The host genus with the most species recorded from it thus far is *Pipturus* (in the Urticaceae), and it has seven species of *Philodoria*, *sensu stricto*, attached to it, but only one *Eophilodoria*. *Dubautia*, in the Compositae, has six species of *Eophilodoria* but no known *Philodoria*, *sensu stricto*, recorded from it. It is strange that the common, widely distributed, endemic Hawaiian species of *Acacia*, which are the hosts of multitudes of Hawaiian insects, are not represented in the hostplant lists. One wonders why it is that there is not more sharing of hosts between *Philodoria* and *Eophilodoria*. Much remains to be learned about the hosts of these beautiful little moths.

The larvae have the thoracic legs partly reduced, and there are ventral prolegs only on abdominal segments 3, 4, and 5. Thus, there are only three, instead of the normal four, pairs of ventral prolegs. The vertical triangle of the head is deep and narrow. The prosternum is armed with a large, pigmented, nodulose pad which evidently assists in the movement of the larva within its mine; there is a pair of less-developed pigmented areas on the pronotum which serve a similar purpose.

The pupae of several species examined by me have broad bands of multitudes of spinules on the abdominal tergites, excepting the first, and which are also reduced on the caudal tergites; the hindlegs extend to near the apex of the abdomen, and the antennae extend much beyond the end of the abdomen (see figure 440). The spiracles are small and the dorsal setae are inconspicuous. *Chedra* pupae may appear to be somewhat similar because of their long legs and antennae, but they are basically very different (see the discussion under *Chedra* in the Momphinae of the Gelechiidae).

The plant family names in the following list are in small capital letters, the plant genera are in boldface type, and the moth names are in italic type.

### HOSTPLANT LIST OF PHILODORIA

#### UNKNOWN

- Eophilodoria epibathra* (Walsingham), Molokai.
- Eophilodoria nigrella* (Walsingham), Hawaii; possibly on *Dubautia*.
- Philodoria spilota* (Walsingham), Maui; possibly on *Pipturus*.

## AMBROSIACEAE

**Xanthium**

*Eophilodoria marginestrigata* (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

## CAMPANULACEAE

**Clermontia**

*Philodoria* species, Maui.

## COMPOSITAE

**Argyroxiphium** (= *Wilkesia*)

*Philodoria wilkesiella* Swezey, Maui.

**Dubautia** (= *Railliardia*)

*Eophilodoria dubauticola* (Swezey), Maui.

*Eophilodoria dubautiella* (Swezey), Oahu.

*Eophilodoria marginestrigata* (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

*Eophilodoria naenaeiella* (Swezey), Oahu.

*Eophilodoria nigrelloides* (Swezey), Kauai.

*Eophilodoria* species, possibly confused with *naenaeiella*, Kauai.

**Hesperomannia**

*Eophilodoria naenaeiella* (Swezey)?, Oahu.

**Lipochaeta**

*Eophilodoria lipochaetaella* (Swezey), Maui.

*Eophilodoria sciallactis* (Meyrick), Oahu.

## MALVACEAE

**Abutilon** (= *Abortopetalum*)

*Eophilodoria marginestrigata* (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

**Hibiscus**

*Eophilodoria hauicola* (Swezey), Kauai, Oahu, Maui, Hawaii.

*Eophilodoria hibiscella* (Swezey), Oahu, Hawaii.

**Sida**

*Eophilodoria marginestrigata* (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

## MYOPORACEAE

**Myoporum**

*Eophilodoria*? species, Hawaii (mines found by Swezey, 1954:136).

## MYRSINACEAE

**Myrsine** (= *Suttonia*)

*Philodoria auromagnifica* Walsingham, Maui, Hawaii.

## MYRTACEAE

**Metrosideros**

*Philodoria basalis* Walsingham, Maui, Hawaii.

*Philodoria splendida* Walsingham, Kauai, Oahu, Molokai, Lanai, Hawaii.

## NYCTAGINACEAE

**Pisonia**

*Eophilodoria*? species, Oahu (see Swezey, 1954:167).

## PITTOSPORACEAE

**Pittosporum**

*Eophilodoria pittosporella* (Swezey), Oahu.

## PRIMULACEAE

**Lysimachia**

*Philodoria lysimachiella* Swezey, Oahu.

*Philodoria molokaiensis* Swezey, Molokai.

*Philodoria* species, Kauai (see Swezey, 1954:121).

## URTICACEAE

**Neraudia**

*Eophilodoria neraudicola* (Swezey), Kauai, Oahu, Molokai, Hawaii.

**Pipturus**

*Eophilodoria neraudicola* (Swezey), Kauai, Oahu, Molokai, Hawaii.

*Philodoria costalis* Swezey, Oahu.

*Philodoria floscula* Walsingham, Molokai, Maui, Hawaii.

*Philodoria micropetala* Walsingham, Kauai.

*Philodoria pipturiana* Swezey, Hawaii.

*Philodoria pipturicola* Swezey, Oahu.

*Philodoria pipturiella* Swezey, Oahu.

**Touchardia**

*Eophilodoria touchardiella* (Swezey), Maui.

**Urera**

*Eophilodoria ureraella* (Swezey), Oahu.

*Eophilodoria urerana* (Swezey), Oahu, Hawaii.

## DISTRIBUTION OF EOPHILODORIA AND PHILODORIA BY ISLAND

A + sign following a species name indicates that it is found also on the other island or islands listed. If the type locality is an island other than that under which the species is listed, the word "type" is inserted following the type locality island.

NIHOA, 1 species

*Eophilodoria marginestrigata* (Walsingham), + Kauai, Oahu (type), Molokai, Hawaii

## KAUAI, 8 species

- Eophilodoria haucicola* (Swezey), + Oahu (type), Maui, Hawaii  
*Eophilodoria marginestrigata* (Walsingham), + Nihoa, Oahu (type), Molokai, Hawaii  
*Eophilodoria neraudicola* (Swezey), + Oahu (type), Molokai, Hawaii  
*Eophilodoria nigrelloides* (Swezey)  
*Eophilodoria* species
- Philodoria micropetala* Walsingham  
*Philodoria splendida* Walsingham, + Oahu, Molokai, Lanai (type), Hawaii  
*Philodoria* species

## OAHU, 17 species

- Eophilodoria dubautiella* (Swezey)  
*Eophilodoria haucicola* (Swezey), + Kauai, Maui, Hawaii  
*Eophilodoria hibiscella* (Swezey), + Hawaii  
*Eophilodoria marginestrigata* (Walsingham), + Nihoa, Kauai, Molokai, Hawaii  
*Eophilodoria naenaeiella* (Swezey)  
*Eophilodoria neraudicola* (Swezey), + Kauai, Molokai, Hawaii  
*Eophilodoria pittosporella* (Swezey)  
*Eophilodoria sciallactis* (Meyrick)  
*Eophilodoria* species  
*Eophilodoria ureraella* (Swezey)  
*Eophilodoria urerana* (Swezey), + Hawaii
- Philodoria auromagnifica* Walsingham, + Molokai, Hawaii.  
*Philodoria costalis* Swezey  
*Philodoria lysimachiella* Swezey  
*Philodoria pipturicola* Swezey, + Maui  
*Philodoria pipturiella* Swezey  
*Philodoria splendida* Walsingham, + Kauai, Molokai, Lanai (type), Hawaii

## MOLOKAI, 7 species

- Eophilodoria epibathra* (Walsingham)  
*Eophilodoria marginestrigata* (Walsingham), + Nihoa, Kauai, Oahu (type), Hawaii  
*Eophilodoria neraudicola* (Swezey) + Kauai, Oahu (type), Hawaii
- Philodoria auromagnifica* Walsingham, + Oahu (type), Hawaii  
*Philodoria floscula* Walsingham, + Maui, Hawaii (type)  
*Philodoria molokaiensis* Swezey  
*Philodoria splendida* Walsingham, + Kauai, Oahu, Lanai (type), Hawaii

## LANAI, 1 species

- Philodoria splendida* Walsingham, + Kauai, Oahu, Molokai, Hawaii

## MAUI, 11 species

<i>Eophilodoria dubauticola</i> (Swezey)	<i>Philodoria basalis</i> Walsingham,
<i>Eophilodoria hauicola</i> (Swezey),	+ Hawaii
+ Kauai, Oahu (type), Hawaii	<i>Philodoria floscula</i> Walsingham,
<i>Eophilodoria lipochaetaella</i> (Swezey)	+ Molokai, Hawaii (type)
<i>Eophilodoria touchardiella</i> (Swezey)	<i>Philodoria pipturicola</i> Swezey,
	+ Oahu
	<i>Philodoria</i> species
	<i>Philodoria spilota</i> (Walsingham)
	<i>Philodoria succedanea</i> Walsingham,
	+ Hawaii
	<i>Philodoria wilkesiella</i> Swezey

## HAWAII, 13 species

<i>Eophilodoria hauicola</i> (Swezey),	<i>Philodoria auromagnifica</i>
+ Kauai, Oahu (type), Maui	Walsingham, + Oahu,
<i>Eophilodoria hibiscella</i> (Swezey),	Molokai
+ Oahu (type)	<i>Philodoria basalis</i> Walsingham,
<i>Eophilodoria marginestrigata</i>	+ Maui
(Walsingham), Nihoa, Kauai, Oahu	<i>Philodoria floscula</i> Walsingham,
(type) Molokai	+ Molokai, Maui
<i>Eophilodoria neraudicola</i> (Swezey),	<i>Philodoria pipturiana</i> Swezey
+ Kauai, Oahu (type), Molokai	<i>Philodoria splendida</i> Walsingham,
<i>Eophilodoria nigrella</i> (Walsingham)	+ Kauai, Oahu, Molokai,
<i>Eophilodoria</i> species	Lanai (type)
<i>Eophilodoria urerana</i> (Swezey),	<i>Philodoria succedanea</i> Walsingham,
+ Oahu (type)	+ Maui (type)

Our knowledge of the geographical distribution of the species is fragmentary. It is surprising, however, that so many of these tiny moths are so widely spread over the islands. The greater number of species listed from Oahu probably reflects only the greater amount of collecting which has been done there. Lanai no doubt has several species, and all of the other islands surely have more species than those listed here. It is interesting that there are about twice as many *Eophilodoria* as *Philodoria* reported from Oahu, whereas, on Maui, the situation is reversed.

Type-species: *Gracilaria marginestrigata* Walsingham, 1907b:721.  
 “*Parectopa*”, in the sense of Meyrick and Swezey, not of Clemens.  
 Similar to *Philodoria* but maxillary palpi fully developed.

1. Forewings with two or three oblique pale maculae from costa within basal three-fourths (the more basal one or two of these may or may not continue across the wing), or much of costal area pale . . . . . 2  
Forewings with only one oblique pale macula from costa and this at about the distal one-fourth . . . . . 8

2(1). Much of costal area pale, as in figure 446 . . . . .  
. . . . . **ureraella** (Swezey).  
Not so . . . . . 3

3(2). Forewings with two oblique white or pale maculae from costa in basal three-fourths, as in figure 441 . . . . . 4  
Forewings with three oblique pale maculae from costa in basal three-fourths . . . . . 6

4(3). Forewing with a white submedial vitta in basal one-third (along plica), and posterior margin with only two white maculae, as in figure 441 . . . . .  
. . . . . **dubauticola** (Swezey).  
Forewings without such a white submedial vitta, and posterior margin with three white maculae . . . 5

5(4). Forewings with the first oblique costal pale macula beginning basad of middle and very much longer than the second, as in figure 442 . **haucicola** (Swezey).  
Forewings with the first oblique pale costal macula beginning at about middle and subequal in length to the second, as in figure 441 . . . . .  
. . . . . **dubautiella** (Swezey).

6(3). Most of posterior edge of forewing white, as in figure 442 . . . . . **lipochaetaella** (Swezey).  
Posterior edge of forewing not mostly white . . . . . 7

7(6). Subbasal oblique white costal macula on forewing continued basad along costa to or about to wing base; second oblique white costal macula not continued distinctly across wing, as in figure 445 . . . . .  
. . . . . **sciallactis** (Meyrick).



- Subbasal white costal macula on forewing distinctly separated from base of wing and continued more as a fascia directly across wing to posterior margin; second oblique white costal macula continued across the wing as a sub->- shaped fascia; figure 443. ....
- .....**marginestrigata** (Walsingham).
- 8(1). Posterior margin of forewing almost continuously white, pattern as in figure 445; on *Pittosporum*, Waianae Mountains, Oahu. ....
- .....**pittosporella** (Swezey).
- Not so. ....9
- 9(8). Posterior margin of forewing with the three white maculae shaped as in figure 441, the first and third distinctly broad and suborbicular or subquadrate; Molokai. ....**epibathra** (Walsingham).
- White maculae on posterior margin of forewing differently formed. ....10
- 10(9). First (subbasal) white maculae on posterior margin of forewing very small and confined to margin, as in figure 444; forewings with background color bronzy brown; on *Dubautia* on Kauai. ....
- .....**nigrelloides** (Swezey).
- Not so. ....11
- 11(10). Middle white macula on posterior margin of forewing not strongly curved distad, as in figures 444-445 of *nigrella* and *touchardiella*. ....12
- Middle white macula on posterior margin of forewing strongly curved distad, as in figures 442, *hibiscella*; 443, *naenaeiella*; 444, *neraudicola*; and 446, *urerana*. ....13
- 12(11). Forewing with the apex of the white macula at about distal one-third of posterior margin separated from the opposite white macula arising from costa by a distance subequal to its length; subbasal white macula on posterior margin of wing prominent and extending to plica; male genitalia as in figure 451; Hawaii. ....
- .....**nigrella** (Walsingham).
- Forewing with the maculae mentioned above closer together, separated by only about one-half the length of the macula on the posterior margin of the wing; subbasal white macula on posterior

- margin of the wing small and not extending on to plica; male genitalia as in figure 452; on *Touchardia* on Maui. . . . . **touchardiella** (Swezey).
- 13(11). Distal one-fourth of forewing pale lemon yellow; on *Urera* on Oahu and Hawaii; figure 446. . . . . **urerana** (Swezey).  
Not so. . . . . 14
- 14(13). Background color of forewings yellowish; on *Hibiscus* on Oahu and Hawaii; figure 442. . . . . **hibiscella** (Swezey).  
Background color of forewings brownish. . . . . 15
- 15(14). Background color of forewings "brownish fuscous"; on *Neraudia* and *Pipturus* on several islands; figure 444. . . . . **neraudicola** (Swezey).  
Background color of forewings "pale brownish"; on *Dubautia* on Oahu; figure 443. . **naenaeiella** (Swezey).

**Philodoria (Eophilodoria) dubauticola** (Swezey), **new combination**

(figs. 441, moth; 447, male genitalia).

*Parectopa dubauticola* Swezey, 1940b: 463.

Endemic. Maui (type locality: ridge above Haelaau).

Hostplant: *Dubautia plantaginea*?

**Philodoria (Eophilodoria) dubautiella** (Swezey), **new combination**

(figs. 441, moth; 447, male genitalia; 454, female genitalia).

*Gracilaria dubautiella* Swezey, 1913f: 278.

*Parectopa dubautiella* (Swezey) Swezey, 1928d: 191.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Dubautia plantaginea*.

Parasites: *Eucremnus* sp.? (misprinted *Necremnus* in Swezey, 1954:73), *Euderus metallicus* (Ashmead), *Pnigalio externa* (Timberlake), *Sierola planiceps* Fullaway.

The eggs are deposited singly on the surface of the leaves; circular, about .5 mm. in diameter, broadly convex and with the surface reticulated and somewhat iridescent [*sic*]. The young larva on hatching, immediately eats into the leaf, at first producing a very slender mine lengthwise in the leaf and back and forth a few times, but eventually broadening to a blotch. A purplish discoloration is produced in the leaf by the mining larva, forming streaks following the course of the mines. Often several mines are begun in the same leaf. I have found as many as 11, but not all of the larvae reach maturity, however, often 3 or 4 cocoons are found in the same leaf.

The full-grown larva is 6–7 mm. long; pale greenish-yellow, head pale brownish, eyes black; head very deeply notched and retracted into segment 2 which is widened and has a fuscous longitudinal dorsal streak each side of median line, darkest at posterior margin; ventrally there is a large squarish patch of fuscous which is minutely roughened, cervical shield also slightly roughened. . . .

Pupa 4mm., pale greenish, a little browned on thorax, and middle of dorsum of abdomen, leg—and antenna—sheaths; wing-sheaths extend about to apex of fifth abdominal segment; antenna-sheaths extend beyond apex, curved up over abdomen to near middle. The pupa is formed in a cocoon within the mine, its position being indicated by a bit of white silk showing where the larva ate a slit through the epidermis for the emergence of the moth. (Swezey, 1913:279.)

The leaf mines of the larvae may be abundant.

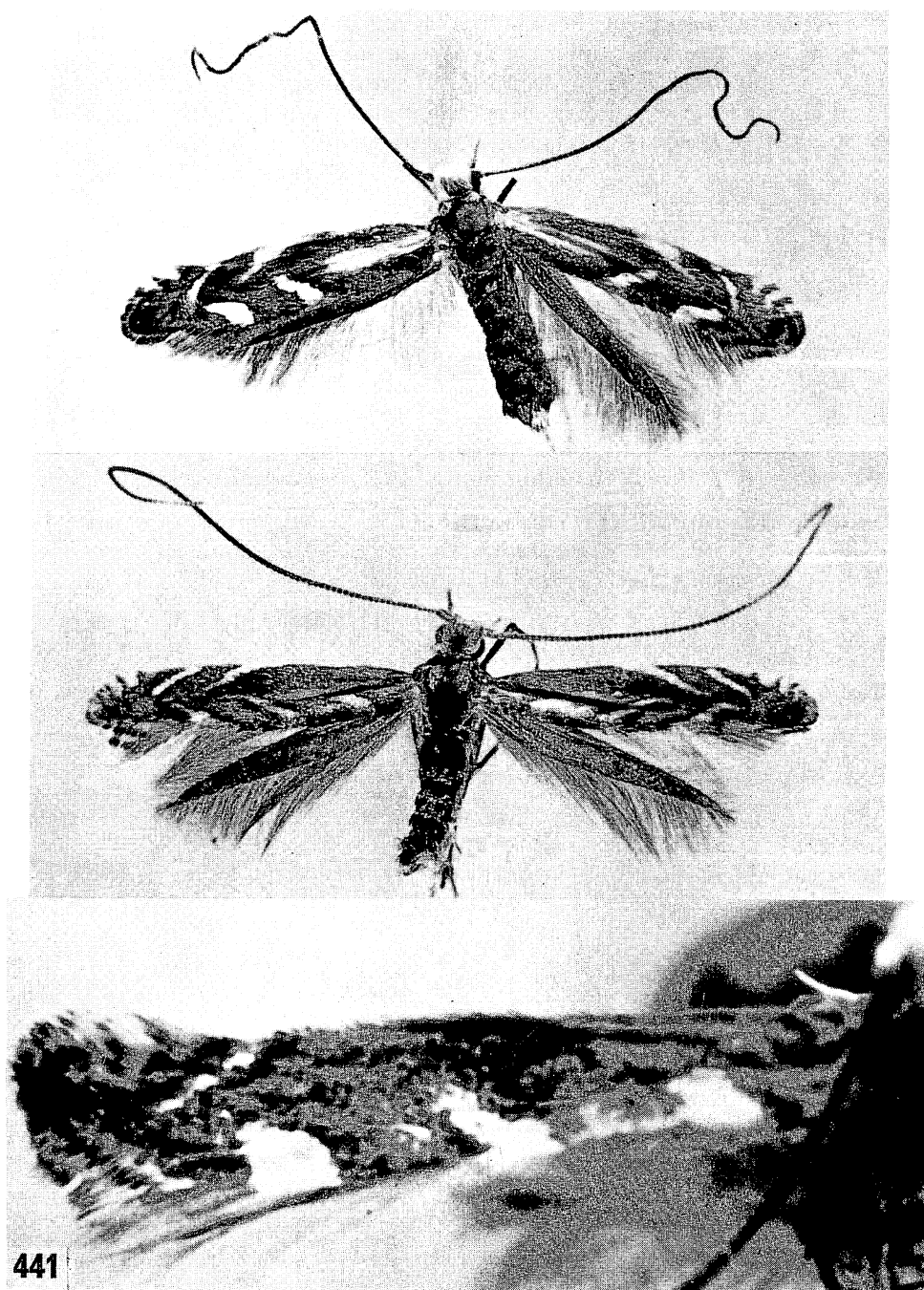


Figure 441—*Philodoria* (*Eophilodoria*). Top, *dubauticola* (Swezey), holotype female; ridge above Haelaau, Maui, ex *Dubautia*; forewing = 4 mm. Middle, *dubautiella* (Swezey), holotype male; Mt. Olympus, Oahu; forewing = 3.5 mm. Bottom, *epibathra* (Walsingham), holotype female; Molokai; forewing = 3.5 mm. (BM slide 2884); this specimen is figured in Walsingham, 1907*b*, pl. 25, fig. 27, but the artist considerably altered its appearance in his drawing.

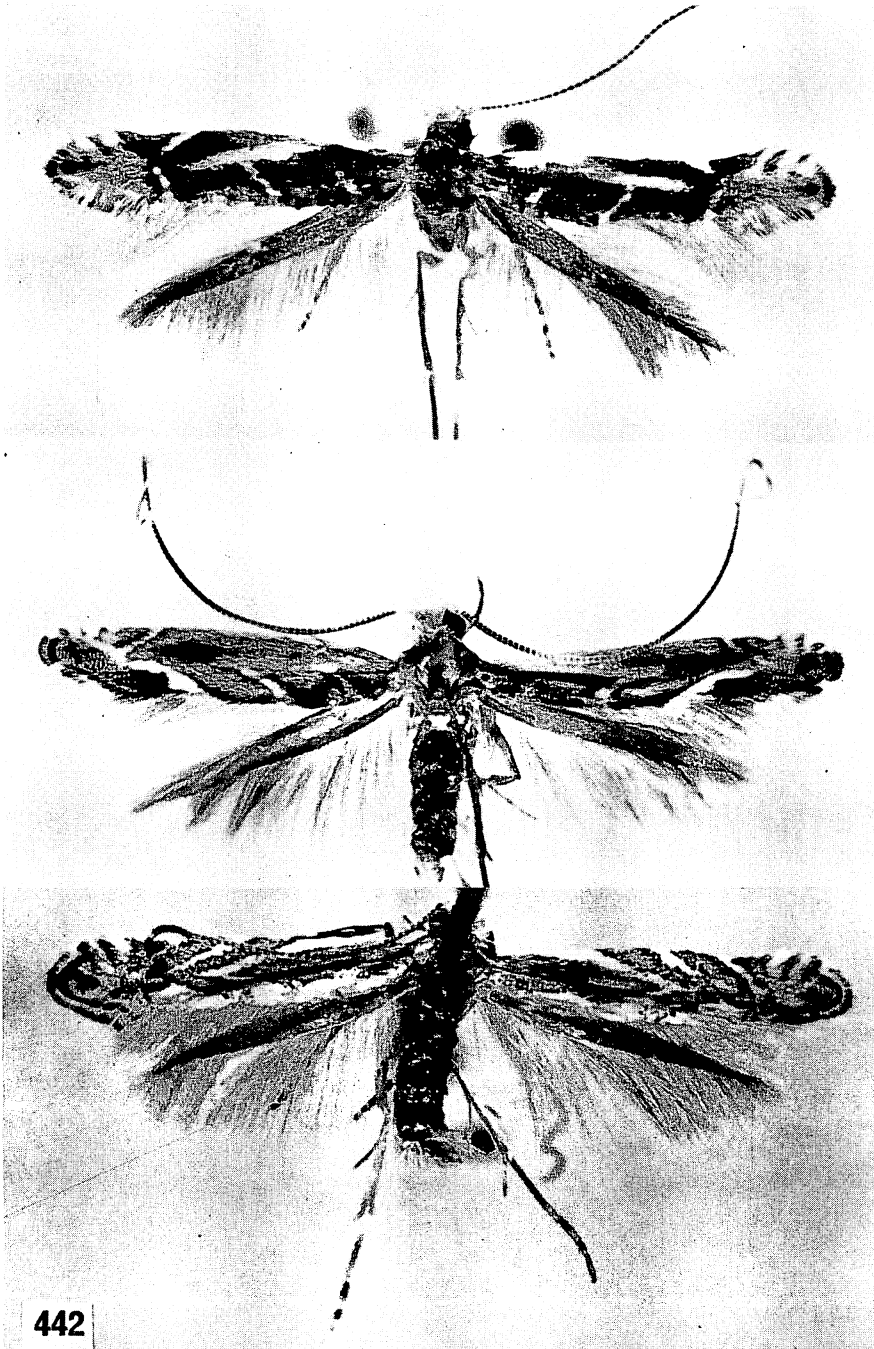


Figure 442—*Philodoria* (*Eophilodoria*). Top, *haucicola* (Swezey), holotype; Mt. Tantalus, Oahu; forewing = 3.25 mm. Middle, *hibiscella* (Swezey), lectotype, hereby selected from the two cotypes on the type mount; Mt. Tantalus, Oahu; forewing = 4 mm. Bottom, *lipochaetaella* (Swezey), lectotype, hereby selected from the four cotypes on the type mount; Lahainaluna, Maui; forewing = 3 mm.

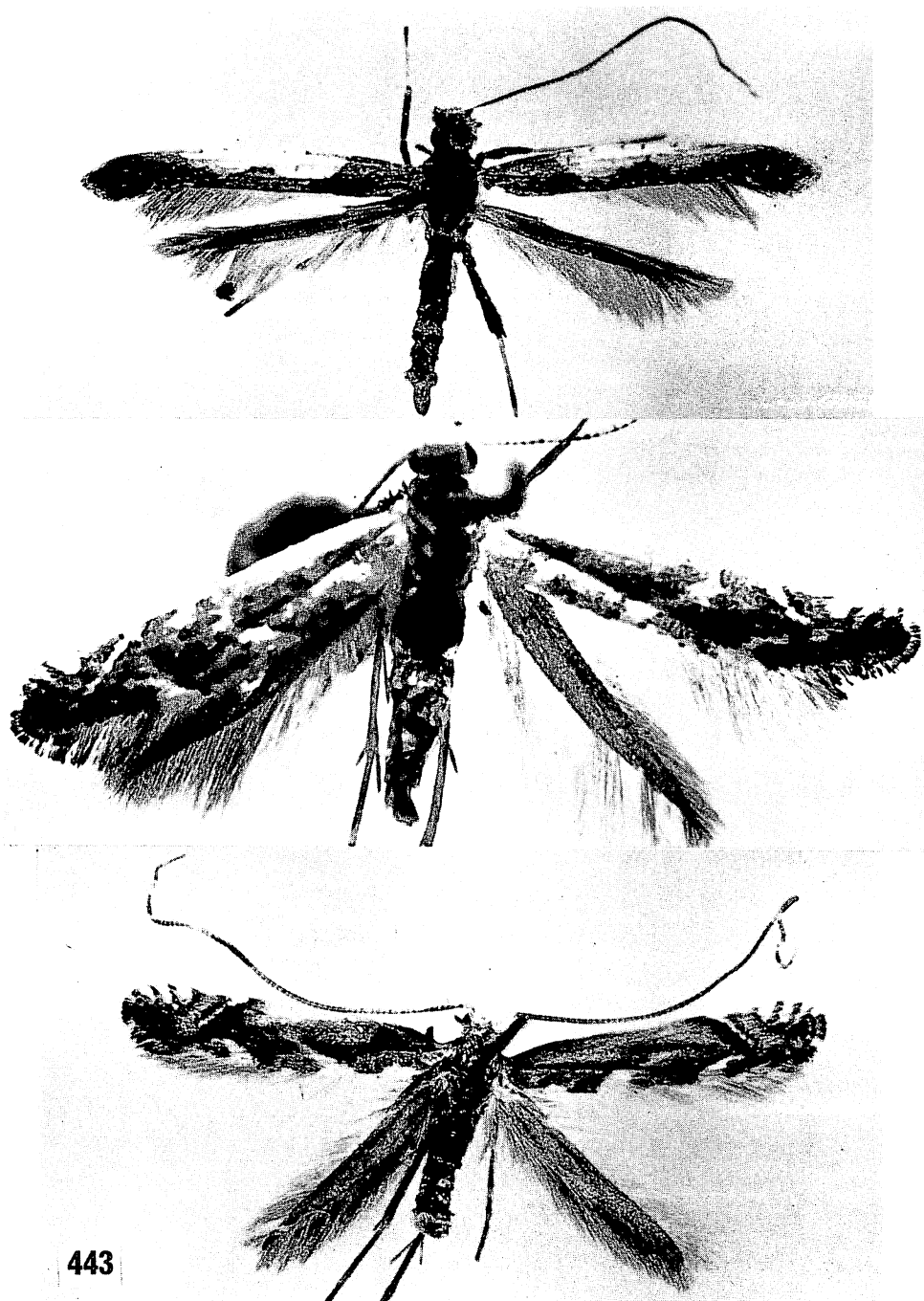
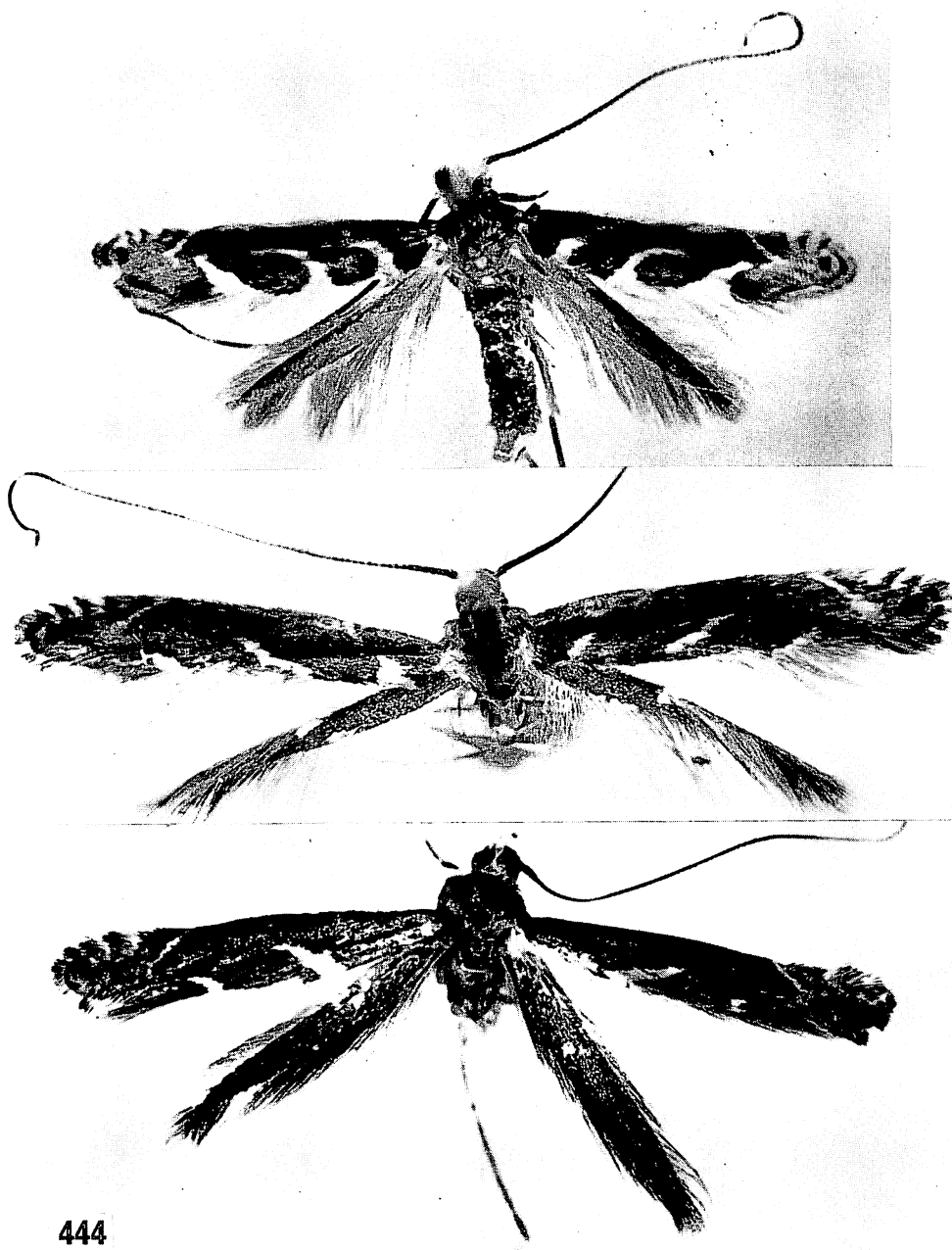
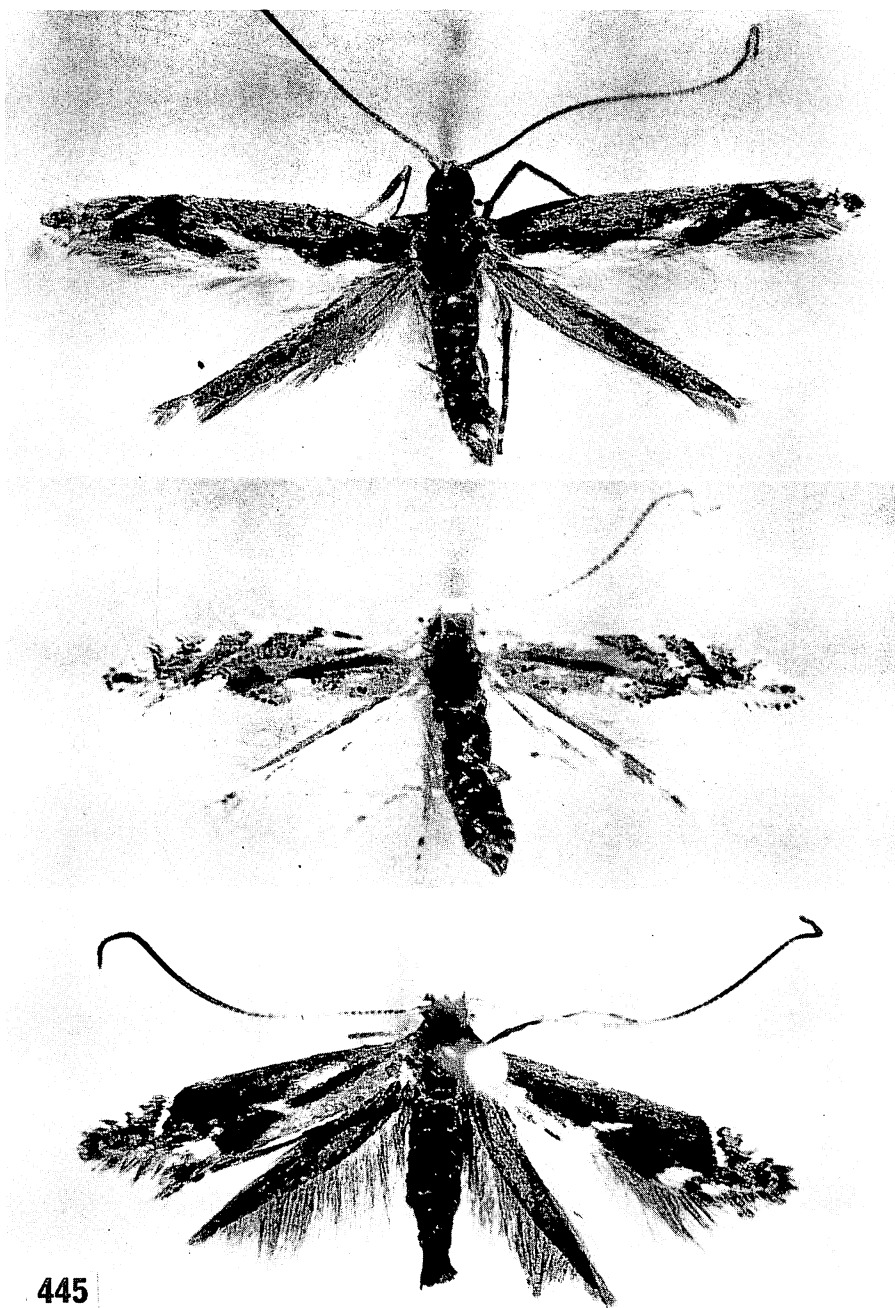


Figure 443—Top, *Caloptilia mabaella* (Swezey), holotype male; Wahiawa, Oahu; forewing=5 mm.; this photograph shows the expansion of the mesotibia which is exposed on the right side. Middle, *Philodoria* (*Eophilodoria*) *maginestrigata* (Walsingham), female holotype; Waianae Mts., 1,400 feet, Oahu; expanse=6.5 mm. This is a rather poor photograph. This specimen is figured in Walsingham, 1907b, pl. 25, fig. 26, but that figure is inaccurate and misleading. Bottom, *Philodoria* (*Eophilodoria*) *naenaeiella* (Swezey), holotype male; Mt. Olympus, Oahu; forewing=4 mm.



444

Figure 444—*Philodoria* (*Eophilodoria*). Top, *neraudicola* (Swezey), holotype male; Punaluu, Oahu; forewing=3.75 mm. Middle, *nigrella* (Walsingham), holotype male (BM slide 4173); Hilo, 2,000 feet, Hawaii; expanse 9 mm. Bottom, *nigrelloides* (Swezey), holotype female (slide Z-I-10-67); Alakai Swamp, Kauai; expanse 9 mm. See figure 466 for a photograph of this specimen before it was remounted.



445  
Figure 445—*Philodoria* (*Eophilodoria*). Top, *pitosporella* (Swezey), holotype; Mt. Kaala, Oahu; forewing = 4 mm. Middle, *sciallactis* (Meyrick), paratype; Kaena Point, Oahu; expanse = 5.5 mm. Bottom, *touchardiella* (Swezey), holotype; Iao Valley, Maui; forewing = 3.25 mm. This specimen appears rubbed on the basal parts of the posterior margins of the forewings. However, it has been reported to me that the specimen is not abraded and that the area is clothed with pale scales. Another specimen that I saw is entirely dark in that area.

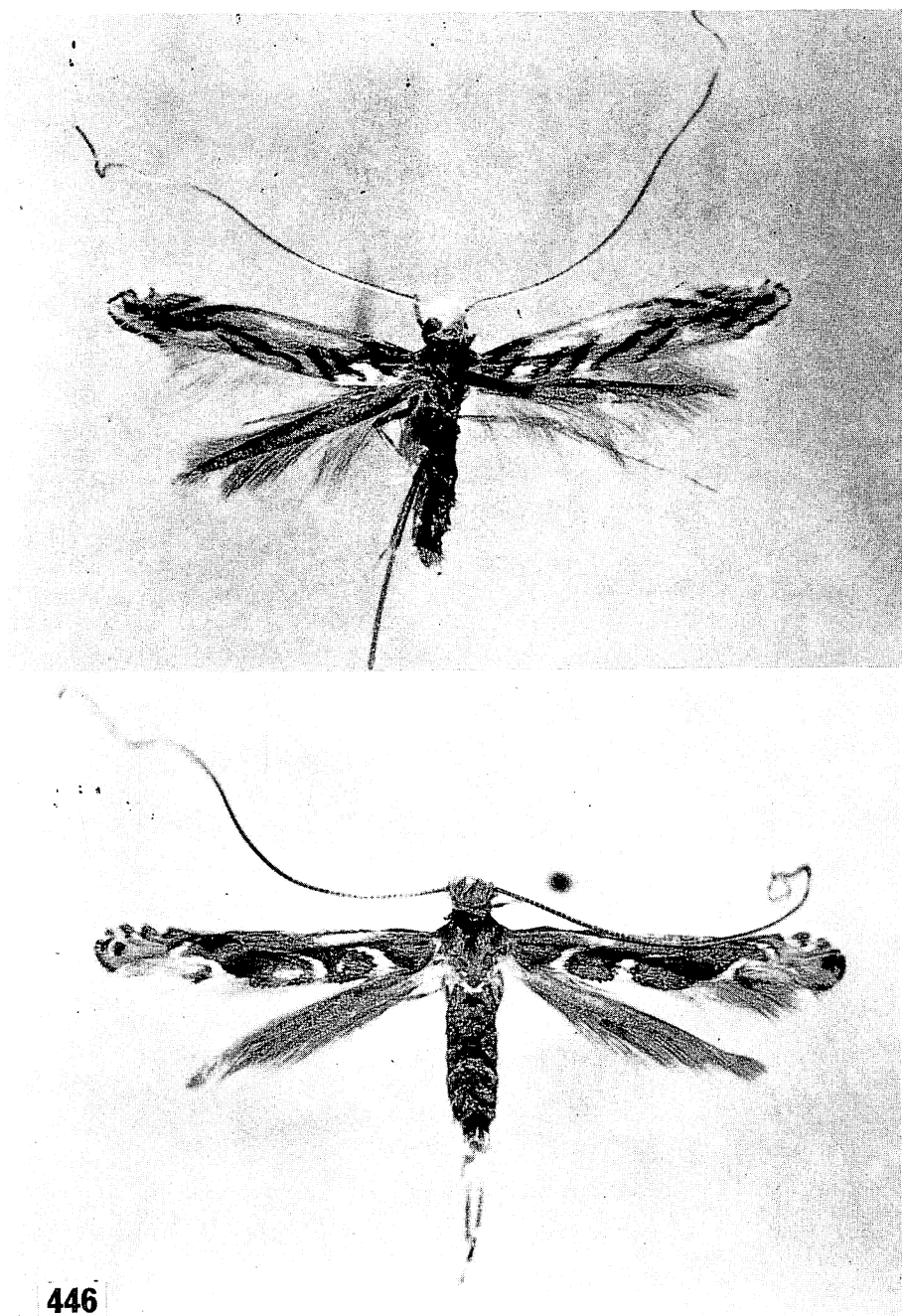
**446**

Figure 446—*Philodoria* (*Eophilodoria*). Top, *uraella* (Swezey), lectotype, hereby selected from one of four cotypes on the type mount 213, Bishop Museum; Mt. Tantalus, Oahu; forewing=4 mm. Bottom, *urerana* (Swezey), holotype; Mt. Tantalus, Oahu; forewing=4.5 mm.



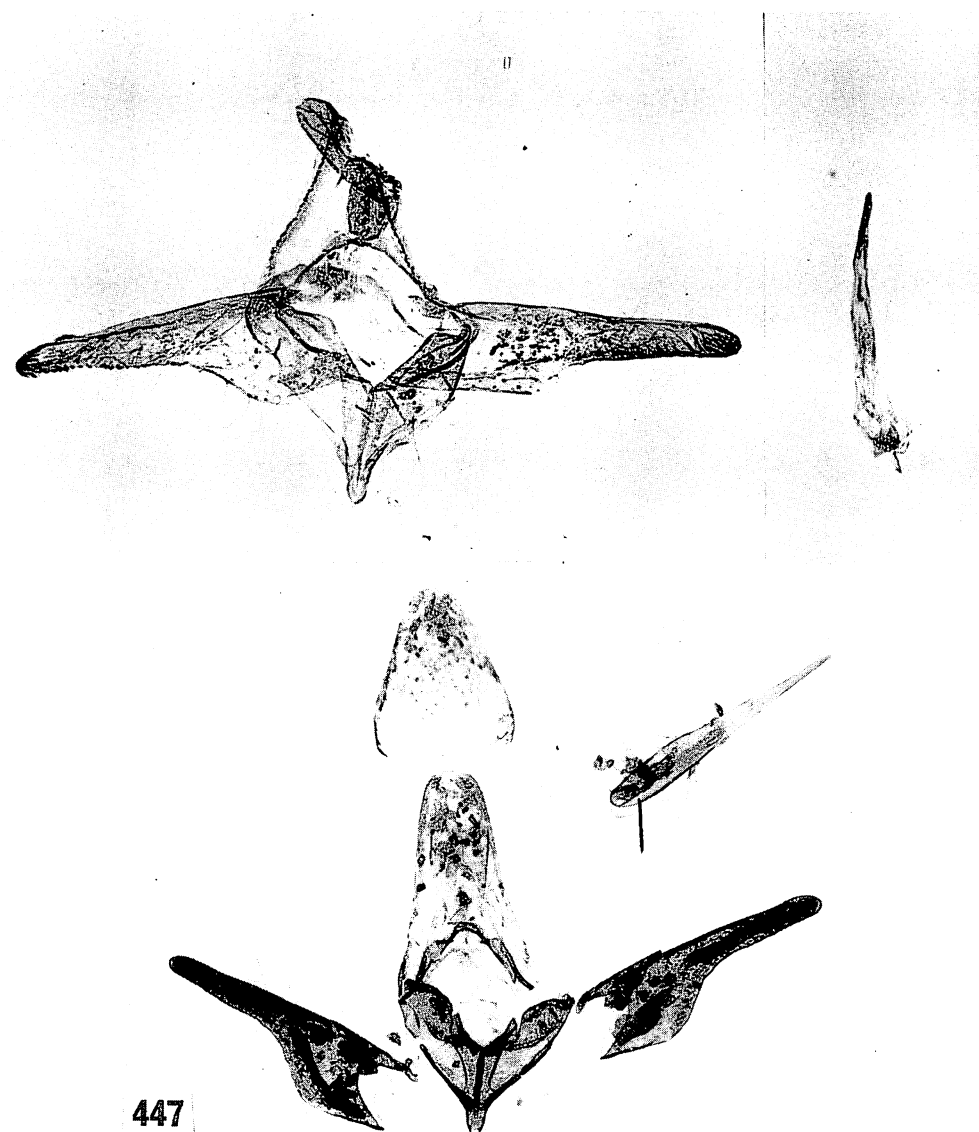


Figure 447—Male genitalia of *Philodoria* (*Eophilodoria*). Top, *dubauticola* (Swezey), paratype (slide Z-I-24, 61-4); Ridge above Haelaau, Maui; ex *Dubautia*. Bottom, *dubautiella* (Swezey) (slide Z-I-28-61-2); Pacific Heights, Oahu; ex *Dubautia*; caudal abdominal segment above, aedeagus at right above.

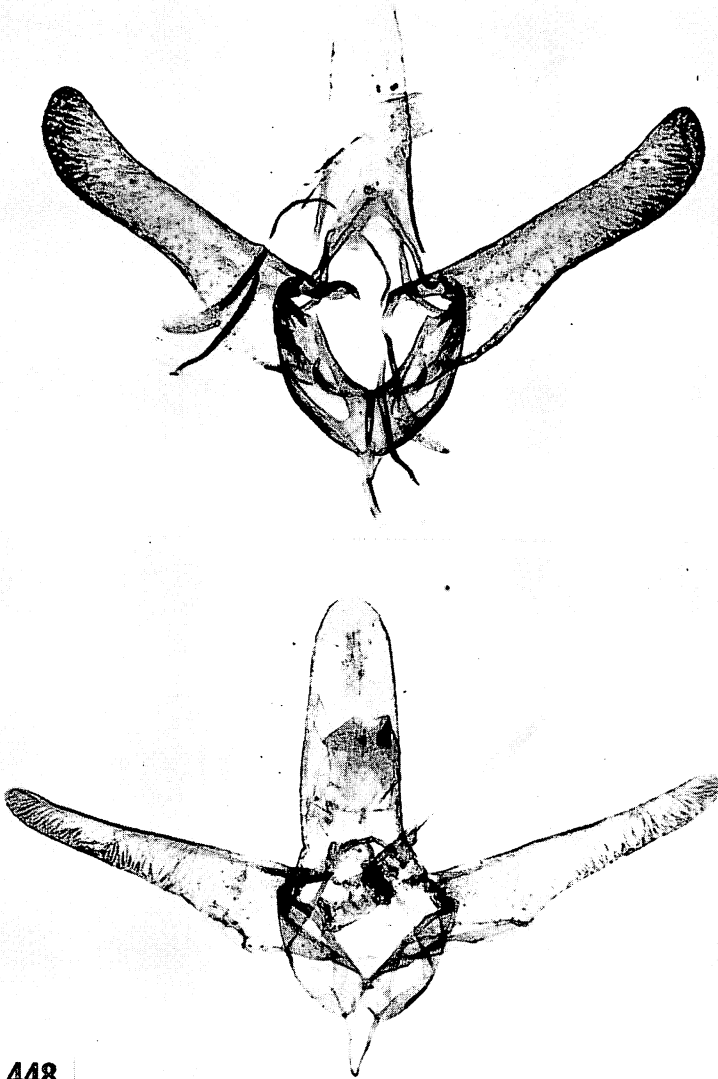
**448**

Figure 448—Male genitalia of *Philodoria* (*Eophilodoria*). Top, *haucicola* (Swezey); Mt. Tantalus, Oahu (slide Z-VI-13-61); aedeagus not photographed. Bottom, *hibiscella* (Swezey), Waiakule, Oahu; ex *Hibiscus* (slide Z-I-26-61-2); aedeagus in situ.

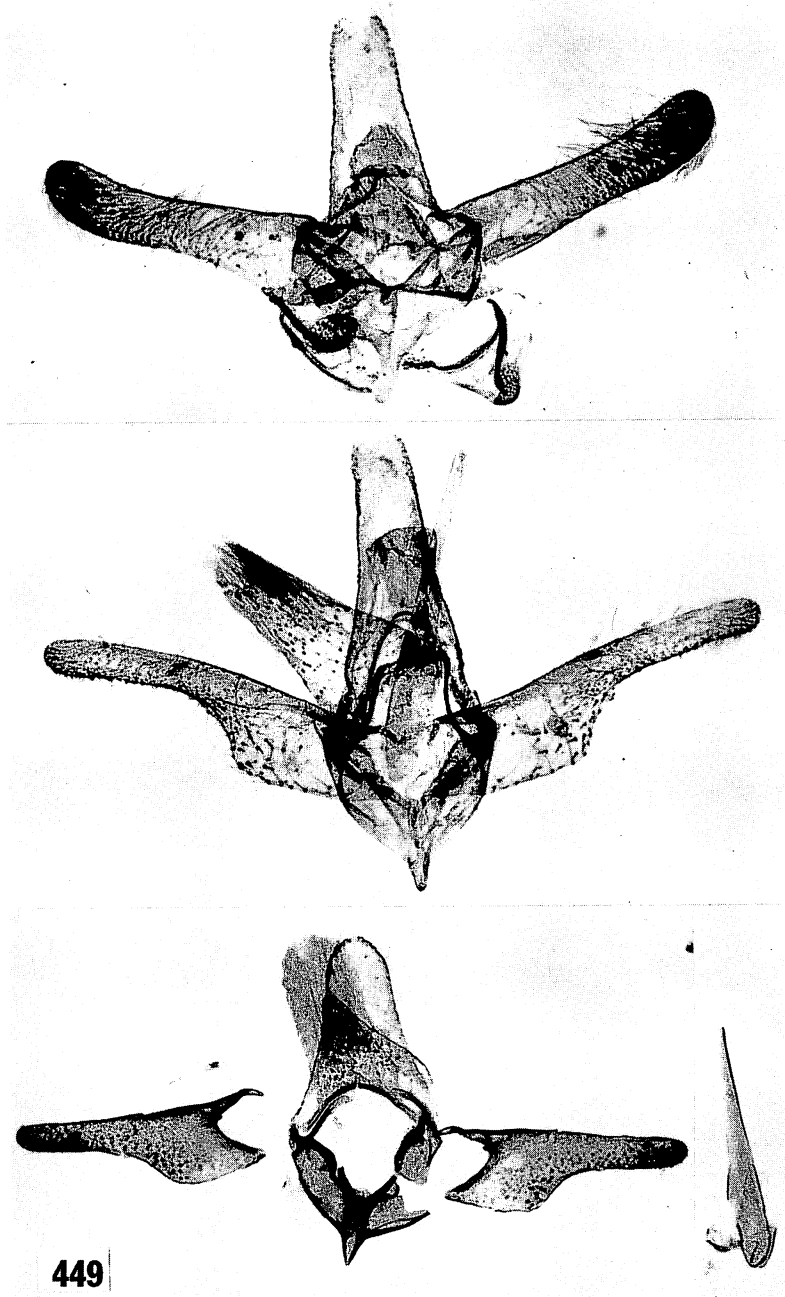


Figure 449—Male genitalia of *Philodoria* (*Eophilodoria*). Top, *lipochaetaella* (Swezey), Lahainalua, Maui, ex *Lipochaeta lavarum* (slide Z-I-27-61-3); aedeagus not photographed. Middle, *naenaeiella* (Swezey), paratype; Pupukea, Oahu; ex *Hesperomannia*; aedeagus in situ (slide Z-I-26-61-1). Bottom, *neraudicola* (Swezey), paratype (slide Z-I-26-61-3); south of Hilo, Hawaii.

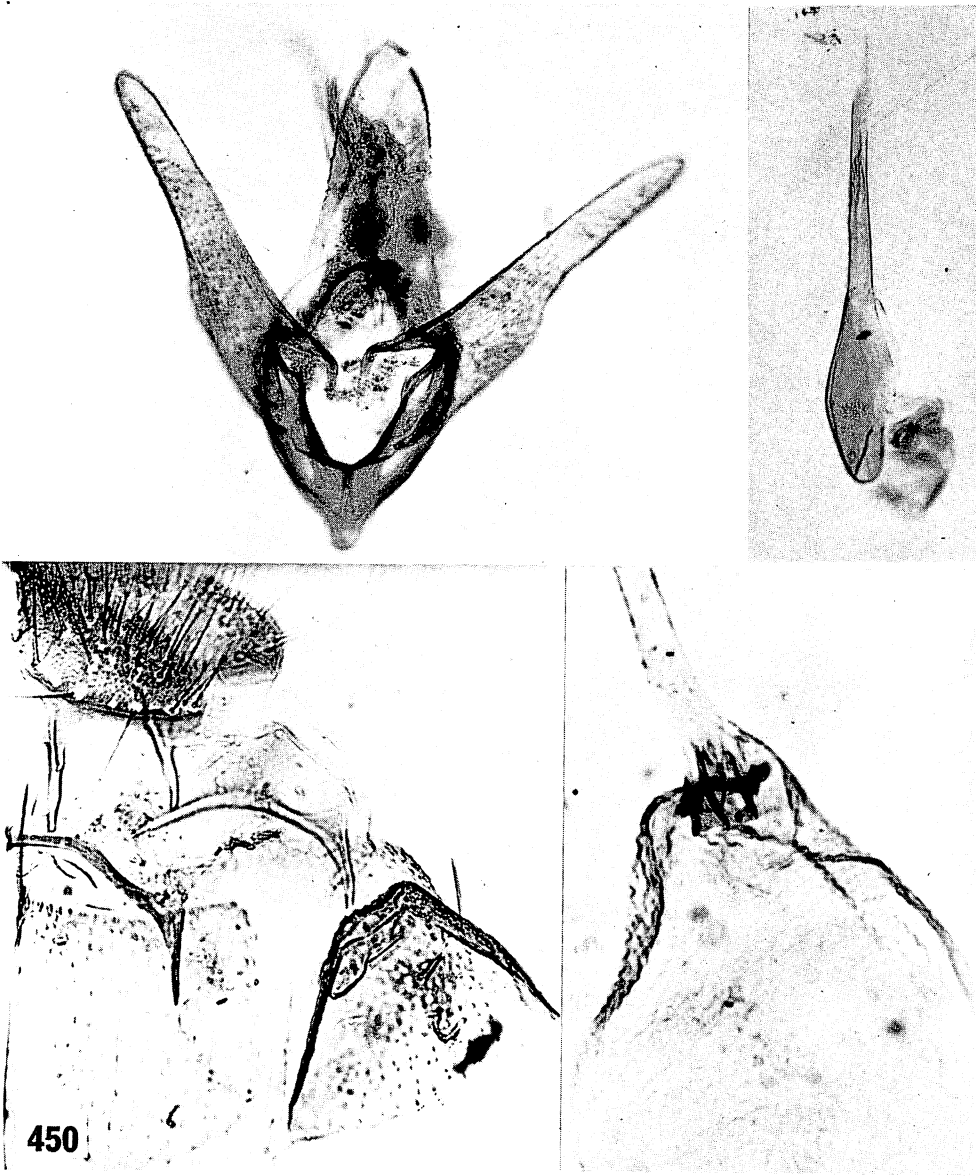


Figure 450—*Philodoria* (*Eophilodoria*) *marginestrigata* (Walsingham), male and female genitalia. Male, holotype, Waianae Mts., 1,400 feet, Oahu (BM slide 2866). Female paratype (BM slide 2019); Molokai, above 3,000 feet; this shows the ostial plate in an oblique view, also see figure 455.

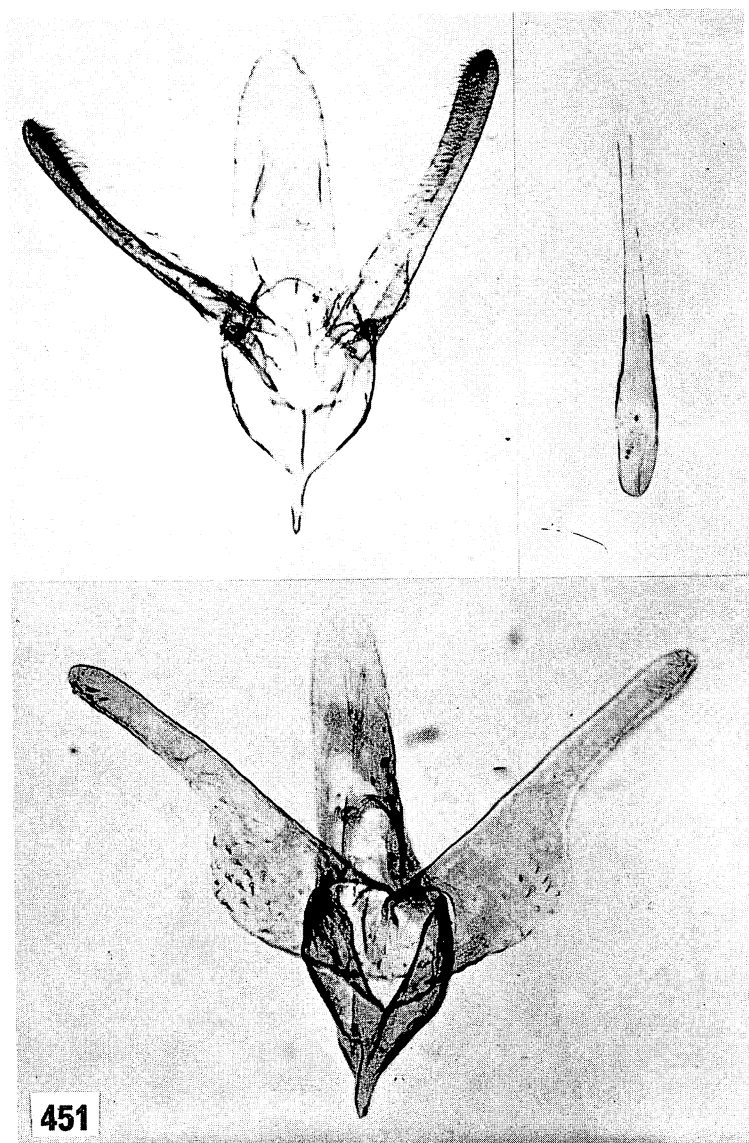


Figure 451—Male genitalia of *Philodoria* (*Eophilodoria*). Top, *nigrella* (Walsingham), holotype (BM slide 4173); Hilo, 2,000 feet, Hawaii. The left valva is mounted in a poor position, and the right valva is nearly in full view with the lobe of the sacculus visible. The valva is distinctly different in shape from that of *sciallactis*, for example. Bottom, *sciallactis* (Meyrick), Kaena Point, Oahu (BM slide 2754); from the Meyrick collection; aedeagus not photographed; note the stout setae on the valvae.

**Philodoria (Eophilodoria) epibathra** (Walsingham), **new combination**  
(figs. 441, moth; 459, female genitalia).

*Gracilaria epibathra* Walsingham, 1907b:722, pl. 25, fig. 27.

*Parectopa epibathra* (Walsingham) Meyrick, 1928c:104.

Endemic. Molokai (type locality: not more specifically noted on the type labels).

Hostplant: unknown.

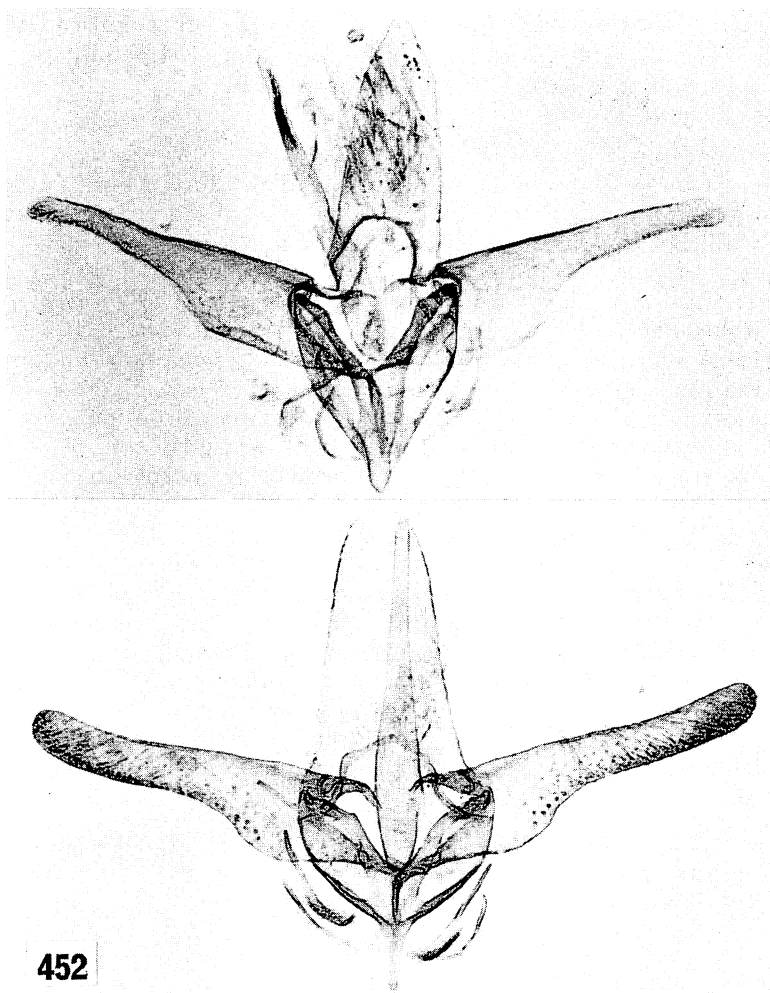


Figure 452—Male genitalia of *Philodoria* (*Eophilodoria*). Top, *pitlosporella* (Swezey), holotype; Mt. Kaala, Oahu, over 3,000 feet (slide Z-I-24-61-5). Bottom, *touchardiella* (Swezey), paratype (slide Z-VII-14-61); Black Gorge, north side of Iao Valley, Maui; ex *Touchardia*.

The unique type is a female, not a male as noted by Walsingham. Dr. Swezey never knew this species. His Kauai record and hostplants given for the species (Swezey, 1928*d*:190) are in error and apply to *naenaeiella* (Swezey). Timberlake [*Proc. Hawaiian Ent. Soc.* 6(3):524, 1927] recorded the parasite *Pnigalio* ("Notanisomorphomyia") *externa* Timberlake from this species from material collected on Oahu and determined by Swezey, but this record also evidently is based upon an incorrect determination of the moth. The record of the parasite *Euderus metallicus* (Ashmead) is also in error.

**Philodoria (Eophilodoria) hauicola** (Swezey), **new combination** (figs. 437, 438, mine; 442, moth; 448, male genitalia; 454, female genitalia).

*Gracilaria hauicola* Swezey, 1910*d*:106, pl. 3, fig. 5.

*Parectopa hauicola* (Swezey) Swezey, 1928*d*:190.

The hau leaf miner.

Endemic. Kauai, Oahu (type locality: Mt. Tantalus), Maui, Hawaii.

Hostplant: *Hibiscus tiliaceus* ("hau"). This is usually a common moth, and frequently all the leaves of its hostplant will be mined.

Parasites: *Apanteles bedelliae* Viereck, *Closterocerus*, *Euderus metallicus* (Ashmead), *Pnigalio externa* (Timberlake), *Sympiesis* ("Pseudopheliminus") *vagans* (Timberlake).

"Often very scarce, this moth at other times may be very abundant; sometimes as many as 60 mines can be found in a large leaf. Even so, the plant does not seem to be severely injured, for it is constantly producing new foliage. The larva issues from the mine to form its oval, white cocoon, usually on the upper leaf surface [but they may also be formed on nearby objects]. In cases where mines are numerous, most of the larvae are parasitized when small, and only about one-third of them attain full growth." (Swezey, 1954:107.)

*Hibiscus tiliaceus* is considered to be an immigrant plant. It was probably introduced by early Polynesians who made extensive use of it, particularly for cordage. It is of interest that this is the only known hostplant of this moth, and one might wonder if the moth originated as a species since the plant was introduced by the Polynesians, perhaps about a thousand years ago. (See Zimmerman, 1960, for other possible evidence of rapid speciation in Hawaiian moths.) The plant may be attacked wherever it grows from the seashore to the mountains. It is probable that the moth has been accidentally distributed about the islands by man.

**Philodoria (Eophilodoria) hibiscella** (Swezey), **new combination** (figs. 437, mine; 440, pupa; 442, moth; 448, male genitalia; 455, female genitalia).

*Gracilaria hibiscella* Swezey, 1913*f*:279.

*Parectopa hibiscella* (Swezey) Swezey, 1928*d*:191.

The hibiscus leaf miner.

Endemic. Oahu (type locality: Mt. Tantalus), Hawaii.

Hostplants: *Hibiscus arnottianus*, *Hibiscus rosa-sinensis*.

Parasites: *Derostenus fullawayi* Crawford, *Diaulinus* species, *Euderus metallicus*

(Ashmead), *Pauahiana* ("Necremnus") *maculatipennis* (Ashmead), (*Pauahiana swzeyi* Yoshimoto has been recorded from this species by Yoshimoto, 1965: 677; one wonders if an error has been made, however, because the other records for the parasite appear to indicate that it is a parasite of Psyllidae), *Pnigalio externa* (Timberlake), *Sympiesis* ("Pseudopheliminus") *vagans* (Timberlake).

The mine usually begins towards base of leaf, proceeding upward irregularly and following the margin for a part of its course, it eventually reaches the apex, then follows down the opposite margin of the leaf rapidly widening until the larva has finished its growth. It then breaks through the epidermis to form its white oval cocoon on the surface of the leaf.

The full-grown larva is about 9 mm.; pale bluish-green; head with blackish mouth-parts, eyes, and 2 lines bordering the paraclypeus, much retracted into segment 2 which is widened and has a large black spot ventrally and 2 black spots near anterior margin dorsally; thoracic legs minute; abdominal prolegs on segments 7-9 [= abdominal segments 3-5].

Pupa 5 mm.; pale testaceous-greenish, with a few fuscous markings ventrally; wing-sheaths extend to apex of fifth abdominal segment, free beyond fourth segment, dark fuscous at tip; posterior leg-sheaths extend to apex of abdomen; antenna-sheaths extend beyond apex of abdomen, recurved over the back forward to base of fourth abdominal segment. Pupal stage about a week. (Swezey, 1913:280.)

The larvae occasionally cause severe local damage to ornamental hibiscus, and extensively mined leaves may drop from the plants. The white, oval cocoon is made on the surface of a leaf.

The specimen on figure 442 is hereby designated lectotype. It is one of two cotypes on the type mount.

**Philodoria (Eophilodoria) lipochaetaella** (Swezey), **new combination** (figs. 439, cocoon; 442, moth; 449, male genitalia; 455, female genitalia).

*Paractopa lipochaetaella* Swezey, 1940b:464.

*Paractopa lipochaetae* Swezey, 1946:627. **New synonym.**

Endemic. Maui (type locality: a gulch above Lahaina).

Hostplant: *Lipochaeta lavarum*.

Dr. Swezey had two series of specimens of this species in two boxes; one series was collected in 1928 and the other in 1929. Because of improper labeling and an oversight, Dr. Swezey described the species twice from these series. I have selected the specimen shown on figure 442 as the lectotype from the series of four specimens on the type mount.

**Philodoria (Eophilodoria) marginestrigata** (Walsingham), **new combination** (figs. 432, head, wing venation; 443, moth; 450, male, female genitalia; 455, female genitalia).

*Gracilaria marginestrigata* Walsingham, 1907b:721, pl. 25, fig. 26.

*Paractopa marginestrigata* (Walsingham) Meyrick, 1928c:104.

The ilima leaf miner.

Endemic. Nihoa, Kauai, Oahu (type locality: Waianae Mountains, 1,400 feet), Molokai, Hawaii.

Hostplants: *Abutilon incanum*, *Abutilon* (*Abortopetalum*) *molle*, *Dubautia* (*Railliardia*), *Sida cordifolia*, *Sida fallax*, *Sida meyeniana*, *Sida rhombifolia*, *Xanthium strumarium echinatum*.

Parasites: *Derostenus fullawayi* Crawford, *Cirrospilus* species, *Diglyphus* ("Solenotus") *begini* (Ashmead), *Euderus* ("Secodella") *metallicus* (Ashmead), *Mirax* species, *Pnigalio externa* (Timberlake), *Sympiesis* ("Pseudopheliminus")



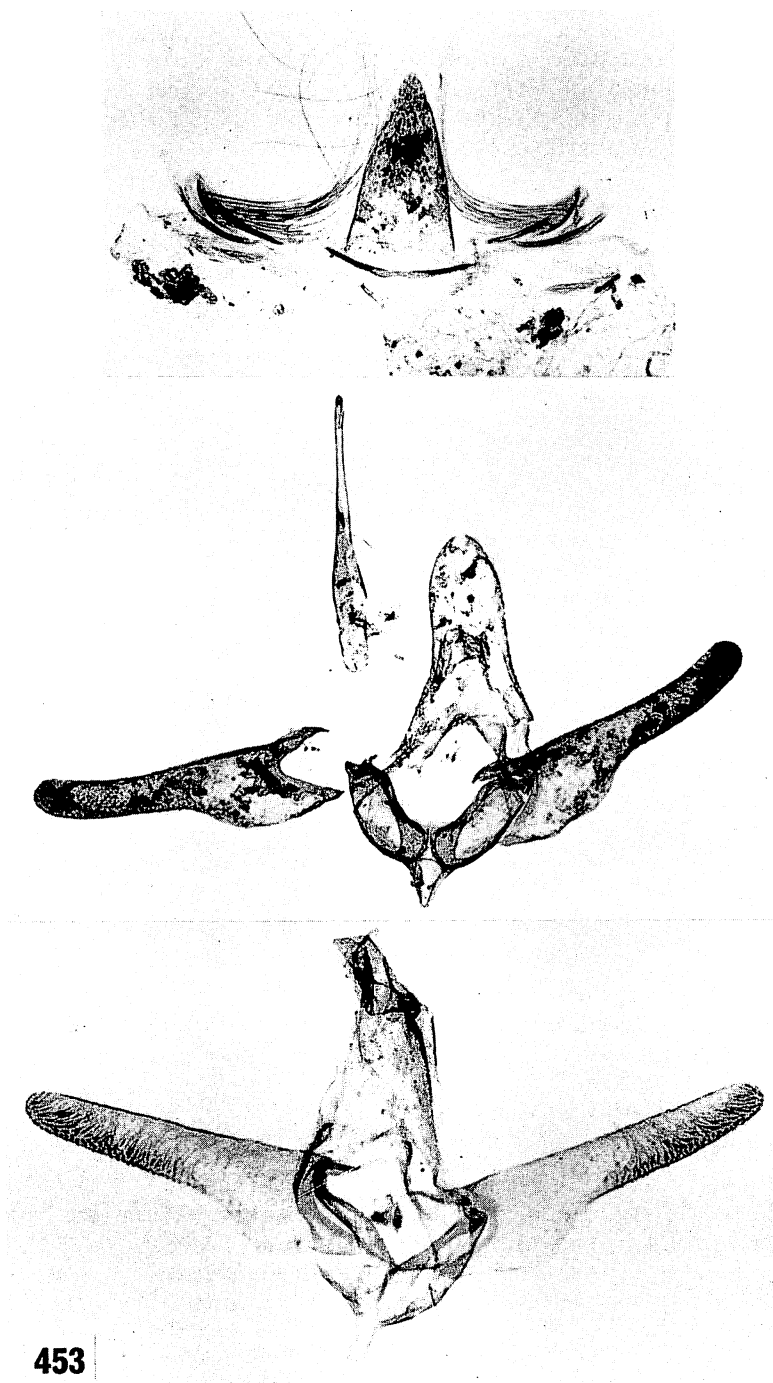


Figure 453—Male genitalia of *Philodoria* (*Eophilodoria*). Top and middle, *ureraella* (Swezey); at the top is the caudal end of the abdomen; Mt. Tantalus, Oahu (slide Z-I-29-61-3). Bottom, *urerana* (Swezey); Mt. Tantalus, Oahu; ex *Urera* (slide Z-I-29-61-2); aedeagus not photographed.

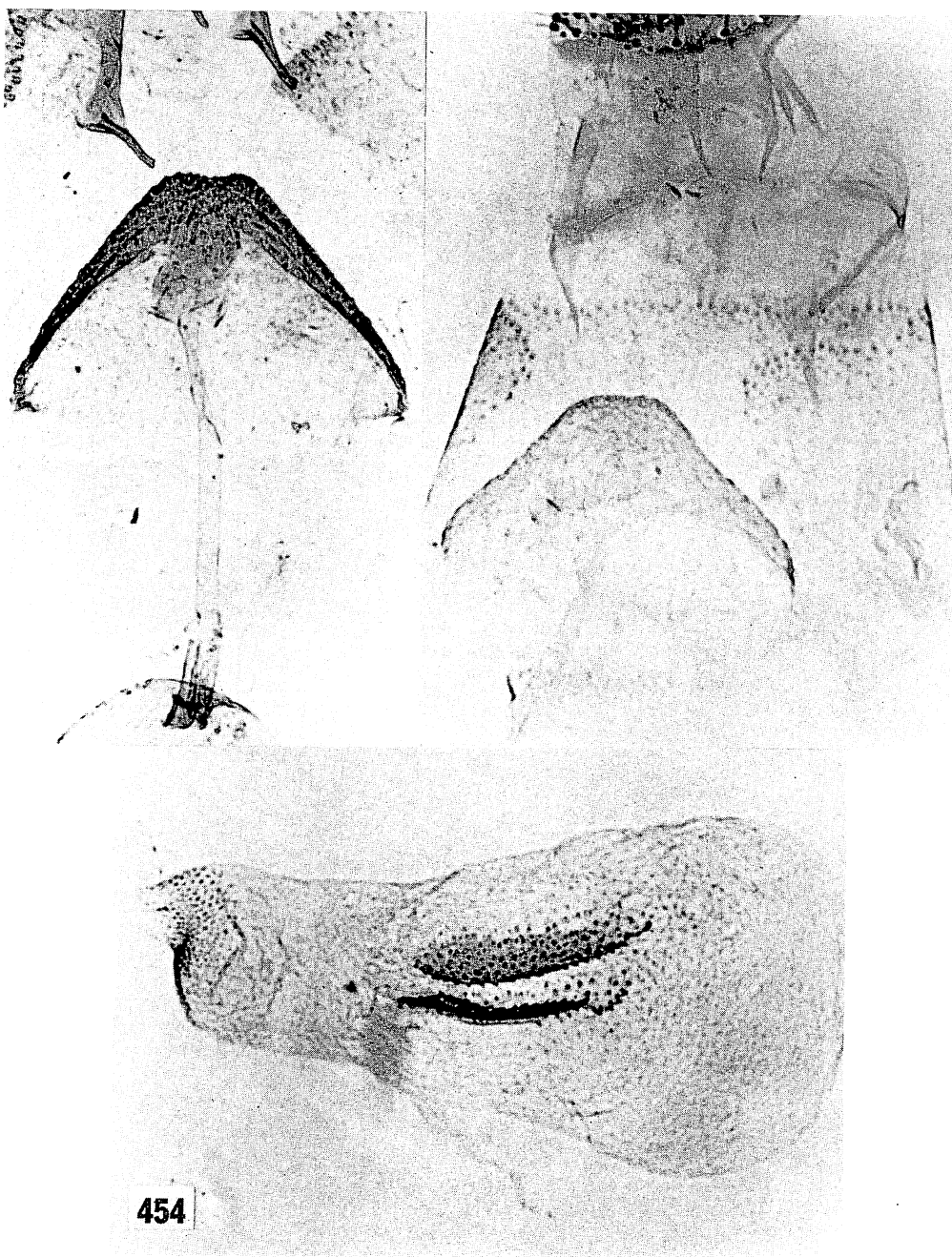


Figure 454—Female genitalia of *Philodoria* (*Eophilodoria*). Top left, *dubautiella* (Swezey); Moanalua, Oahu; ex *Dubautia* (slide Z-31-61-2); this species lacks signa in the bursa. Top right and bottom, *haucola* (Swezey); Punaluu, Oahu; ex *Hibiscus tiliaceus* (slide Z-I-27-61-1); note the strong signa.

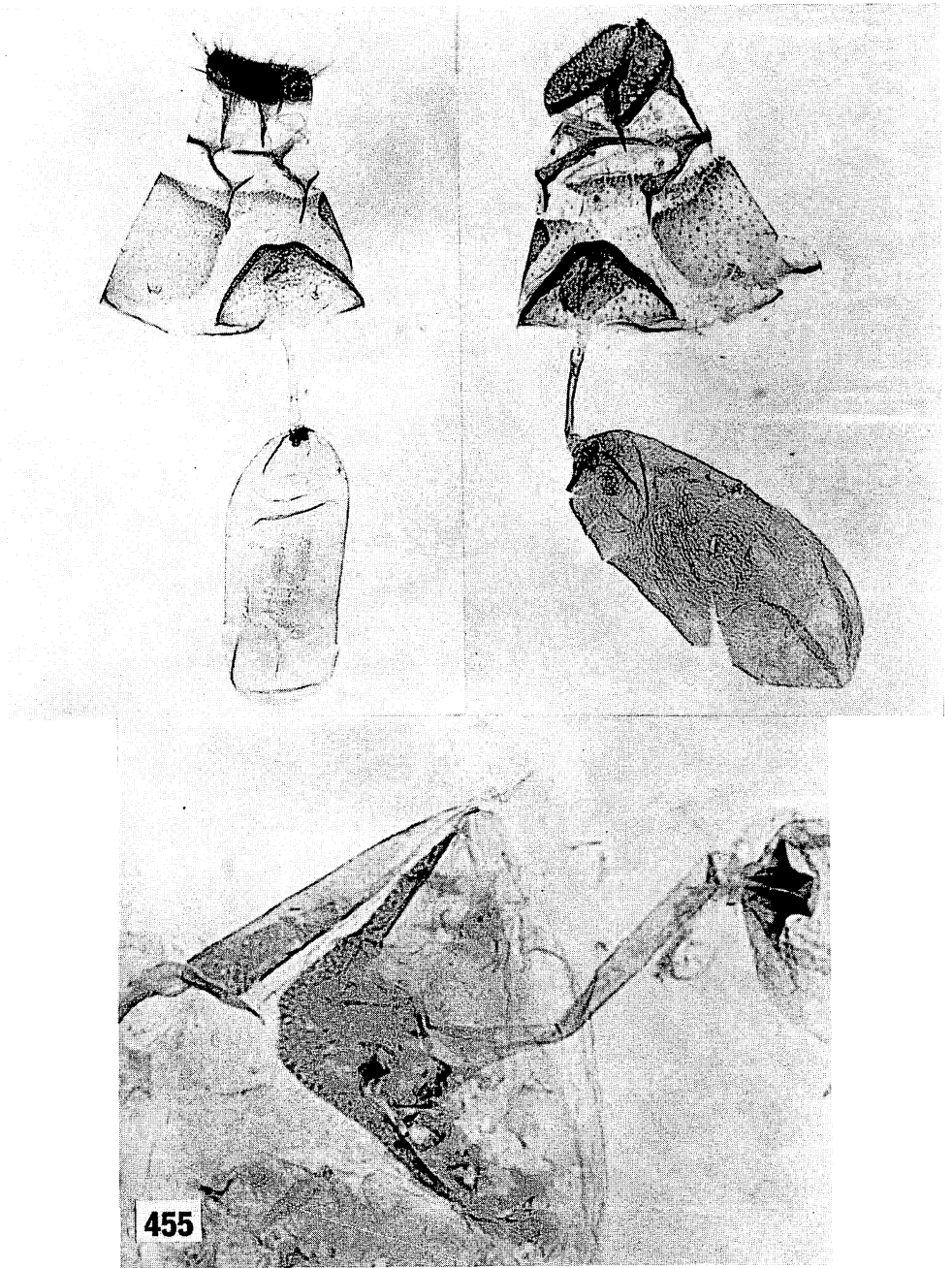


Figure 455—Female genitalia of *Philodoria* (*Eophilodoria*). Top left, *hibiscella* (Swezey); Mt. Tantalus; ex *Hibiscus* (slide Z-V-16-61-A). Top right, *lipochaetaella* (Swezey); Lahainalua, Maui; ex *Lipochaeta lavarum* (slide Z-V-19-61). Bottom, *marginestrigata* (Walsingham); Kaimuki, Oahu; ex *Xanthium* (slide Z-II-1-61-1); this species also lacks signa; see also figure 450.

*vagans* (Timberlake), *Zatropis tortricidis* Crawford, *Zagrammosoma flavolineatum* Crawford.

The observations on hostplants and localities by Perkins and Walsingham (Walsingham, 1907*b*:722) are confused, and there may be more than one species involved in the records in literature.

This is often a common leaf miner in the lowlands. There may be as many as 12 mines in a single leaf, and the cocoon is made within the mine. It is unusual for an endemic insect to attack introduced plants as does this species.

Walsingham's figure of the moth is inaccurate and misleading and does not show the white maculae on the costa of the forewing.

**Philodoria (Eophilodoria) naenaeiella** (Swezey), **new combination** (figs. 443, moth; 449, male genitalia; 457–458, female genitalia).

*Parectopa naenaeiella* Swezey, 1940*b*–462.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplants: *Dubautia laxa* (“naenae”), *Hesperomannia swezeyi*?

Parasites: *Euderus metallicus* (Ashmead), *Sympiesis vagans* (Timberlake).

“The larva issues from its mine to form a white, flat cocoon on the leaf.” (Swezey, 1954:73.)

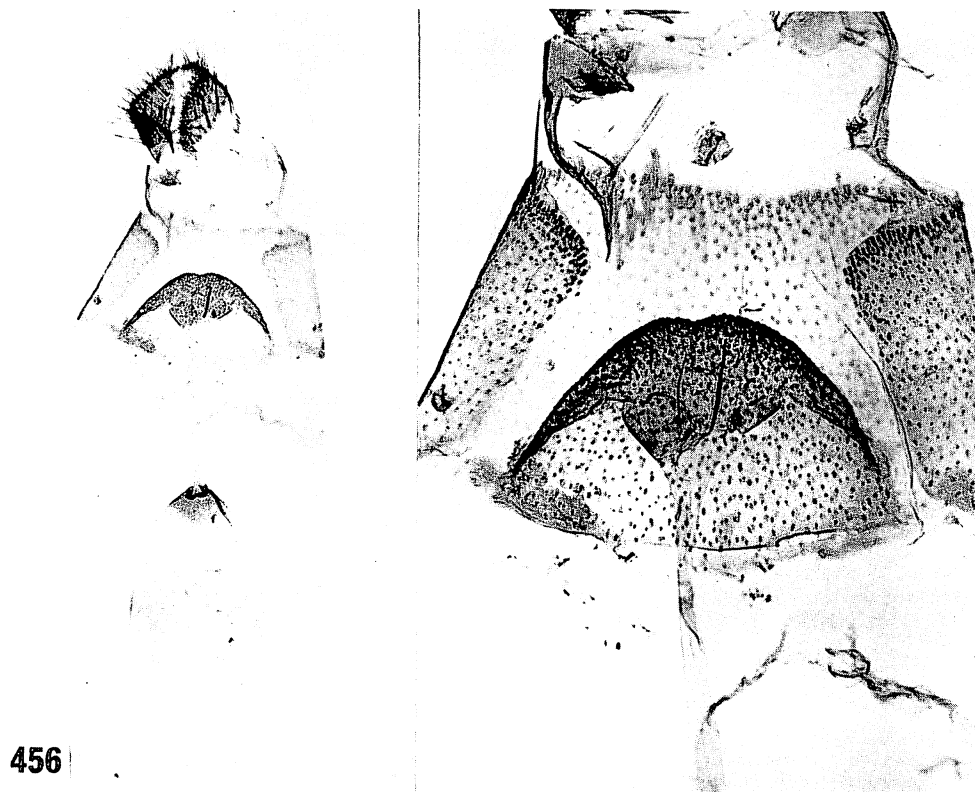


Figure 456—*Philodoria* (*Eophilodoria*) species? Female genitalia of a specimen incorrectly identified as *naenaeiella* by Swezey, Kumuwela, Kauai; ex *Dubautia latifolia* (labeled as coming from an “unknown composite”) (slide Z-1-10-66-A). Compare figures 457, 458.

In addition to the two hostplants recorded above, which are both Compositae, Dr. Swezey (1954:113) reported that he had once reared the moth from *Hedyotis* (= *Kaunia*) at Kumuwela, Kauai. I have deleted that record as a probable error. Because *Hedyotis* is a member of the Rubiaceae, it probably does not serve as a host of this species. Dr. Swezey included in his type series material reared from *Hesperomannia* on Oahu on two occasions (see figures 457 and 458, female genitalia), yet he did not mention this as a hostplant in his 1954 book on Hawaiian forest entomology. Dr. Swezey also included in his type series material he had reared from *Dubautia latifolia* on Kauai (although at that time he did not know the identity of the plant and called it an "unknown composite"). However, in 1954:75, he appears to have recorded the same material again, stating that "a single poor specimen of the moth was obtained . . .," which he considered to represent another species. The latter opinion is correct as can be determined from an examination of my figures 456–458 of the female genitalia. All of these problems require further detailed study.

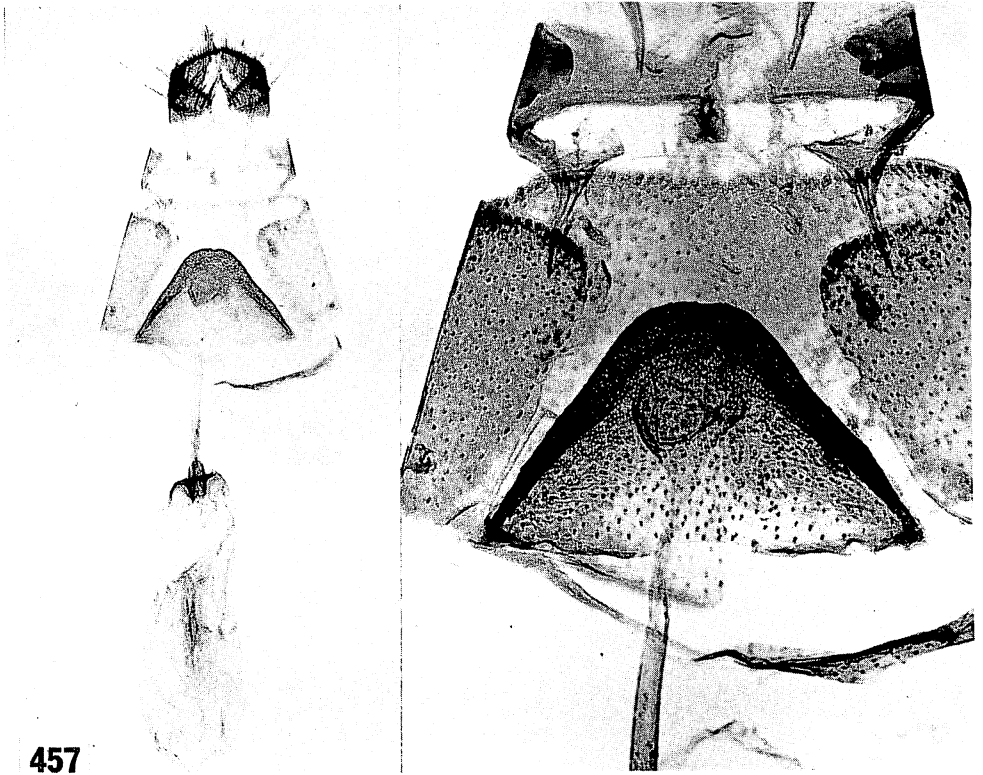
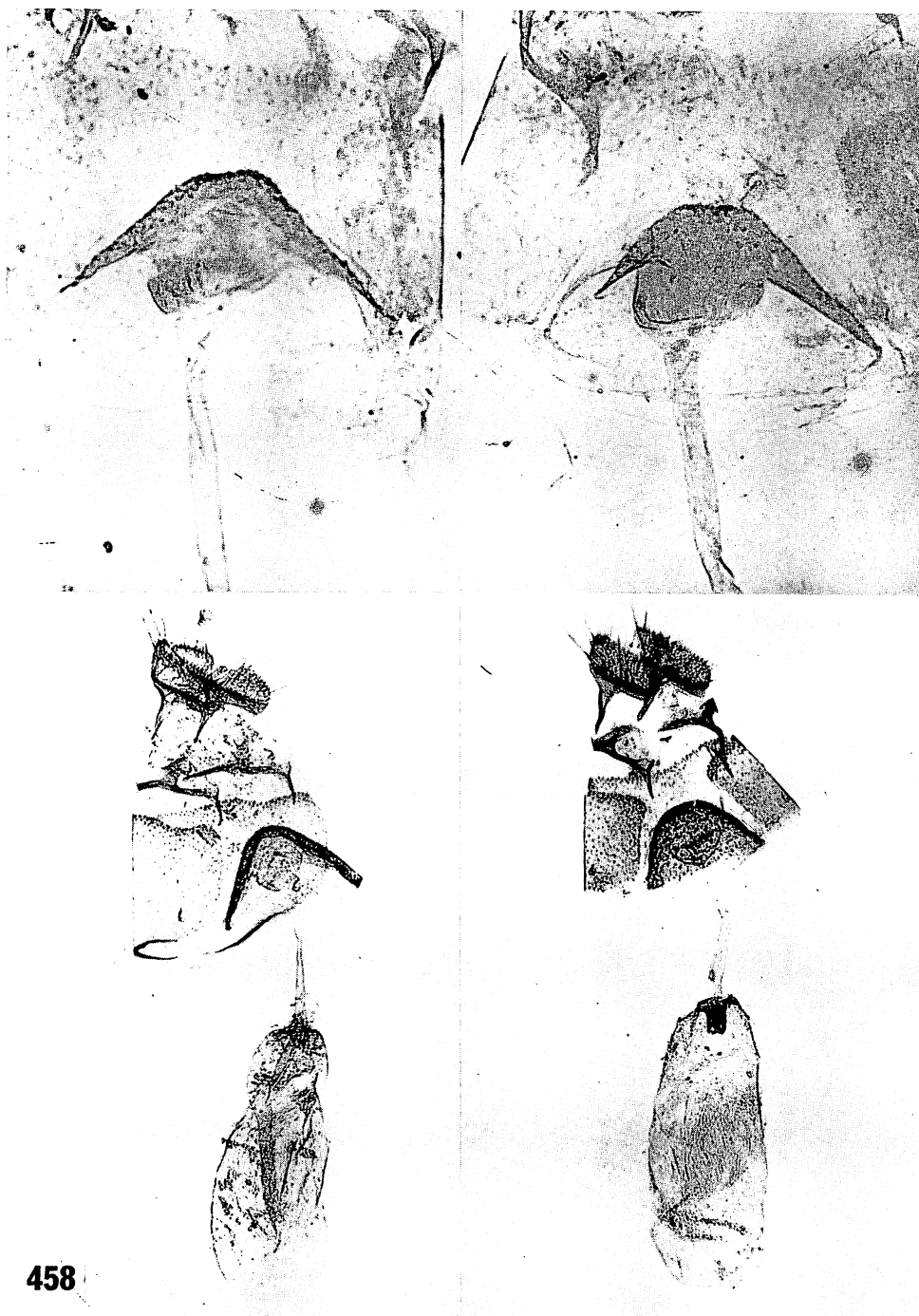
**457**

Figure 457—*Philodoria* (*Eophilodoria*). Female genitalia of a paratype of *naenaeiella* (Swezey); Pupukea, Oahu; ex *Hesperomannia* (slide Z-I-10-66-B). This requires careful comparison with material reared from the type host at the type locality. Compare figures 456, 458.



458

Figure 458—Female genitalia of *Philodoria* (*Eophilodoria*). Top two figures are of *sciallactis* (Meyrick); that on the left is from Barber's Point, Oahu (slide Z-I-29-61-1); that on the right is from Kaena Point, Oahu (slide Z-I-30-61-1); both specimens ex *Lipochaeta*. Bottom left, *naenaeiella* (Swezey); Pupukea, Oahu; ex *Hesperomannia* (slide Z-V-17-61). Bottom right, *neraudicola* (Swezey); south of Hilo, Hawaii; ex *Pipturus* (slide Z-V-18-61).

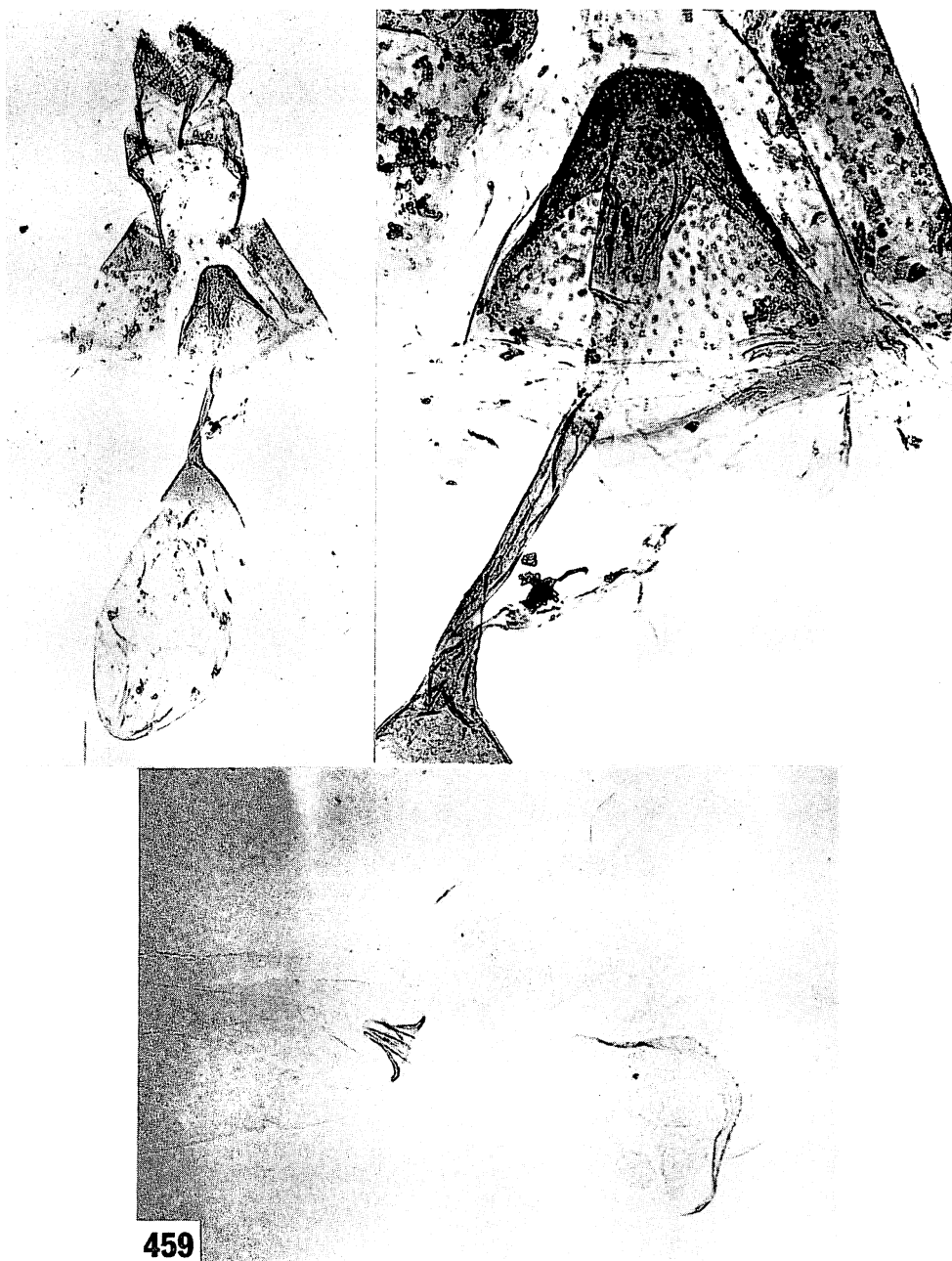


Figure 459—Female genitalia of *Philodoria* (*Eophilodoria*) *nigrelloides* (Swezey) holotype (slide Z-I-10-67); Alakai Swamp, Kauai; ex *Dubautia*. Bottom, *epibathra* Walsingham, holotype (BM slide 2884); Molokai.

**Philodoria (Eophilodoria) neraudicola** (Swezey), **new combination**  
(figs. 444, moth; 449, male genitalia; 458, female genitalia).

*Gracilaria neraudicola* Swezey, 1920b:385.

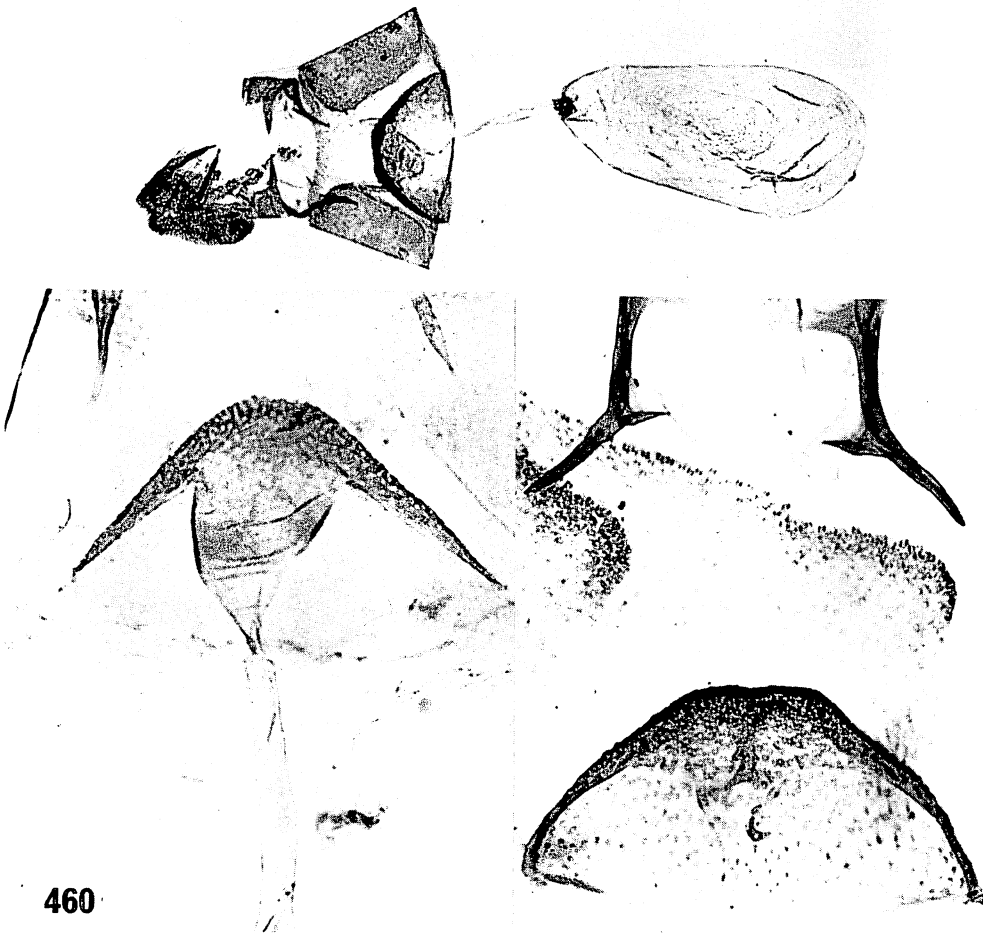
*Parectopa neraudicola* (Swezey) Swezey, 1928d:191.

Endemic. Kauai, Oahu (type locality: Punaluu), Molokai, Hawaii.

Hostplants: *Neraudia melastomaefolia*, *Pipturus albidus* (the preferred host).

Parasites: *Euderus metallicus* (Ashmead), *Phigalia externa* (Timberlake).

The type host of this species is *Neraudia*, but Dr. Swezey stated that he later found that the larvae prefer *Pipturus*. I have not had an opportunity to examine material under this name from the two hosts and from different islands. It is possible that more than one species is involved in the records.



460

Figure 460—Female genitalia of *Philodoria* (*Eophilodoria*). Top, *touchardiella* (Swezey); Iao Valley, Maui; ex *Touchardia* (slide Z-I-27-61-2). Bottom left, *ureraella* (Swezey); Puu Kana, Oahu (slide Z-I-31-61-1). Compare the similar *sciallactis*, figure 458; two specimens of *ureraella* were studied and also found to be similar. Bottom right, *urerana* (Swezey); Mt. Tantalus, Oahu; ex *Urera* (slide Z-I-30-61-2).



**Philodoria (Eophilodoria) nigrella** (Walsingham), **new combination**  
(figs. 444, moth; 451, male genitalia).

*Philodoria nigrella* Walsingham, 1907b:721, pl. 25, fig. 25.

Endemic. Hawaii (type locality: Hilo, 2,000 feet).

Hostplant: unknown.

I have no record of this species having been collected since Perkins captured the original two specimens.

Although this moth has developed maxillary palpi and is typical of "*Parectopa*", in the sense of Walsingham, it was, for reasons unknown, described in *Philodoria* by Walsingham. It is closely similar to *touchardiella* (Swezey) (see the notes under that species below).

**Philodoria (Eophilodoria) nigrelloides** (Swezey), **new combination**  
(figs. 444, moth; 459, female genitalia).

*Parectopa nigrelloides* Swezey, 1946:628.

Endemic. Kauai (type locality: Alakai Swamp, 4,000 feet).

Hostplant: *Dubautia*.

This moth is known only from one female specimen reared from a leaf mine by Dr. Swezey in 1921.

**Philodoria (Eophilodoria) pittosporella** (Swezey), **new combination**  
(figs. 445, moth; 452, male genitalia).

*Parectopa pittosporella* Swezey, 1928d:189.

Endemic. Oahu (type locality: Mt. Kaala, above 3,000 feet).

Hostplant: *Pittosporum*.

The larva emerges from its mine to spin a cocoon on the leaf surface.

**Philodoria (Eophilodoria) sciallactis** (Meyrick), **new combination** (figs. 445, moth; 451, male genitalia; 458, female genitalia).

*Parectopa sciallactis* Meyrick, 1928c:104.

Endemic. Oahu (type locality: Kaena Point).

Hostplant: *Lipochaeta integrifolia*.

**Philodoria (Eophilodoria) touchardiella** (Swezey), **new combination**  
(figs. 445, moth; 452, male genitalia; 460, female genitalia).

*Parectopa touchardiella* Swezey, 1928d:189.

Endemic. Maui (type locality: Black Gorge, north side of the Iao Valley).  
Hostplant: *Touchardia latifolia*.

Externally, this species so closely resembles *nigrella* that I am not sure that the wing maculation characters I have used in the key will prove to be adequate to separate all specimens of the species. I have not seen enough specimens to test the effectiveness of the key characters I have used. The male genitalia are different, and there is no doubt that two species are involved.

**Philodoria (Eophilodoria) ureraella** (Swezey), **new combination** (figs. 446, moth; 453, male genitalia; 460, female genitalia).

*Gracilaria ureraella* Swezey, 1915e:94.

*Parectopa ureraella* (Swezey) Swezey, 1928d:191.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplants: *Urera sandwicensis*, *Urera kaalae*.

Parasites: *Euderus* ("Omphale", "Secodella") *metallicus* (Ashmead), *Pauahiana* ("Necremnus") *maculatipennis* (Ashmead), *Sierola pulchra* Fullaway, "an undetermined chalcid". Dr. Swezey found that nearly as many parasites as moths emerged from the material he reared.

Dr. Swezey (1933b:303) noted that the specimens he reared from *Urera kaalae* in the Waianae Mountains differ slightly from those he reared from *Urera sandwicensis* in the Koolau Mountains. I have not made a study of specimens from the two localities and cannot comment upon the situation. It is possible that more than one species is involved.

LARVA. Full-grown larva about 6mm.; slender, segment 2 much enlarged, head mostly retracted into it; pale greenish[;] head strongly bilobed, testaceous with brown sutures, eyes black; cervical shield slightly testaceous and roughened on the disk; a similarly roughened area on ventral side between the legs, black lengthwise in middle; abdominal prolegs on segments 7-9.

PUPA. Pupa slender, 4mm., pale greenish; wing-sheaths extend to apex of 5th abdominal segment, free beyond 4th segment; posterior leg-sheaths extend to apex of abdomen; antenna-sheaths extend to apex of abdomen and curve up over the back to about middle of abdomen; cremaster rounded, unarmed.

MINE. The mine at first is a small roundish blotch becoming irregular as it becomes larger from the eating of the larva within. The larva emerges to spin its whitish cocoon on the surface of the leaf.

The moths emerged from the cocoons in about ten days. (Swezey, 1915:95.)

**Philodoria (Eophilodoria) urerana** (Swezey), **new combination** (figs. 446, moth; 453, male genitalia; 460, female genitalia).

*Gracilaria urerana* Swezey, 1915e:95.

*Parectopa urerana* (Swezey) Swezey, 1928d:191.

Endemic. Oahu (type locality: Mt. Tantalus), Hawaii. The determination of specimens from Kilauea, Hawaii as this species is that of Dr. Swezey. I have not made a comparative study of specimens from the two widely separated localities and cannot confirm the distribution records.

Hostplant: *Urera sandwicensis*.

Parasites: *Euderus* ("Omphale", "Secodella") *metallicus* (Ashmead), *Sierola* species.

"The mine is very slender where it starts from an egg placed on the under side of the leaf, it gradually widens as the larva grows, becomes serpentine and towards the last enlarges to a blotch. The larva emerges to spin its whitish cocoon on the surface of the leaf. The moths emerged from the cocoons in about ten days." (Swezey, 1915d:96.)

It is of interest to note that the type series of this species was reared by Dr. Swezey from the same lot of leaves from which the type series of *ureraella* was reared. Are mines of both of these species to be found in the same leaf at the same times?

The specimen illustrated on figure 446 is designated lectotype from the series of four cotypes on the type mount.

Subgenus **PHILODORIA** Walsingham, *sensu stricto*

Maxillary palpi greatly reduced, vestigial, or obsolescent.

## KEY TO THE SPECIES OF PHILODORIA, SENSU STRICTO

1. Forewings basically brown with the maculae consisting of conspicuous white maculae only (figures 465, 466, *pipturiana*, 467, *wilkesiella*) . . . . . 2  
 Not so . . . . . 3
- 2(1). Posterior margin of forewing with three prominent white maculae; one near base, one just basad of middle and one beyond middle, and opposite the interspaces between these white maculae there are two similar white maculae on the costa and there are no maculae along the plica; on *Argyroxiophium* (= *Wilkesia*) *grayana* on Maui; figure 467 . . . . . **wilkesiella** Swezey.  
 Posterior margin of forewing with only one prominent white macula and that situated at about the apical one-third; a prominent, elongate, white macula or vitta runs along plica from base toward an orbicular white macula on plica at basal one-third of the wing length, and on costa at a point beyond the macula on the plica is a short, oblique, white dash (directed toward the white macula on posterior wing margin) and beyond this on costa is a white crescent (this extends beyond apex of the white macula on posterior margin); on *Pipturus* in the Kohala Mountains, Hawaii; figure 465 . . . . . **pipturiana** Swezey.
- 3(1). Background scaling of forewings basically yellow with an iridescent white or metallic white submedial vitta extending from extreme base to about one-fourth or to near about one-half the length of the wing (in addition to other markings) . . . . . 4  
 Not so, forewings never with a submedial basal vitta . . . . . 5
- 4(3). Forewings with a basal, submedial (along the plica) vitta extending distad nearly to middle of wing, and beyond its apex only one similarly colored pale diagonal fascia completely crosses the wing from costa to posterior margin before the dark terminal area (also with other maculae); on *Lysimachia* on Oahu; figure 463 . . . . . **lysimachiella** Swezey.

- Forewings with the basal, submedial vitta extending out into area of cell for only about one-fourth the length of wing, and beyond its apex two similarly colored pale diagonal fasciae completely cross the wing from costa to posterior wing margin (also with other maculae); on *Lysimachia* on Molokai; figure 464 . . . . . **molokaiensis** Swezey.
- 5(3). Forewings with one or more diagonal fasciae extending completely across the wing from costa to posterior margin within about the basal two-thirds (do not include those maculae that are in the apical one-third or less) . . . . . 6
- Forewings without any of the maculae within the basal two-thirds extending entirely across the wing as complete diagonal fasciae . . . . . 9
- 6(5). Background scaling of forewings chocolate brown with bright yellow or orange, metallic silvery white and black maculae; with four orange costal maculae and between these there are three metallic white maculae; the subbasal orange macula surrounded almost entirely by dark brown scaling; posterior margin of wing with an orange macula distad of the submedial metallic white fascia; on *Myrsine* on Oahu; figure 461 . . . . . **auromagnifica** Walsingham.
- Background scaling of forewings partly yellow or orange and with a different pattern . . . . . 7
- 7(6). Almost entire basal half of forewing concolorous creamy-grey (or an approximation to such a color) or mauve and without any enclosed maculae or any yellow in this basal area which is continuous in color with that of pronotum; on *Metrosideros* on Maui and Hawaii; figure 461 . . . . . **basalis** Walsingham.
- Not so colored, basal area maculate . . . . . 8
- 8(7). Forewing with basal one-fourth of costal area black or very dark brown; the metallic white costal macula between the submedial and subapical fasciae directed obliquely distad from costa; on *Myrsine* on Maui and Hawaii; figure 467 . . . . . **succedanea** Walsingham.

- Forewing with basal one-fourth of costal area pale; the metallic white costal macula between the submedial and subapical fasciae directed almost straight toward opposite side of wing; on *Metrosideros* on various islands; figure 466.....
- .....**splendida** Walsingham.
- 9(5). Background scaling of forewing brownish, with a short, subbasal, white vitta on plica followed by a suborbicular white macula on plica before middle of wing, and beyond this is a diagonal, narrow, white macula from costa pointing toward a suborbicular white macula at about the apical one-third of the posterior margin of the wing and another small white macula on costa and some small subterminal white patches; Maui; figure 467.....**spilota** (Walsingham).
- Not so.....10
- 10(9). At about distal one-third of forewing there is a sub->-shaped fascia which is black at the point and white at the apices of the arms (that is, forming a white spot on costa and on posterior margin of wing with black scaling on the mid line of the wing), and beyond this fascia is an area containing yellow or orange squamae; the aforementioned area of yellow or orange scaling containing numerous dark squamae which normally form a dark medial vitta; on *Pipturus* on Kauai; figure 463.....**micropetala** Walsingham.
- The above-mentioned subapical area formed entirely of yellow to orange squamae and with no indication of a dark medial vitta through the yellow to orange area.....11
- 11(10). Forewing with costa entirely dark scaled basad of middle and wing without any yellow to orange scaling excepting a bright orange subapical macula which extends from costal margin to posterior margin and is preceded and followed by black scaling; Hawaii; figure 462.....
- .....**floscula** Walsingham.
- Forewing with costa narrowly white or pale-scaled from near base to the oblique white costal macula beyond middle and wing with a yellow area or yellow maculae basad of the subterminal yellow macula.....12

- 12(11). Forewing with an oblique, white, costal macula just distad of middle and the area basad of this oblique macula entirely dark or brown-scaled except for the costa which is narrowly white and a white suborbicular plical macula; with only one area of yellow scaling basad of the subterminal yellow fascia and that is a costal macula distad of the oblique white costal macula; on *Pipturus* on Oahu; figure 464. . . . . **pipturiella** Swezey.

Forewings with the color pattern rather similar but with more orange or yellow areas, and the subcostal area basad of the above-mentioned oblique costal macula is yellow to orange at least as far basad as the suborbicular plical macula. . . . . 13

- 13(12). Mid line area of forewing between suborbicular plical macula and the sub- > -shaped fascia at about the distal one-third dark to brown-scaled; suborbicular white plical macula distinctly removed from posterior margin of wing; on *Pipturus* on Oahu; figure 462. . . . . **costalis** Swezey.

The mid line area just described yellow scaled; the macula on plica extending to or near to posterior margin of wing; on *Pipturus* on Oahu and Maui; 464. . . . . **pipturicola** Swezey.

**Philodoria (Philodoria) auromagnifica** Walsingham (figs. 461, moth; 468, male genitalia; 474, female genitalia).

*Philodoria auromagnifica* Walsingham, 1907b:718, pl. 25, fig. 20.

Endemic. Oahu (type locality: mountains near Honolulu, 2,000 feet), Molokai, Hawaii.

Hostplant: *Myrsine* (= *Suttonia*).

Parasite: *Euderus metallicus* (Ashmead).

"The larvae emerge from the mines to pupate in oval cocoons on the surface of the leaves." (Swezey, 1913d:223.)

**Philodoria (Philodoria) basalis** Walsingham (figs. 461, moth; 468, female genitalia, cocoon; 475, female genitalia).

*Philodoria basalis* Walsingham, 1907b:720, pl. 5, fig. 24.

Endemic. Maui (type locality: Olinda, 4,000 feet), Hawaii.

Hostplant: *Metrosideros* (the record by Swezey, 1913d:222, for *Pipturus* was in error).

Parasite: *Euderus metallicus* (Ashmead).

Dr. Swezey told me that the oval cocoon is made on the outer surface of the dead epidermis of the leaf covering the larval mine. The epidermis is cut around at a slight distance from the cocoon so that it falls easily out of the leaf carrying the cocoon with it. *Philodoria splendida* has a similar habit.

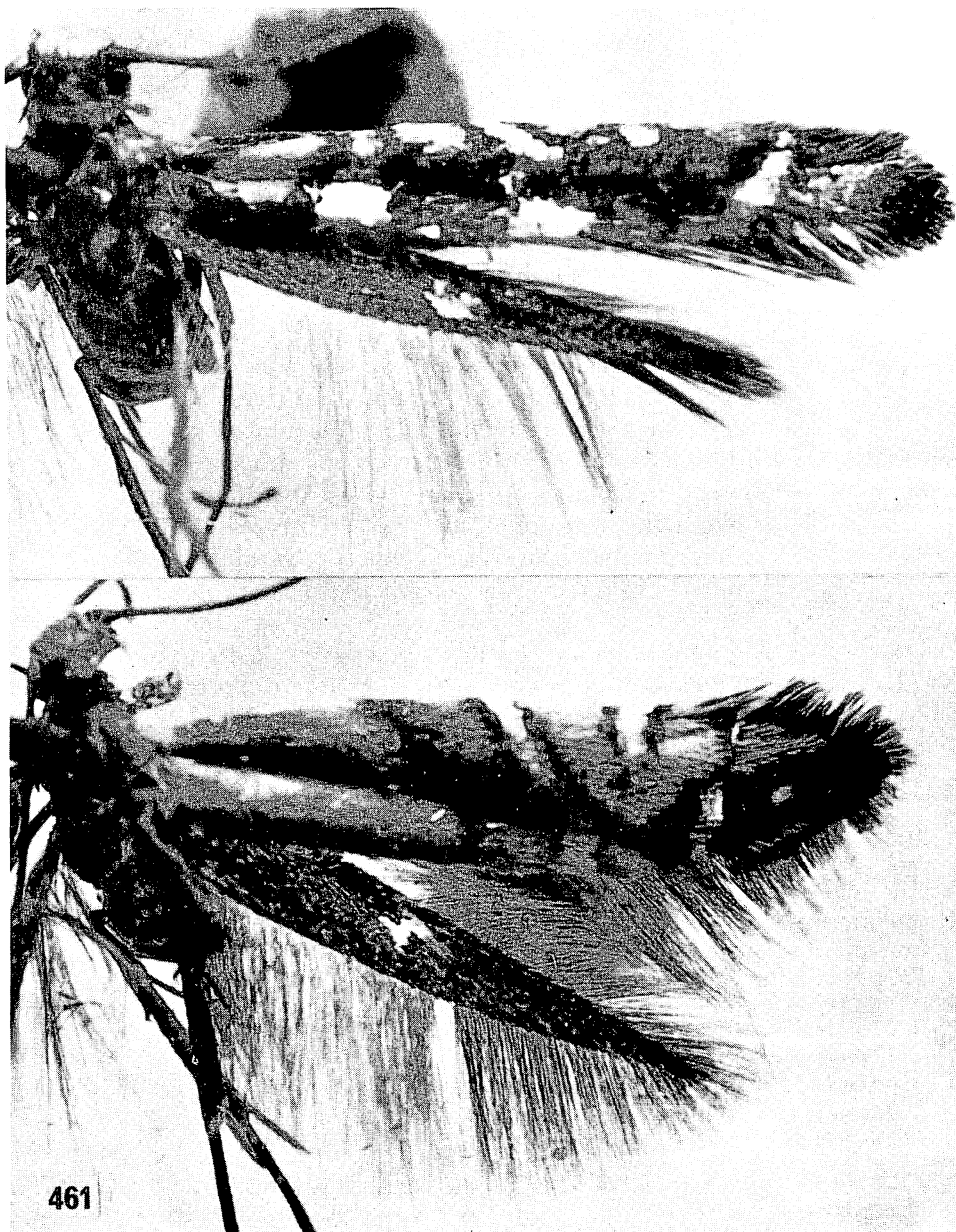


Figure 461—*Philodoria auromagnifica* Walsingham, at top, holotype male; mountains near Honolulu; forewing = 3.5 mm. (BM slide 4172). This photograph gives a poor impression because of the reflections of the metallic scales. This should be compared with colored figure 20 of plate 25 of Walsingham, 1907*b*, which differs so much from this specimen that it would be difficult to determine an example by the use of that figure. At bottom is the female holotype of *basalis* Walsingham; Olinda, 4,000 feet, Maui; forewing = 4.5 mm. (BM slide 3952).

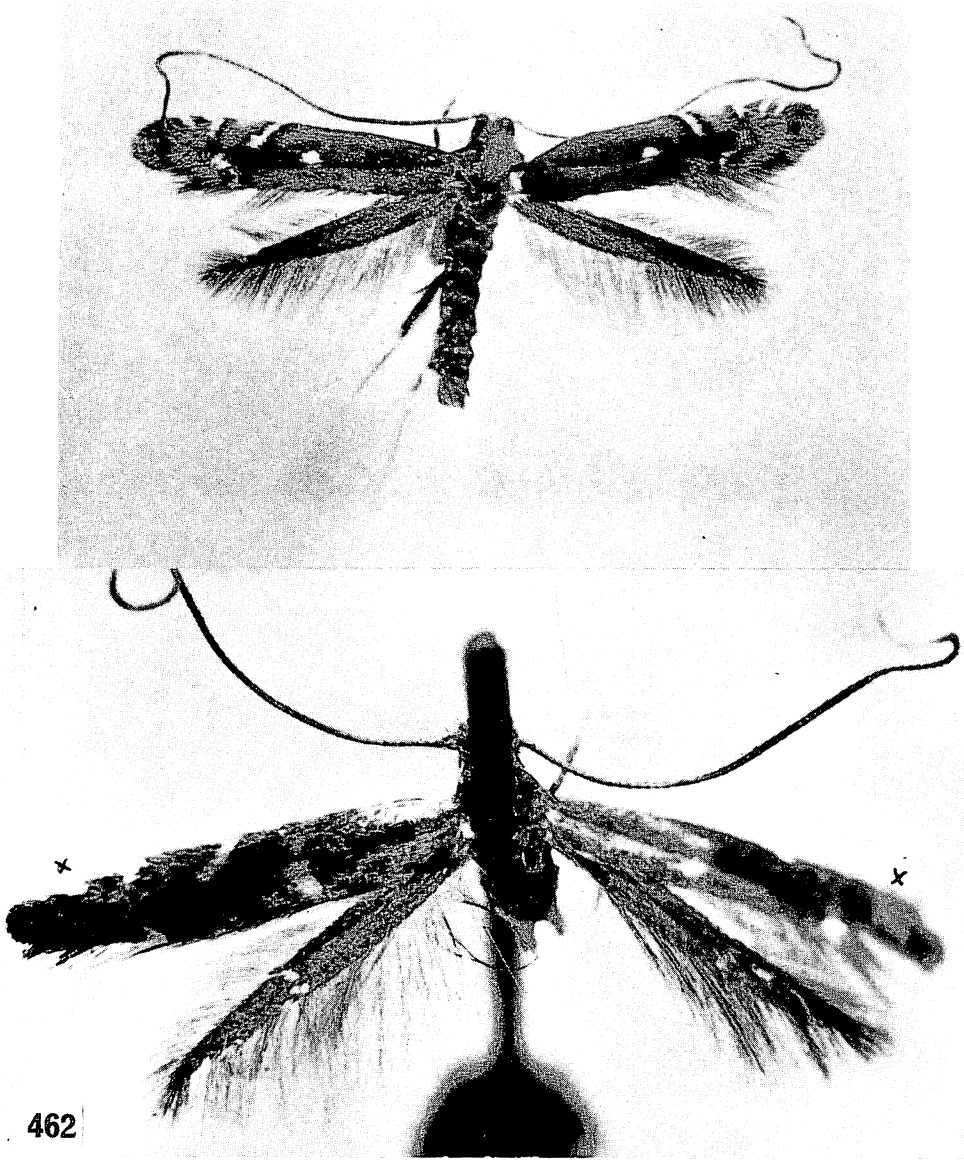


Figure 462—Top, *Philodoria costalis* Swezey, holotype; forewing=3.5 mm.; Makaha, 3,000 feet, Oahu; ex *Pipturus*. Bottom, *Philodoria floscula* Walsingham, holotype female (BM slide 3950); forewing=3 mm.; Hilo, 2,000 feet, Hawaii. The area below the "X" marks on the forewings is a band of orange scales which extends entirely across the wings and is margined basad and distad by black scales. The other marks are white or whitish on a brown background. This orange macula shows as a pale area on the right wing, but it is obscured on the left wing in this photograph. Walsingham's pl. 25, fig. 21 is misleading because it shows the pale fascia basad of the orange band to be continuous, whereas it is broken by the black scaling. This can be seen on the left wing in this figure. Also, the positions of the pale maculae near mid-wing are not correctly shown in the Walsingham figure.



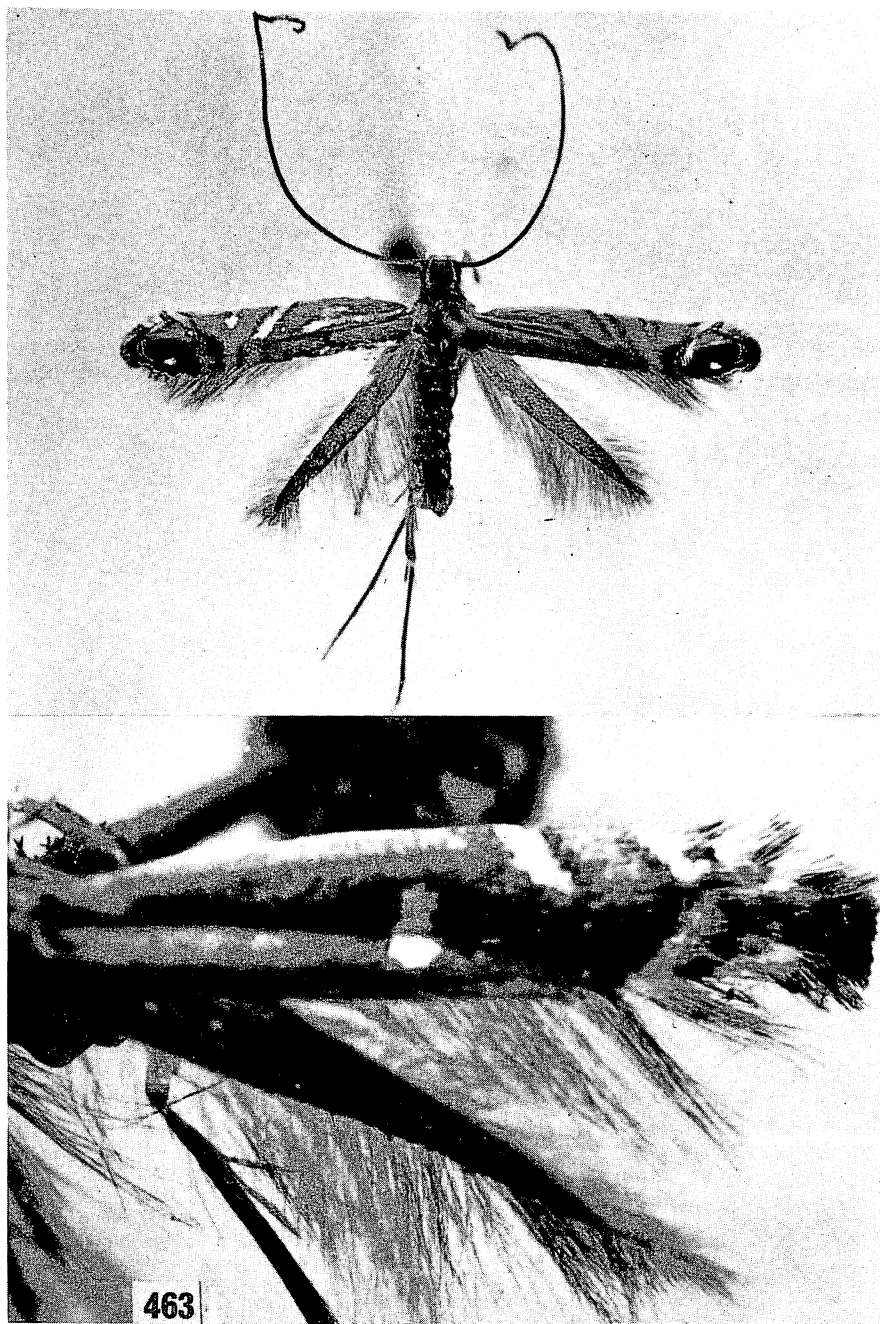


Figure 463—*Philodoria*. Top, *lysimachiella* Swezey, holotype male; Hapapa, Waianae Mts., Oahu; forewing 2.5 mm.; ex *Lysimachia*. Bottom, *micropetala* Walsingham, holotype female (BM slide 3951); Halemanu, Kauai, 4,000 feet.; forewing=3.5 mm.

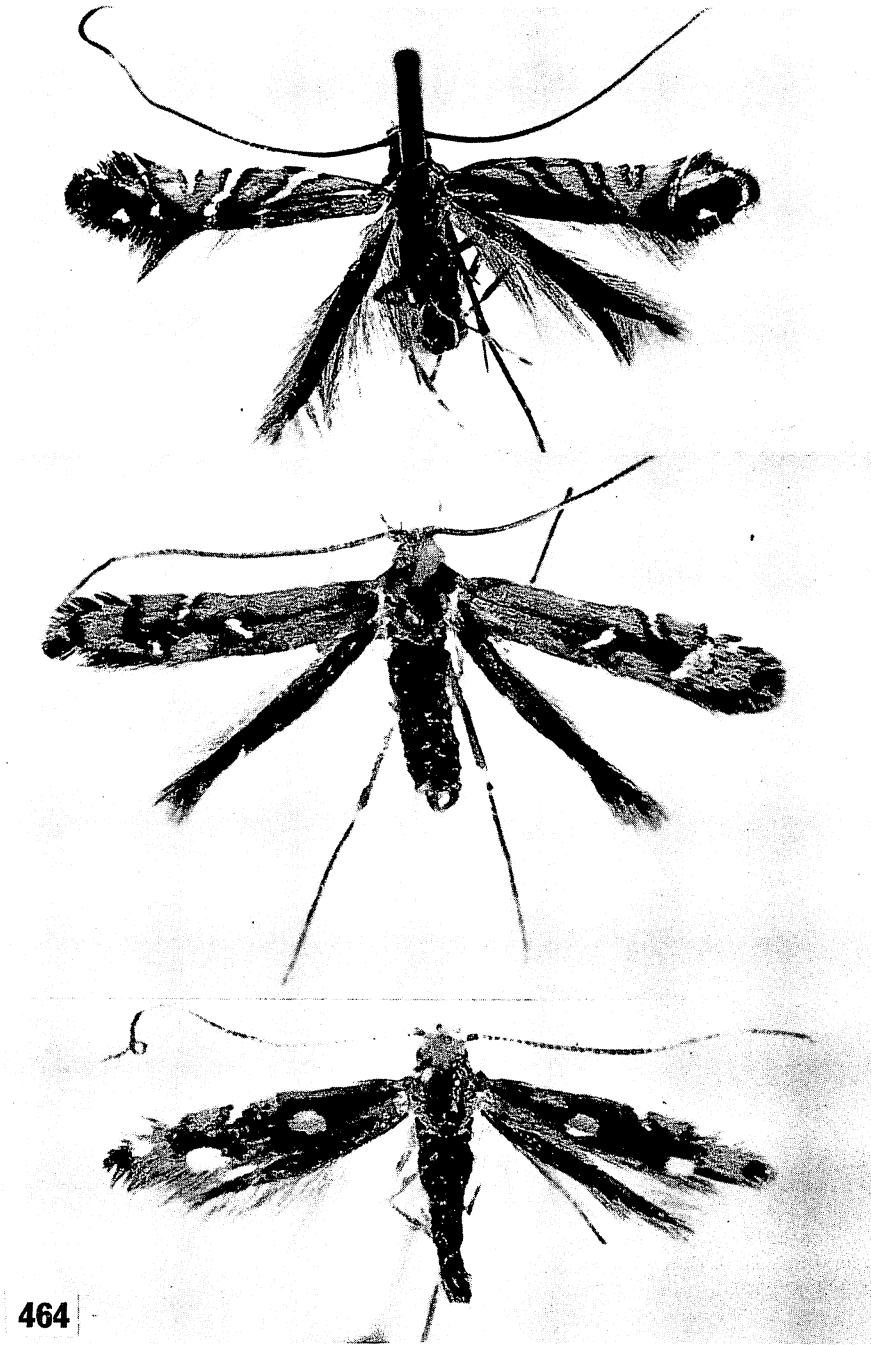


Figure 464—*Philodoria*. Top, holotype of *molokaiensis* Swezey; Kawela, 3,700 feet, Molokai; ex *Lysimachia*; forewing = 4 mm. Middle, *pipturicola* Swezey, lectotype hereby designated from the four cotypes on the original type mount in the Bishop Museum; Punaluu, Oahu; forewing = 3 mm. Bottom, holotype of *pipturiella* Swezey; Palolo, Oahu; ex *Pipturus*; forewing = 2.3 mm.

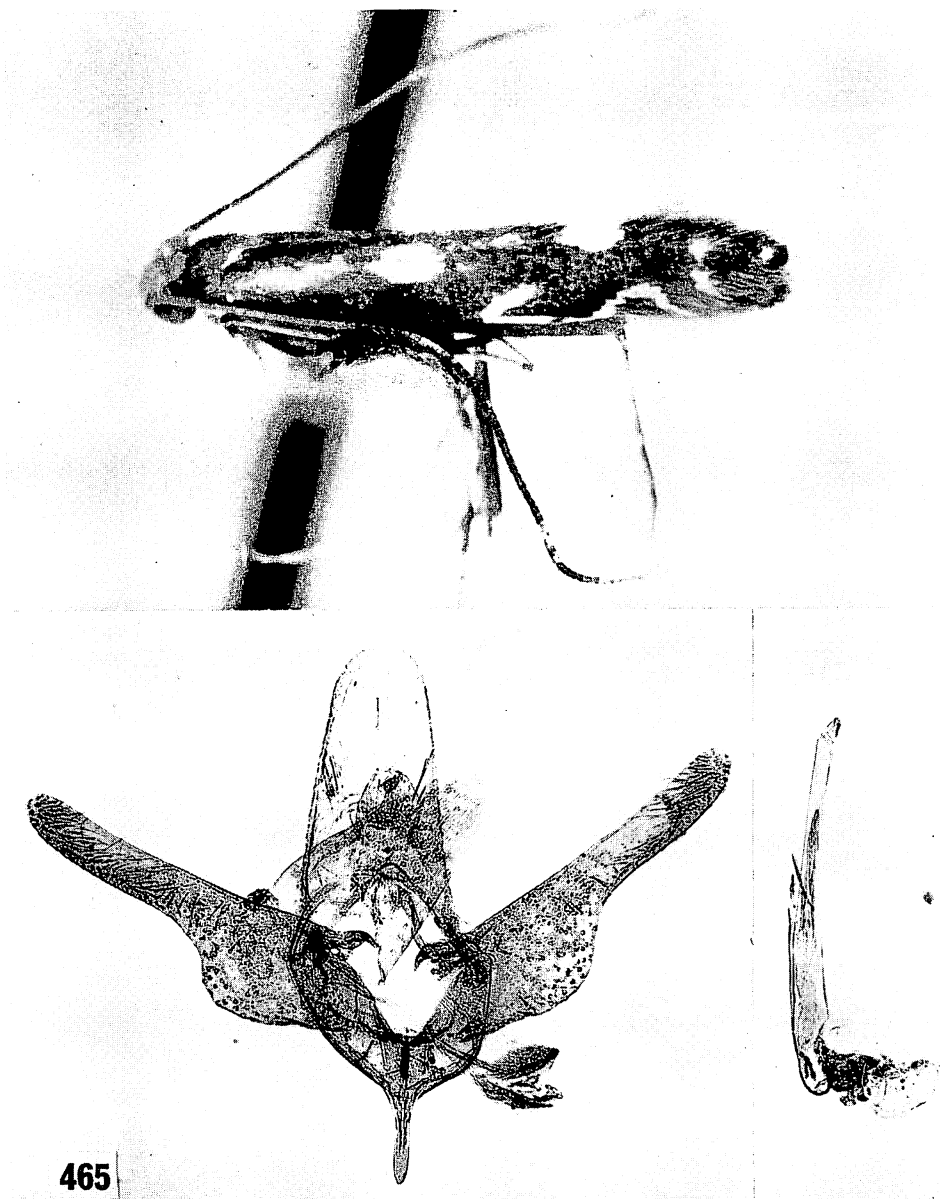
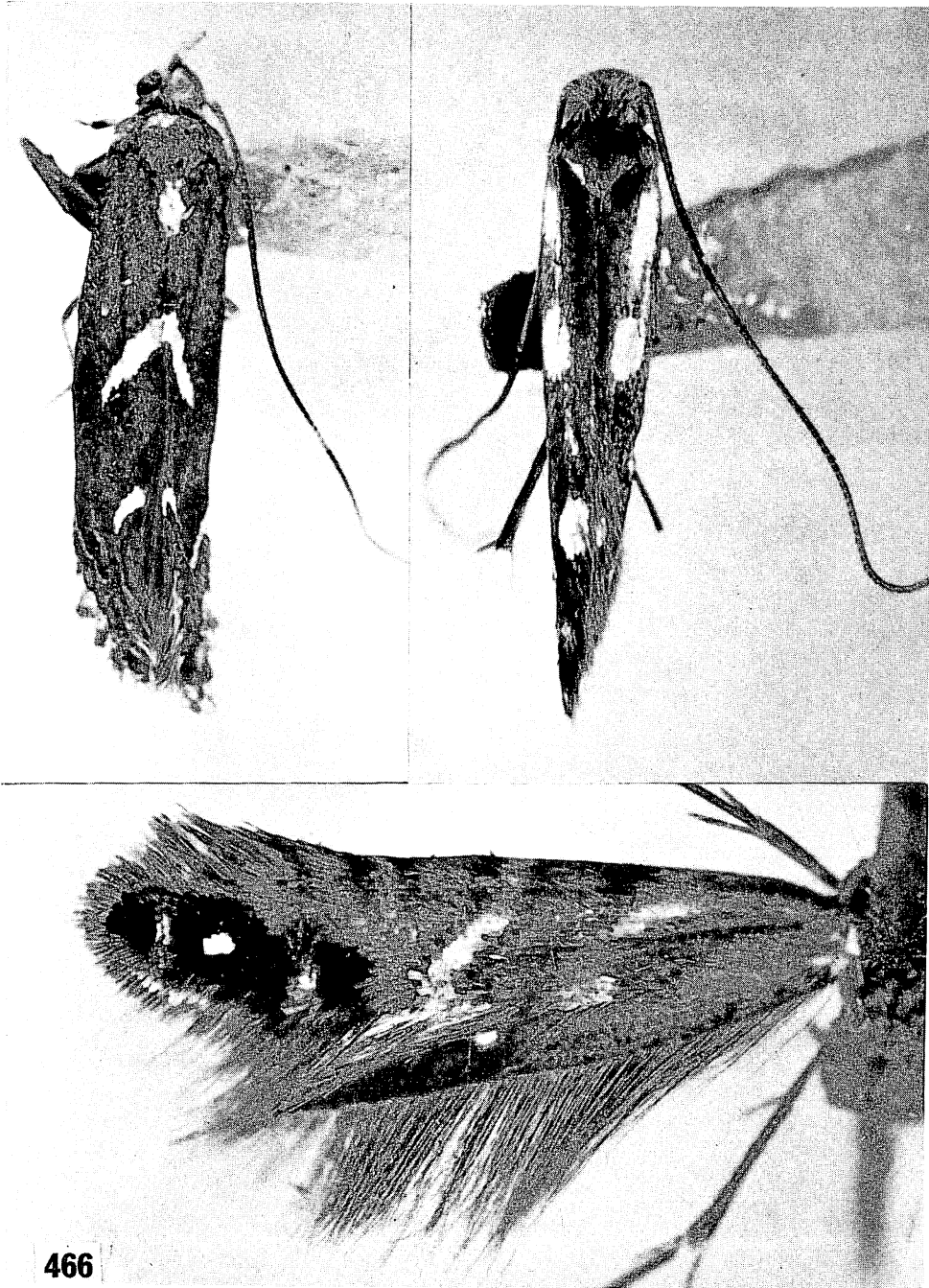


Figure 465—*Philodoria pipturiana* Swezey, holotype male and its genitalia (slide Z-I-10-67-A); Upper Hamakua Ditch Trail, Hawaii; forewing=4 mm., mostly brownish fuscous with white maculae; see figure 466 for a dorsal view.



466

Figure 466—*Philodoria* and *Eophilodoria*. Top left, (*Eophilodoria*) *nigrelloides* (Swezey), the unique holotype; Alakai Swamp, Kauai; ex *Dubautia*; length = 5 mm. See figure 444 which shows this specimen after it was remounted. Top right, *Philodoria pipturiana* Swezey, holotype; Upper Hamakua Ditch Trail, Hawaii; ex *Pipturus*; length = 4.5 mm. See figure 465 for this specimen in lateral view. Bottom, *Philodoria splendida* Walsingham, holotype male (BM slide 1858); Lanai, 2,000 feet; forewing = 4 mm.

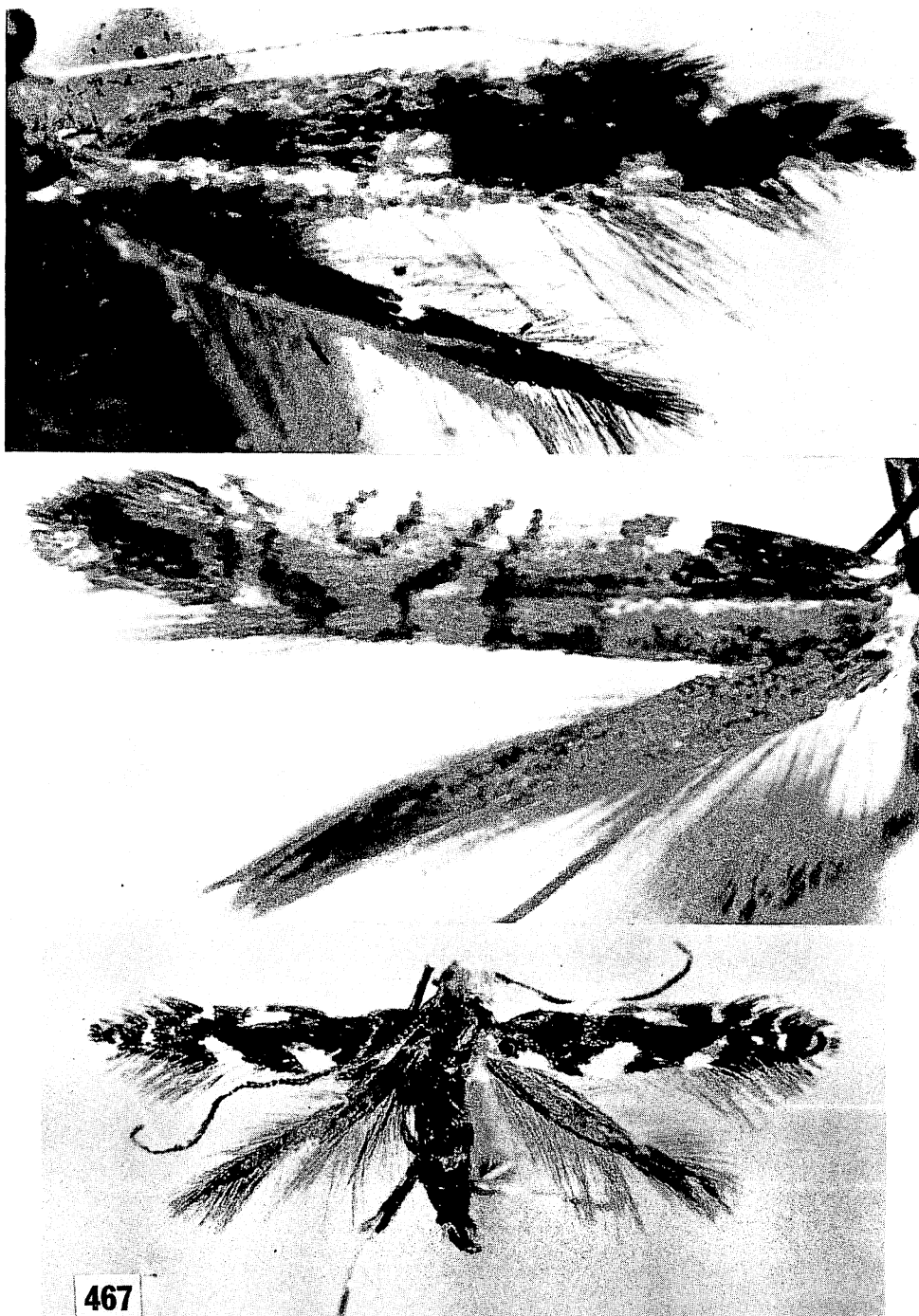


Figure 467—*Philodoria*. Top, *spilota* (Walsingham), holotype female (not male as originally stated); Haleakala, 5,000 feet, Maui; forewing=3 mm. (BM slide 2030). This hardly resembles the Walsingham 1907b, pl. 15, fig. 18; it is a faded, broken specimen. The photograph does not reveal the basal white streak on the fold, but that is shown on the Walsingham figure. Middle, *succedanea* Walsingham, holotype male (BM slide 2755); Haleakala, Maui, 4,000 feet; forewing=4 mm. Bottom, *wilkesiella* Swezey, holotype; forewing=3.25 mm.; Puu Kukui, Maui; ex *Wilkesia grayana*.

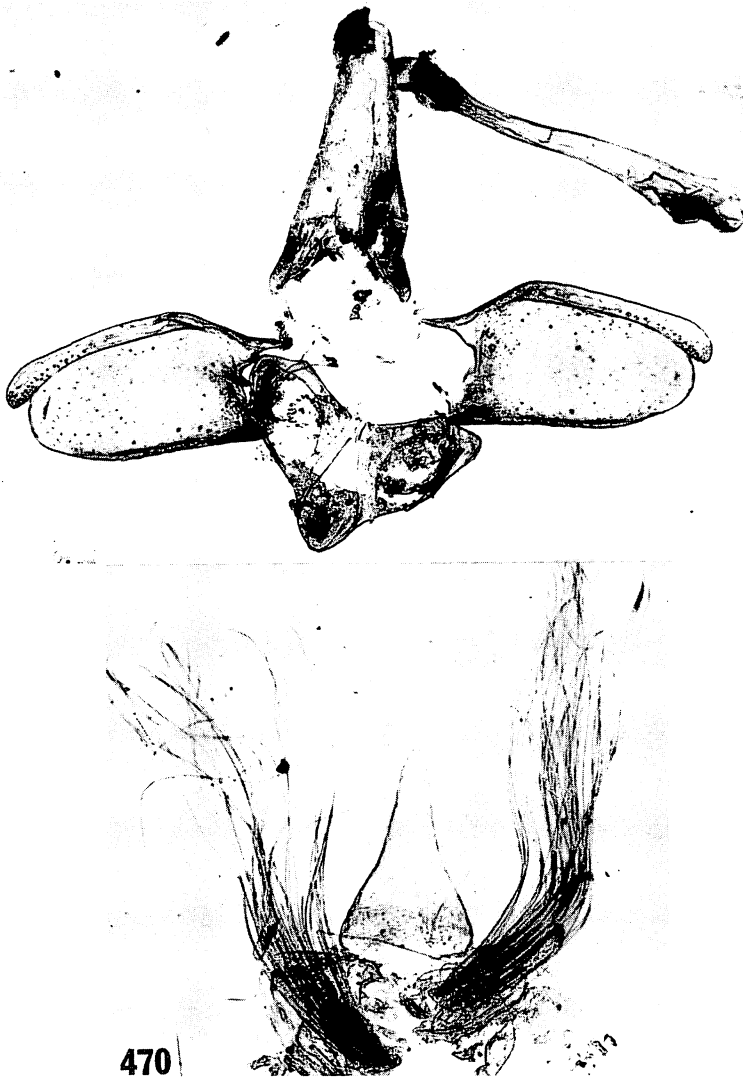


468

Figure 468—*Philodoria*. Top two figures, male genitalia of *auromagnifica* Walsingham, holotype (BM slide 4172); mountains near Honolulu. Middle and bottom figures, *basalis* Walsingham, female genitalia of the holotype (BM slide 3952); Olinda, 4,000 feet, Maui; with cocoon of another specimen inset at lower right (its open end at the right); compare figure 475.



Figure 469—Male genitalia of *Philodoria*. Top, *costalis* Swezey, paratype (slide Z-XII-20-62-2); Makaha, Oahu, 3,000 feet; ex *Pipturus*. Bottom, *lysimachiella* Swezey, paratype (slide Z-XII-20-62-1); Hapapa, Waianae Mts., Oahu; ex *Lysimachia*. Compare figure 470.



470

Figure 470—Male genitalia of *Philodoria molokaiensis* Swezey, holotype (slide Z-XII-19-62-25); Kawela Molokai, 3,700 feet; ex *Lysimachia*. In the upper figure the aedeagus has floated out of position in the mount. The lower figure is the caudal end of the abdomen. The genitalia represent an extreme type in the genus. The wing venation of this species is normal for the group. Compare *lysimachiella*, figure 469, an allied species, and also note figure 472.



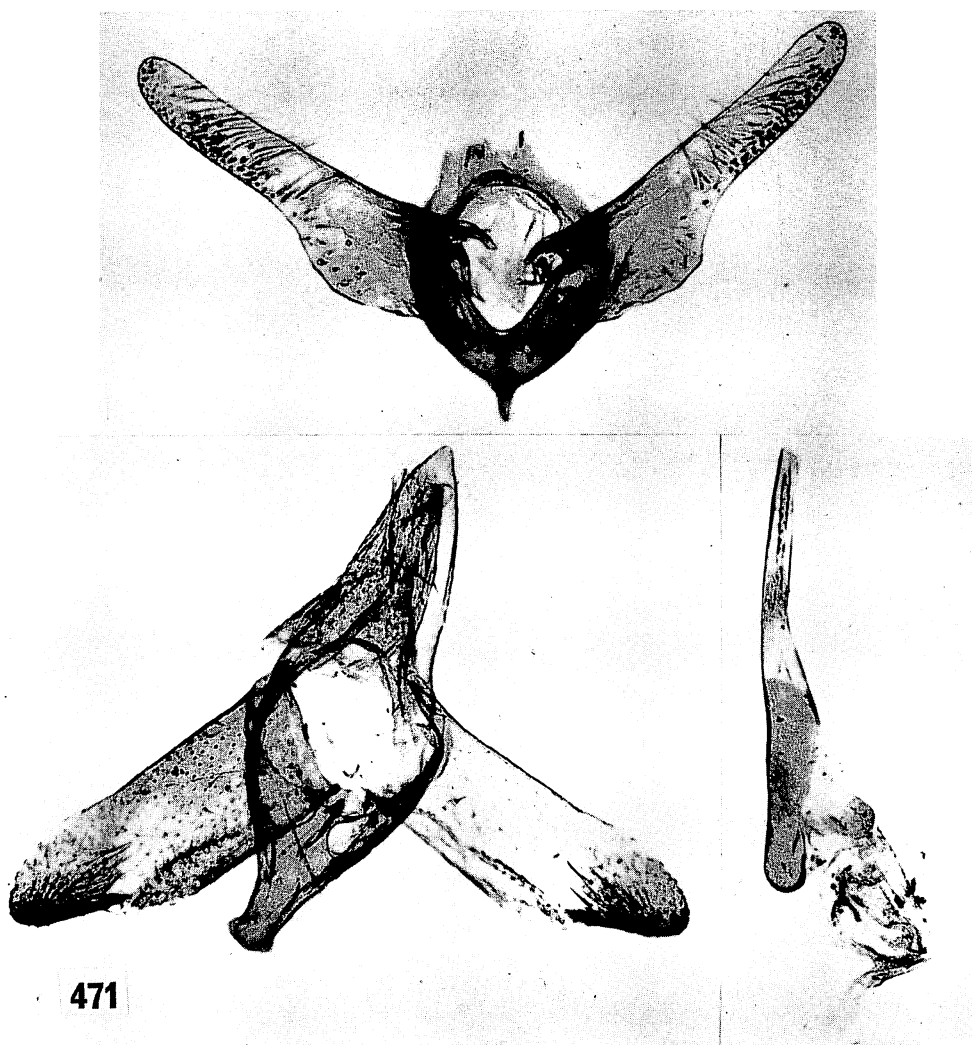


Figure 471—Male genitalia of *Philodoria*. Top, *pipturicola* Swezey; Wailuku, Maui, 2,000 feet; ex *Pipturus* (slide Z-XII-19-62-23); the tegumen has been broken away, and the aedeagus was not photographed. Bottom, *splendida* Walsingham; Waialae Nui, Oahu (slide Z-XII-19-62-20).



Figure 472—*Philodoria succedanea* Walsingham. Top, male genitalia of a paratype (Busck slide 100); note the two small signa in the bursa, the comparatively narrow ostial plate, and the divergent male valvae.

**Philodoria (Philodoria) costalis** Swezey (figs. 462, moth; 469, male genitalia; 476, female genitalia).

*Philodoria costalis* Swezey, 1934:524.

Endemic. Oahu (type locality: Makaha Ridge, about 3,000 feet, on the west side of Mt. Kaala).

Hostplant: *Pipturus*.

The larvae form "oval brown cocoons on the surface of the leaves..." (Swezey, 1934:525.)

**Philodoria (Philodoria) floscula** Walsingham (figs. 462, moth; 477, female genitalia).

*Philodoria floscula* Walsingham, 1907b:718, pl. 25, fig. 21.

Endemic. Molokai, Maui, Hawaii (type locality: Hilo, 2,000 feet).

Hostplant: *Pipturus*.

**Philodoria (Philodoria) lysimachiella** Swezey (figs. 463, moth; 469, male genitalia).

*Philodoria lysimachiella* Swezey, 1928d:188.

Endemic. Oahu (type locality: Puu Hapapa, about 2,000 feet, Waianae Mountains).

Hostplant: *Lysimachia rotundifolia*.

This species is a close ally of *molokaiensis*, but the wing maculation is distinctive.

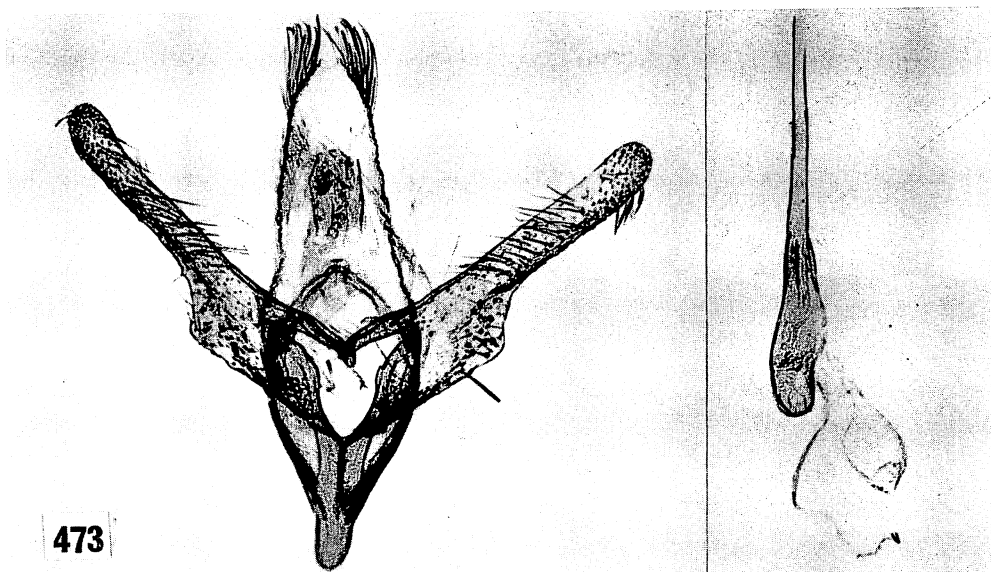


Figure 473—Male genitalia of *Philodoria wilkesiella* Swezey, paratype; Puukukui, Maui; ex *Wilkesia grayana* (slide Z-XII-19-62-18).

Dr. Swezey (1928*d*:188–189) said that he had collected mined leaves of *Lysimachia* on the ridge back of Kalihi Valley, Oahu, and on two occasions from *Lysimachia Hillebrandi* on the high plateau of Kauai, but he was unable to rear any moths. These records may represent the work of additional species of *Philodoria*.

**Philodoria (Philodoria) micropetala** Walsingham (figs. 463, moth; 476, female genitalia).

*Philodoria micropetala* Walsingham, 1907*b*:719, pl. 25, fig. 22.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: *Pipturus*.

Parasites: *Derostenus fullawayi* Crawford, *Euderus metallicus* (Ashmead).

The various records of this species from localities outside Kauai are evidently in error; the species appears to be confined to Kauai. The records for Oahu apply to *pipturiella* Swezey; see the note under that species name.

**Philodoria (Philodoria) molokaiensis** Swezey (figs. 464, moth; 470, male genitalia; 478, female genitalia).

*Philodoria molokaiensis* Swezey, 1928*d*:188.

Endemic. Molokai (type locality: Kawela, 3,700 feet).

Hostplant: *Lysimachia Hillebrandi*, variety.

This species is an ally of *lysimachiella* from Oahu.

**Philodoria (Philodoria) pipturiana** Swezey (figs. 465, moth, male genitalia; 466, moth).

*Philodoria pipturiana* Swezey, 1923*a*:295.

Endemic. Hawaii (type locality: Upper Hamakua Ditch Trail, Kohala Mountains).

Hostplant: *Pipturus*.

This species is known from only two moths collected by Swezey from a *Pipturus* tree, but it was not reared.

**Philodoria (Philodoria) pipturicola** Swezey (figs. 464, moth; 471, male genitalia; 476, 479, female genitalia).

*Philodoria pipturicola* Swezey, 1915*e*:96.

Endemic. Oahu (type locality: Punaluu), Maui.

Hostplant: *Pipturus*.

Parasites: *Euderus metallicus* (Ashmead), *Pnigalio externa* (Timberlake).

LARVA. 7mm.; pale yellowish; head with a dark brown or blackish spot in each lobe, deeply bilobed and mostly retracted into segment 2, which is wider than the rest, other segments gradually tapering backwards; distinct constrictions between segments; cervical shield somewhat roughened, two pale brownish longitudinal streaks; thoracic legs feeble; abdominal prolegs on segments 7–9.

PUPA. 3mm.; very pale brownish, abdomen yellowish; wing-sheaths pointed, extending to 5th abdominal segment; posterior leg-sheaths extend to apex of abdomen; antenna-sheaths extend beyond apex of abdomen and curve over dorsally and forward about two segments.

MINE. At first serpentine, later a blotch. The larva emerges to spin a light brownish cocoon on some convenient surface. (Swezey, 1915*e*:96–97.)

The specimen illustrated in figure 464 is selected as lectotype from the series of four syntypes on the type mount in the Bishop Museum.

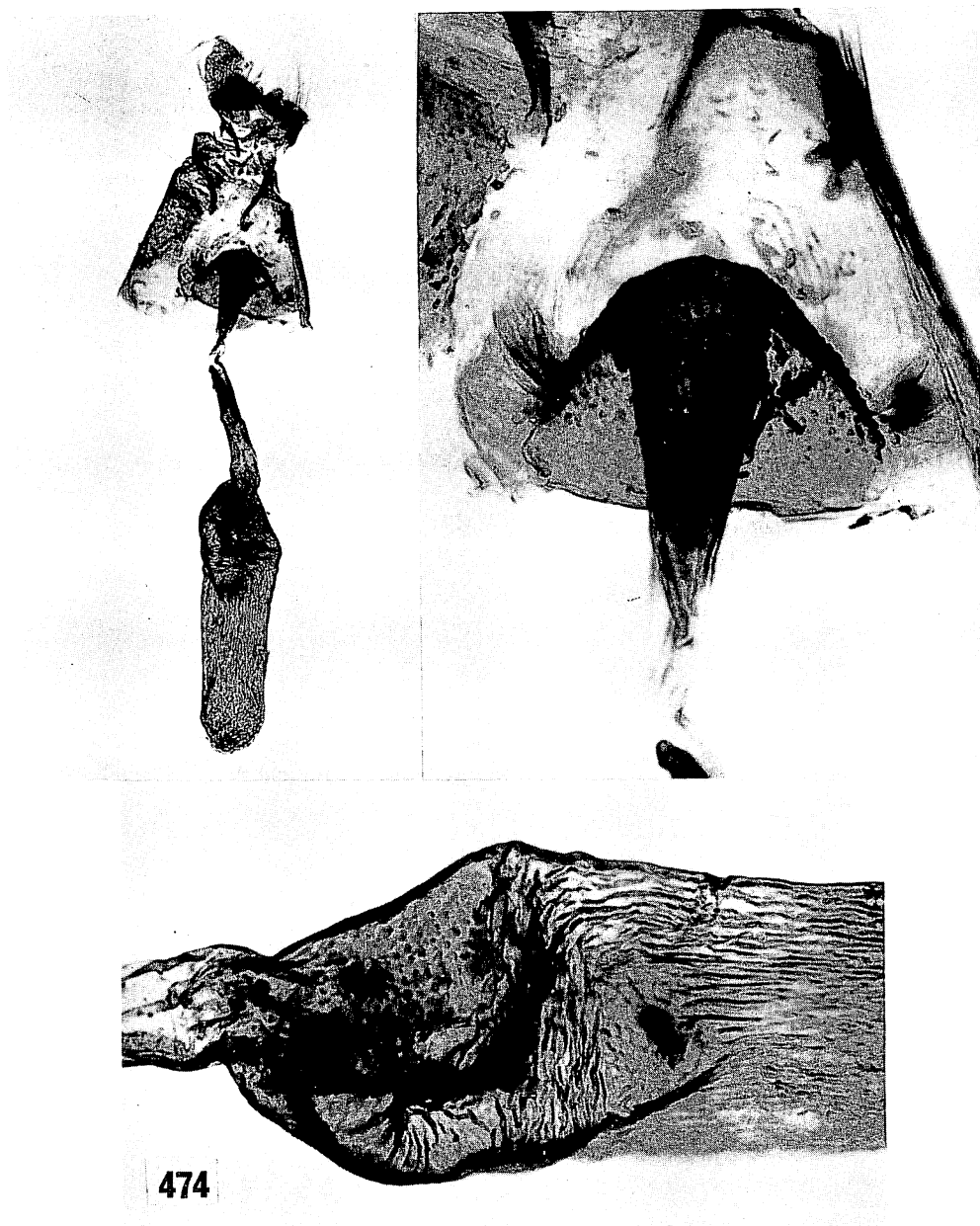


Figure 474—Female genitalia of *Philodoria auromagnifica* Walsingham; Wailupe, Oahu (slide Z-XII-20-62-6).

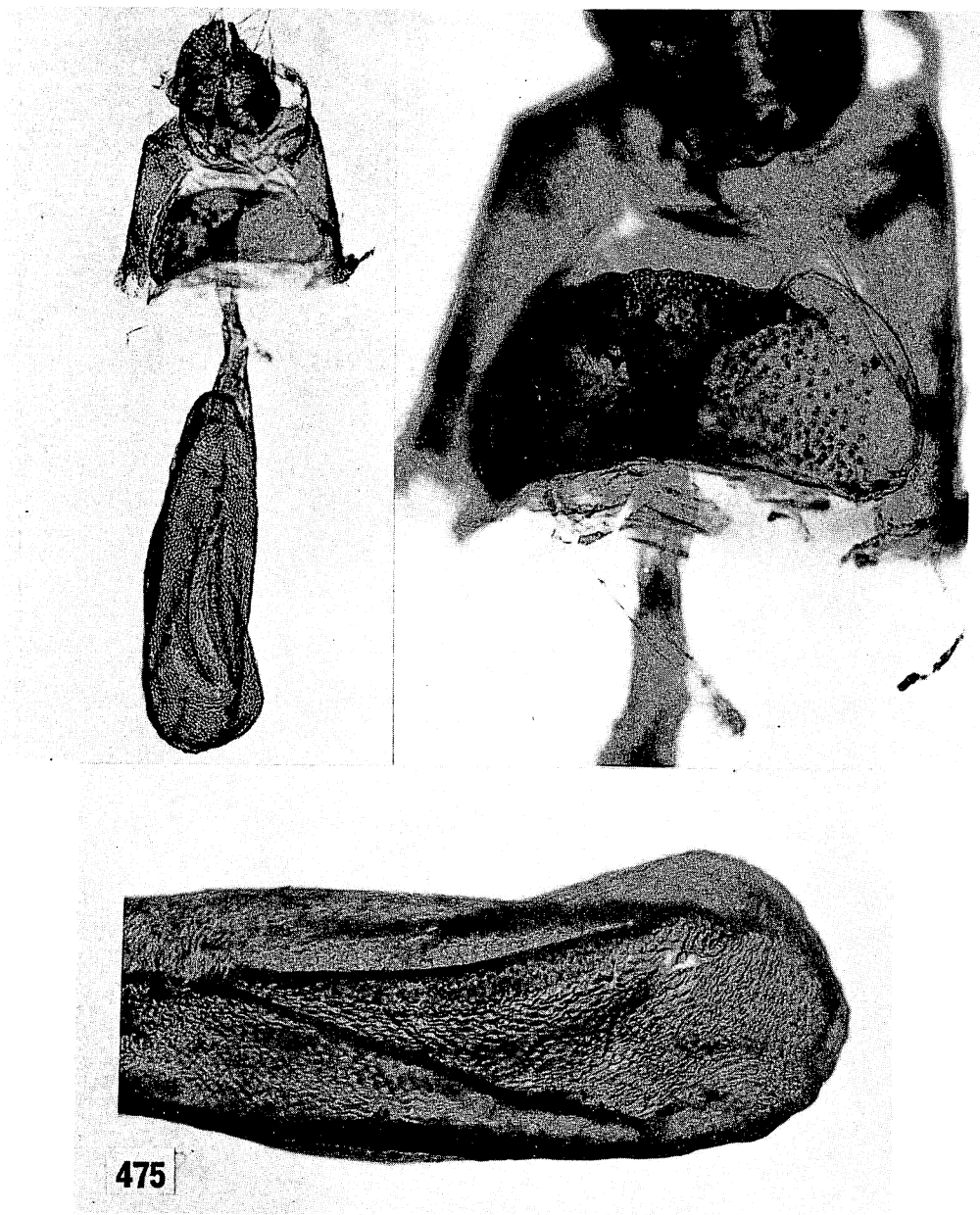


Figure 475—Female genitalia of *Philodoria basalis* Walsingham; Kohala Mts., Hawaii (slide Z-XII-20-62-4); compare figure 468 of the holotype.

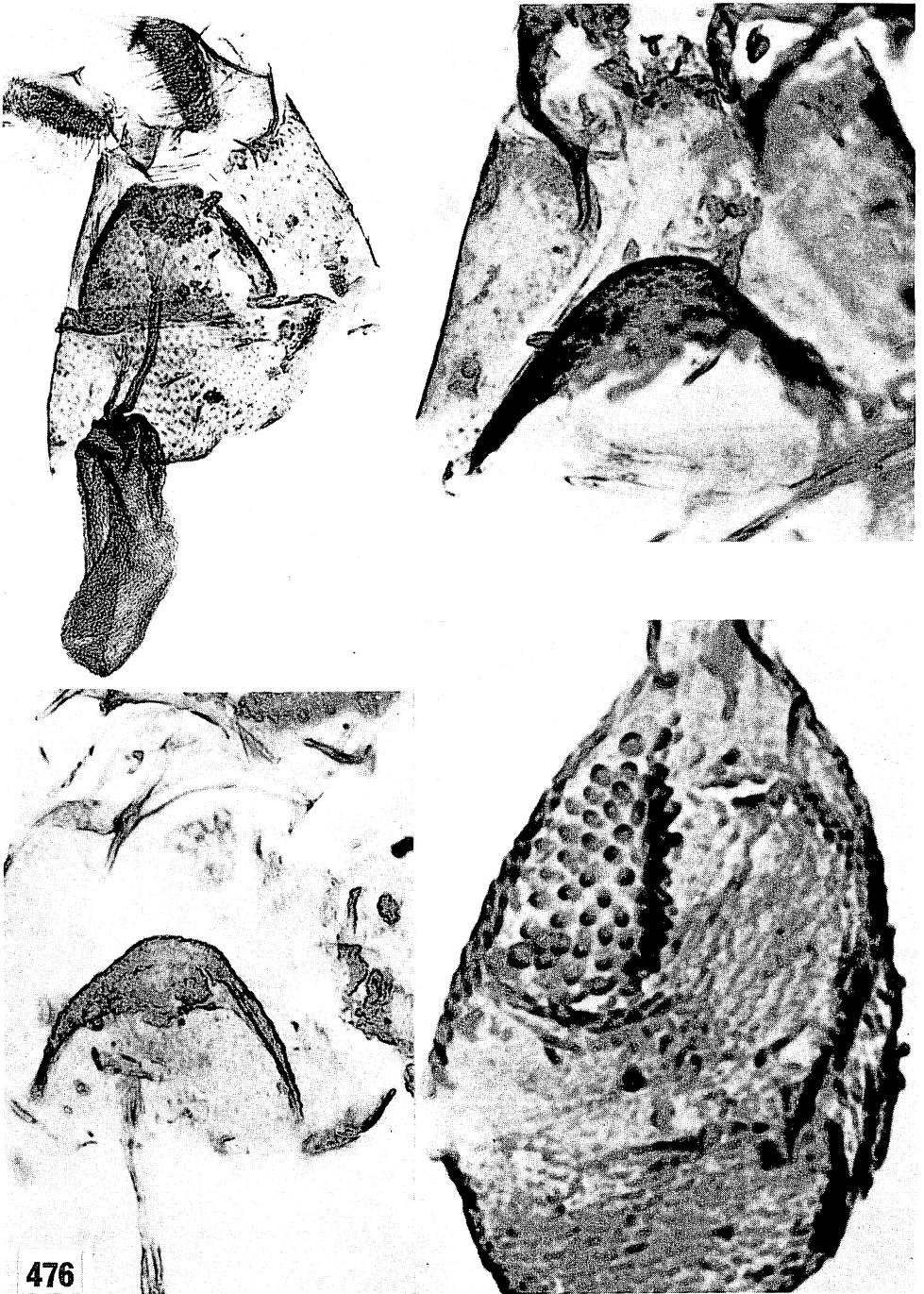


Figure 476—Female genitalia of *Philodoria*. Top left, *costalis* Swezey, paratype (slide Z-XII-20-62-3); Makaha, Oahu, 3,000 feet; ex *Pipturus*. Top right, *micropetala* Walsingham; Kumuwela, Kauai; ex *Pipturus* (slide Z-XII-19-62-27). Bottom, left and right, *pipturicola* Swezey, determined by Swezey; Wailuku, Maui, 2,000 feet; ex *Pipturus* (slide Z-XII-19-62-24); see also figure 479.

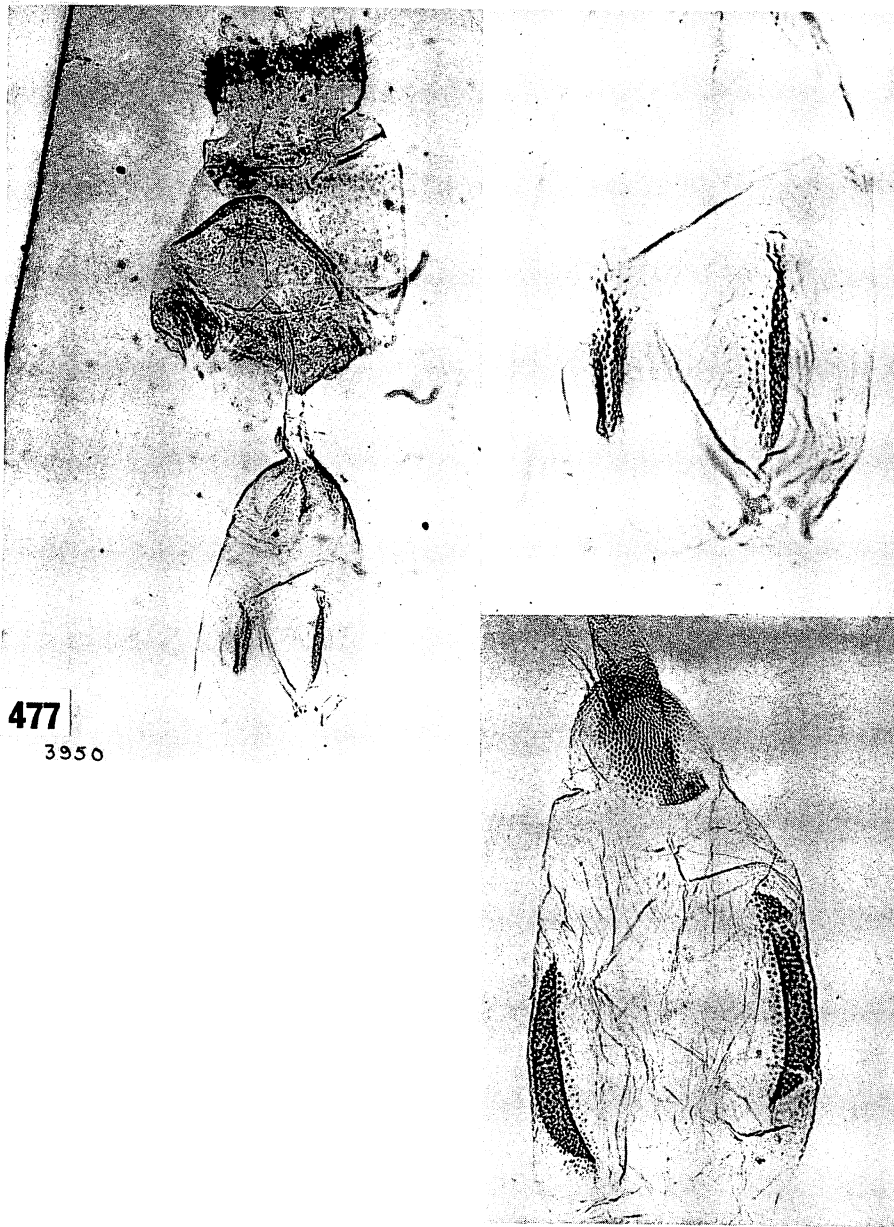


Figure 477—Female genitalia of *Philodoria*. Top, left and right, *floscula* Walsingham, holotype (BM slide 3950); Hilo, Hawaii, 2,000 feet. Bottom, bursa copulatrix of a paratype of *splendida* Walsingham (Busck slide 101); Lanai, 2,000 feet; compare figure 481.



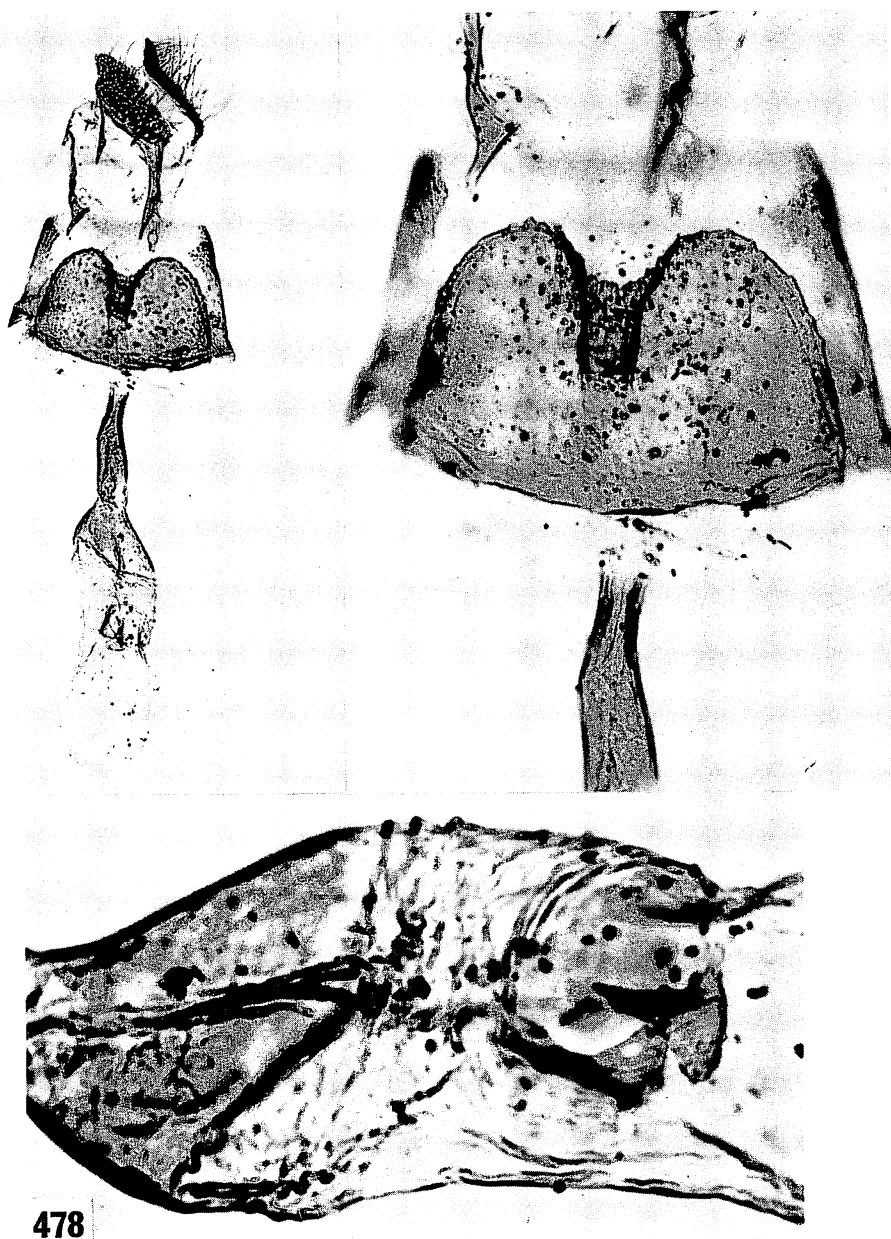


Figure 478—Female genitalia of *Philodoria molokaiensis* Swezey (slide Z-XII-19-62-26); Kawela, Molokai; ex *Lysimachia*.

**Philodoria (Philodoria) pipturiella** Swezey (figs. 464, moth; 480, female genitalia).

*Philodoria pipturiella* Swezey, 1923a:294.

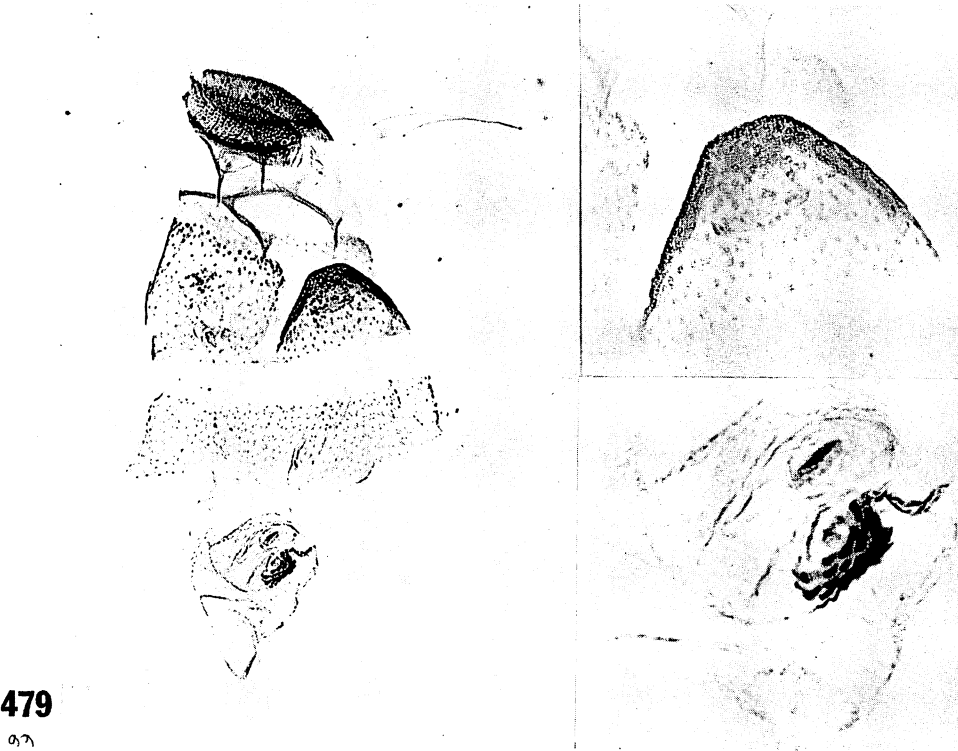
Endemic. Oahu (type locality: Palolo).

Hostplant: *Pipturus*.

Parasites: *Derostenus fullawayi* Crawford, *Euderus metallicus* (Ashmead), *Sympiesis sparsus* Yoshimoto.

Dr. Swezey said (1923a:294–295) that he had found it on “practically the whole island [of Oahu] wherever *Pipturus* grows. I have reared it many times from mines in *Pipturus* leaves collected at various places in the S.E. Koolau Mountains: Palolo, Kaumuahona, Tantalus, and Pacific Heights, and also from Mount Kaala and Makaleha, in the Waianae Range. The large leaves of *Pipturus* often contain great numbers of the mines, even up to a hundred, but usually the larvae in most of them die or are parasitised so that but few of them reach their full growth and spin cocoons. The cocoons are made on the under side of the leaf alongside a prominent vein, white and not very conspicuous.

“Any mention that I have previously made to *micropetala* in the Proceedings of the Hawaiian Entomological Society pertains to this species.”



479

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Figure 479—Female genitalia of *Philodoria pipturicola* Swezey (Busck slide 99); a Maui specimen determined by Swezey; ex *Pipturus*; see also figure 476.



Figure 480—Female genitalia of *Philodoria*. Top left and right, *spilota* (Walsingham), holotype (BM slide 2030); Haleakala, 5,000 feet, Maui. Bottom left, *pipturiella* Swezey, ostial plate; Palikea, Waianae Mts., Oahu; ex *Pipturus* (slide Z-XII-19-62-22). Bottom right, *wilkesiella* Swezey, ostial plate of a paratype (slide Z-XII-19-62-19); Puu Kukui, Maui; ex *Wilkesia grayana*.



481

Figure 481—*Philodoria splendida* Walsingham, genitalia of a female specimen determined by Swezey (slide Z-XII-19-62-21); Mt. Tantalus, Oahu. This should be compared with topotypic material from Lanai when additional specimens from Lanai are collected. Compare figure 477.

**Philodoria (Philodoria) spilota** (Walsingham), **new combination** (figs. 434, head, wing venation; 467, moth; 480, female genitalia).  
*Elachista spilota* Walsingham, 1907b:513, pl. 15, fig. 18.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

It is strange that Walsingham separated this species from the other *Philodoria* he described and placed it in *Elachista*, which he placed in the Hyponomeutidae, a genus and family to which it does not belong. The unique holotype is a faded, damaged female and not a male as Walsingham stated in his original description. Walsingham said that the type was "injured when being figured". It is badly broken—the hindwings and abdomen are glued to the fore part of the body; the head is badly abraded and glued to the thorax; the left antenna is missing.

**Philodoria (Philodoria) splendida** Walsingham (figs. 466, moth; 471, male genitalia; 477, 481, female genitalia).

*Philodoria splendida* Walsingham, 1907b:719, 737, pl. 25, fig. 23. Meyrick, 1914:26. pl. 2, figs. 21, 35.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality: 2,000 or 3,000 feet), Hawaii.

Hostplant: *Metrosideros*.

Parasites: *Pauahiana metallica* Yoshimoto, *Sierola philodoriae* Fullaway.

The larvae of this species mine the leaves of *Metrosideros polymorpha*. They are found common on all the Islands. The larva emerges to form its oval cocoon, which is made on the surface of the mine, the dead epidermis being cut around a little distance from the cocoon so that it readily falls away carrying the cocoon with it. The silk of the cocoon is light brownish resembling the dead epidermis of the mined leaf (Swezey, 1913d:223.)

**Philodoria (Philodoria) succedanea** Walsingham (figs. 433, 435, head, wing venation; 467, moth; 472, male, female genitalia).

*Philodoria succedanea* Walsingham, 1907b:717, pl. 25, fig. 19.

Endemic. Maui (type locality: Olinda, Haleakala, 4,000 feet), Hawaii.

Hostplant: *Myrsine* (= *Suttonia*).

Walsingham recorded the species doubtfully from Kauai on the basis of one specimen in poor condition. I have deleted the Kauai record because the Walsingham specimen is not *succedanea*.

**Philodoria (Philodoria) wilkesiella** Swezey (figs. 467, moth; 473, male genitalia; 480, female genitalia).

*Philodoria wilkesiella* Swezey, 1940b:464.

Endemic. Maui (type locality: Puu Kukui).

Hostplant: *Argyroxiphium* (= *Wilkesia*) *grayana*.

This species has a distinctive color pattern. Although Dr. Swezey stated that "it is not closely related to any other of the known species", its genitalia are of the most common type and are close to such species as *Eophilodoria naenaeiella* which breeds in the related plant genus *Dubautia*. It is one of the few moths known to attack the extraordinary endemic composite *Argyroxiphium*.

Family **BUCCULATRIGIDAE** Fracker

*Bucculatrigenidae* Fracker, 1915:61, 67. Mosher, 1916:61. Swatschek, 1958:24.

*Bucculatrigenini* of Gracilariinae of Tineidae: Handlirsch, 1924:881.

*Bucculatrigeninae* of Gracilariidae: Hering, 1932:78.

*Bucculatricidae*: Börner, 1939:1372. Sattler, 1971:334, 343. Svensson, 1971:99.

This group is represented in Hawaii by one immigrant American species of *Bucculatrix* which was discovered established on Oahu after this text was submitted for publication. I have added details concerning it during editing of the text, because there is reason to believe that the moth, its larvae, and the damage it does to cotton may be noticed frequently and because it is a family new to the Hawaiian fauna.

*Bucculatrix* has been a "problem group" of moths which has caused taxonomists considerable difficulty. Fracker (1915:67) said:

Systematists have come to think of the genus *Bucculatrix* as a chronic obstacle to the satisfactory classification of the lower Micros. It has been driven from "pillar to post" and the end is not in sight. The situation usually consists in the positive denial of admittance to the particular family which an investigator is studying. The author erects a new family for the genus, first because specialists on adult Microlepidoptera will not admit the validity of placing *Bucculatrix* in any one of the recognized families, second, because the larvae can not be closely associated with those of any other genus of which specimens have been examined.

The moths, each of whose heads has a characteristic large, spreading tuft on the crown (which may resemble some tineids) and whose basal antennal segments have such enlarged pectens that they appear to be eye-caps, are externally so similar to *Lyonetia* and *Bedellia* that one would tend upon superficial examination to consider them to belong to the same family. However, the wing venation and genitalia are quite different (see the illustrations), and the larvae and pupae are conspicuously different. As demonstrated by my illustrations, the pupa of *Bucculatrix*, which has exposed coxae and loose appendages and is enclosed in a cocoon, is a more primitive form than *Bedellia*, which has a naked, butterfly-like pupa with concealed coxae and tightly fused appendages.

In the Hawaiian fauna, *Bucculatrix* moths can be separated from the outwardly closely similar *Bedellia* on external characters—their labial palpi are unusually short (hardly projecting beyond the apex of the pointed face), and the metatibiae have very long dorsal hairs which extend far beyond their apices. On *Bedellia*, the labial palpi are well developed, the face is apically broadly rounded, and the metatibiae have only short dorsal setae.

Genus **BUCCULATRIX** Zeller

*Bucculatrix* Zeller, 1839:214. Type-species: *Bucculatrix albedinella* Zeller.

*Ceroclastis* Zeller, 1848:295, pl. 2, fig. 47. Type-species: *Ceroclastis nigricomella* Zeller.

Stainton, 1862 (1855–1867):2–145, beautifully illustrated general account of the biologies of the species in England.

Braun, 1958:105, study of ovipositors; 1963:1–208, monograph of the North American species.

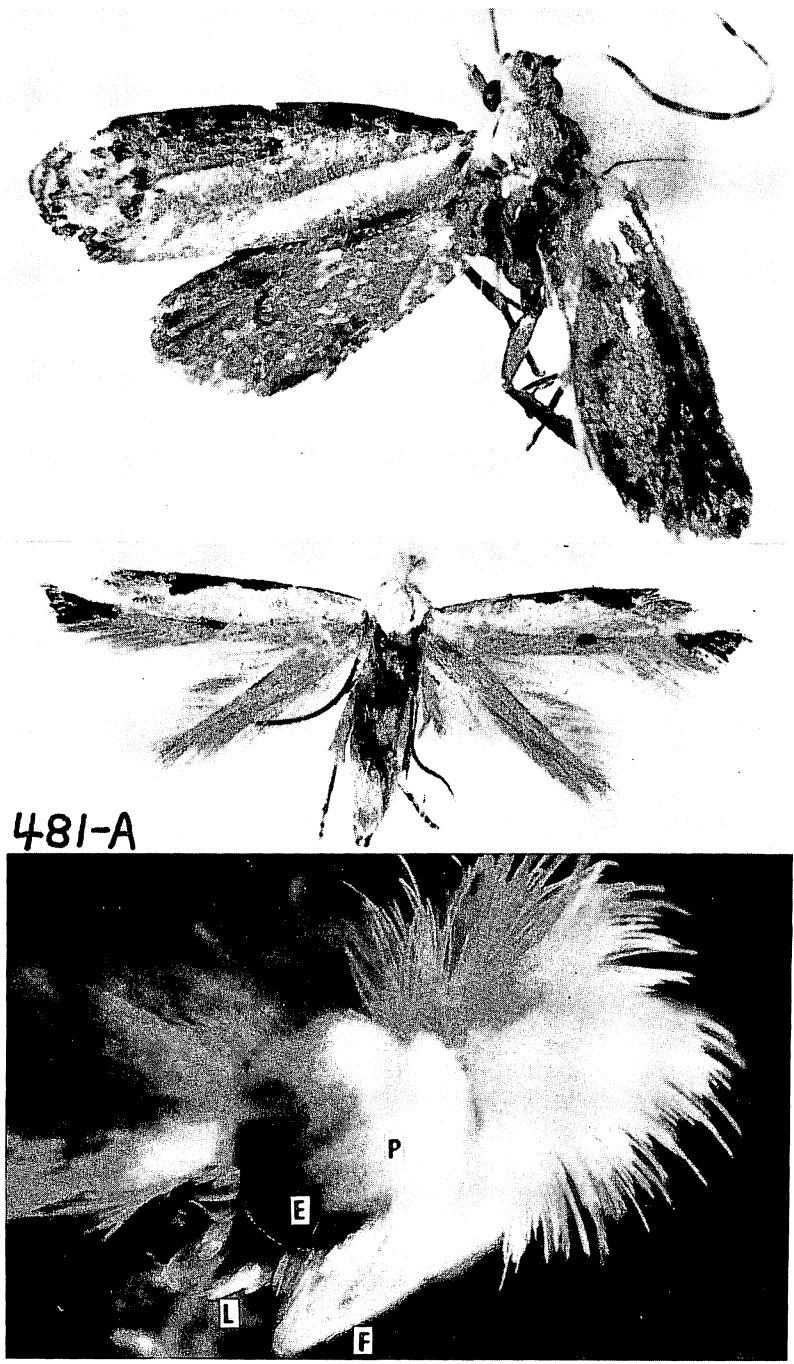


Figure 481-A—See legend on page 721.

*Bucculatrix* is a large genus of more than 200 species and is known from all of the continents. More than 100 species occur in North America. It appears to me, however, that more than one genus is involved in the complex as it is now constituted. The genitalia, larvae, and pupae support such a conclusion.

The relationships of *Bucculatrix* remain obscure. Braun (1963:13), suggested (perhaps without having seen it) that *Comodica* might have a possible relationship. *Comodica* is, however, a member of the Tineidae that has been wrongly assigned to the Lyonetiidae by some authors.

Many female *Bucculatrix* have only the posterior pair of apophyses, but some species, including the one established in Hawaii, have a partly developed second (anterior) pair.

The known eggs of the North American species are flattened, excepting for those of *thurberiella* which are upright.

The larvae are miners in the first two instars and part of the third, but they feed exposed in instars four and five.

The pupal skin is partly extruded from the cocoon before emergence of the imago.

The only representative of *Bucculatrix* in Hawaii is the following newly immigrant species:

***Bucculatrix thurberiella*** Busck (figs. 11-A, *e*, antenna; 481-A, moth, head; 481-B, forewing maculation, wing venation, cauda, male and female genitalia; 481-C, 481-D, 481-E, larva; 481-F, pupa; 481-G, larval damage).

*Bucculatrix thurberiella* Busck, 1914c:30. McGregor, 1916:505-510, pls. 36-37. Morrill, 1927a:94-98, figs. 1 (egg), 5, 6 (male and female genitalia). Braun, 1963:185, figs. 13, 23, 239, 239a-e, 240, 240a-b; redescription.

The cotton leaf perforator.

Oahu.

Immigrant. Native to the southwestern United States and northern Mexico (type locality: Santa Catalina Mts., Arizona; discovered originally on wild cotton in Arizona by W.D. Pierce in 1913). First found in Hawaii at Nanakuli, Oahu, early in 1971 by J. W. Beardsley.

Hostplant: *Gossypium tomentosum* (endemic Hawaiian cotton). In America, the species is associated with the wild cotton, *Thurberia thespesioides*, but it not infrequently attacks cultivated cotton (Essig, 1929:750, fig. 628).

McGregor, who discovered the species on cultivated cotton at El Centro, Imperial Valley, California, in 1916, has published a noteworthy, illustrated account of the species, and much of what he had to report applies equally

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Figure 481-A—Top, *Choropleca advena* Zimmerman, new species, male; length of forewing 5.0 mm.; Wailupe Valley, Oahu. Middle, *Bucculatrix thurberiella* Busck, the cotton-leaf perforator; male; expanse 8.5 mm.; Nanakuli, Oahu. Bottom, right lateral aspect of head of another specimen of *Bucculatrix thurberiella* from the same locality. On the bottom figure, note the strongly tufted crown, the pointed, smooth-scaled face (F), the heavy pecten (P) (out of focus) on the basal antennal segment which covers most of the eye (E), and the greatly reduced labial palpus (L).



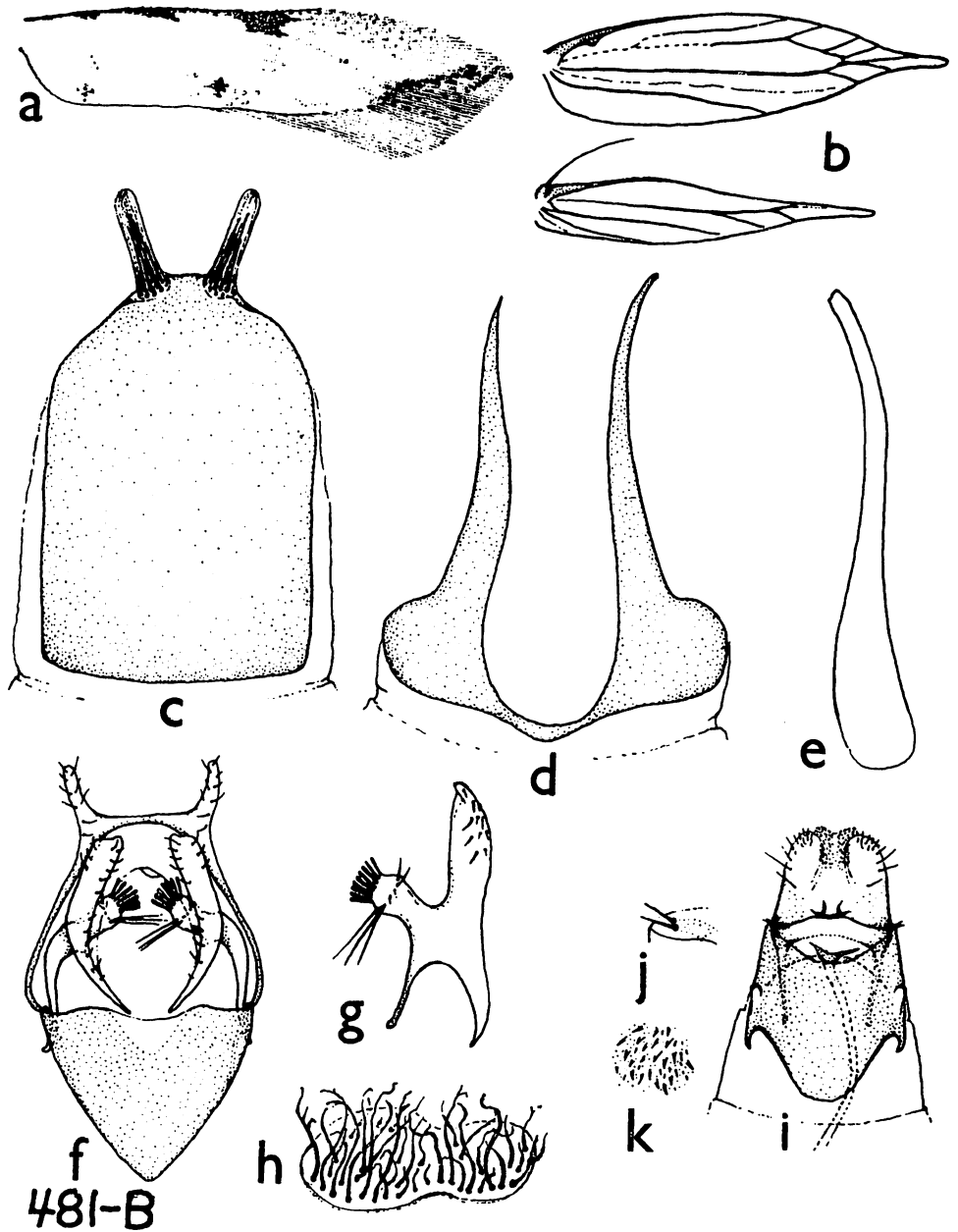


Figure 481-B—Details of *Bucculatrix thurberiella* Busck. *a*, sketch of color pattern of a forewing; *b*, wing venation; *c*, eighth abdominal tergite of male; *d*, processes of eighth abdominal sternite of male; *e*, aedeagus; *f*, male genitalia, ventral aspect; *g*, ental aspect of right genital valva of male, artificially flattened; *h*, eversible "scale sac" of male (in membrane between abdominal tergites two and three); *i*, ventral aspect of female genitalia, bursa copulatrix not shown; *j*, setae on sclerotized area of eighth abdominal somite of female; *k*, a small area of the signum of the female to show the spicules. (Rearranged from Braun, 1963; slide preparations by August Busck.)

to the study of the species in Hawaii. I therefore quote extensively from McGregor. He found as much as 100 percent of the leaves of some cotton plants attacked by the larvae, and he considered the species a major pest of cotton in California in 1916. He said (1916:506-509):

When present, cotton clearly shows the effect of the caterpillar, the foliage being riddled and perforated, often, until little more than veins and epidermis remain (Pl. 37, fig. 4). Small, ill-nourished plants are usually killed, while larger plants are often severely injured. Occasionally larvae feed upon the calyx and involucral bracts which results usually in the shedding of the form. On account of the thickly honeycombed nature of the leaf lesions, which is so characteristic of *Bucculatrix*-infested cotton, we propose as a common name for this species the "cotton leaf-perforator."

#### LIFE-HISTORY

**THE EGG.**—The egg is very small, being barely discernible to the naked eye. It is projectile-shaped, pale straw-color, with about ten longitudinal ridges and intervening grooves, giving it a strongly fluted appearance. In addition to this, a reticulate system of smoky-colored mottlings decorate the surface. The egg is placed upright on the leaf, standing on its largest end. No preference seems to be shown in ovipositing as between the top and under sides of the leaf. Since we have been unable to induce egg-laying under control, it is impossible to present data as to the duration of the incubation period. Eggs in out-of-door locations on a few occasions have been observed 24 hours prior to hatching which indicates that the period is somewhat in excess of that interval.

**THE LARVA.**—First Instar.—Upon hatching the larva bores into the leaf directly at the point of attachment of the egg and begins to tunnel. The mine lies nearer the upper surface than the lower, and progresses tortuously, ever widening in calibre. The average total length of the tunnel, as determined from a measured series, is about one inch. When this instar is about completed an exit hole is cut through the upper epidermis, and the larva deserts for all time the inner tissue. Upon coming to the exterior the first instar individual occasionally feeds for a brief period on the upper leaf tissue. The time required for the completion of this instar is about three days.

When the feeding activities of this stage are finished the larva weaves a tiny circular web over some slight depression on the under side of the leaf into which it repairs for the first molt. The initial molting web consists of two fabrics, first a "fly" web of loose texture is woven and under this is spun the more compact fabric. A somewhat concealed aperture is left through which the individual makes its exit after molting. A large series of these primary molting webs averaged  $\frac{1}{16}$  inch in diameter. The molting period covers about twenty-four hours.

**Second Instar.**—Upon the appearance on the leaf of the second larval instar, feeding at once begins. This may take place on either the upper or the under surface. The leaf tissue is devoured only to the opposite epidermis, but the remaining tissue often collapses, thus forming irregular-shaped lesions (see Pl. 36, fig. 2). After about 1.5 days at El Centro, the larva selects a concavity, normally on the under surface between two large veins, and spins the second molting cocoon. These are similar to the primary cocoons but are larger, averaging about  $\frac{3}{32}$  inch in diameter. The larva lies in a looped position—head to tail. The quiescent period is determined from our data to be 1.1 days.

**Third Instar.**—At the conclusion of the second molt the larva of the third instar emerges and at once begins to feed in a manner similar to individuals of the second instar. This is the most aggressive stage and the one causing the greatest amount of injury to the cotton leaf. As a rule, not more than two or three larvae occur on a single leaf, but occasionally as many as a half dozen have been seen. The last act of the third larval instar individual, after the completion of the pupal cocoon, is the shedding of the larval skin which occupies a position within the cocoon just behind the posterior end of the chrysalis. Just prior to pupation the color of the mature larva undergoes a change from the olive-green of the active condition to a smokydrab which is apparently indicative of maturity. The third instar at El Centro required during midsummer about 1.9 days of completion.

#### THE PUPA

The pupal cocoon may be placed in one of several locations. It is occasionally seen at some point on a leaf; it is often formed on the leaf petioles; but most frequently it is placed at some point along the main or lateral stems (see Pl. 36, figs. 1 and 3). Just before making the cocoon a series of stout, upright bristles is placed in a graceful ellipse so as finally to surround the cocoon. These closely set stalks form a stockade and are intended, probably, as a protection against predatory species. . . .

In constructing the cocoon each end is woven to a point near the middle, whereupon the larva withdraws into one half of the cocoon and deftly spins a few tie-fibrils between the ends of the opposed flutings; the gap is then entirely closed with a mesh of cross-fibrils. From the pupal records of a large series of bred individuals we find that the average duration of the pupal period for June and July at El Centro is 5.7 days. The development of the cotton leaf-perforator may be summarized, then, as follows:

	Days
Egg stage.....	1 (plus)
Leaf-mining stage.....	3
First molt.....	1
Second larval instar.....	1.5
Second molt.....	1.1
Third larval instar.....	1.9
Pupal period.....	5.7
Total.....	15.2

McGregor thought that the “stockade hairs” (see Jäckh, 1955, and Ross, 1953, for illustrations) that the larva places around the cocoon no doubt imitate the hairs of the cotton plant, but he was evidently not aware that the

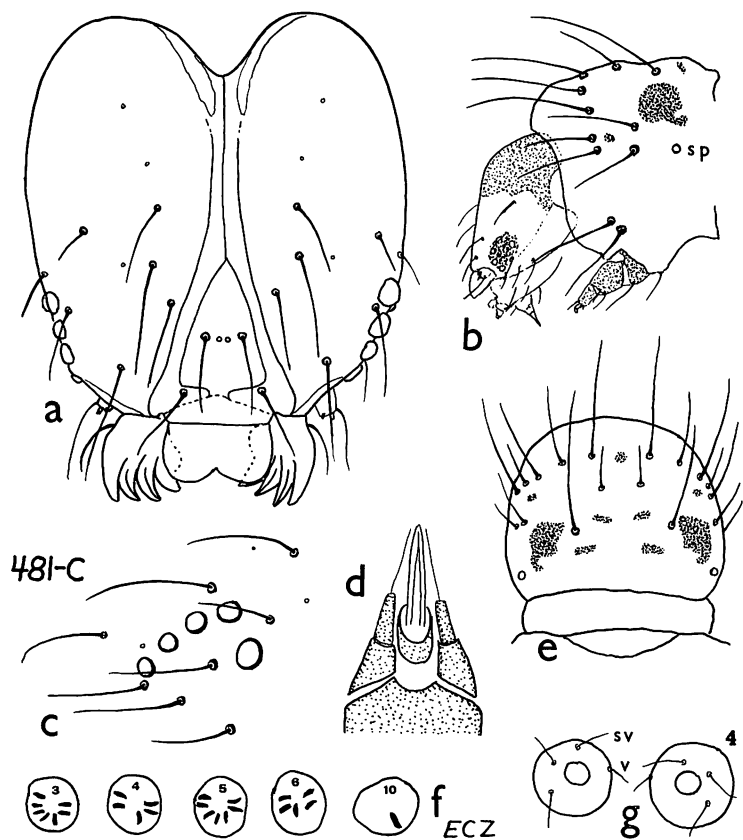


Figure 481-C—Details of the larva of *Bucculatrix thurberiella* Busck; length about 6.0 mm.; Nanakuli, Oahu. *a*, frontal aspect of head, color pattern omitted. *b*, left lateral aspect of head and pronotum; sp= spiracle. *c*, an enlarged sketch of the ocellar area. *d*, spinneret, ventral aspect. *e*, dorsal aspect of pronotum. *f*, ventral aspects of prolegs of left side (segments 3 to 6 and 10, as numbered) to show crochets; it should be noted that the number and arrangement of the crochets varies individually. *g*, ventral aspect of the fourth abdominal segment to show the arrangement of the V and SV setae.

hairs are characteristic of many species of *Bucculatrix*. Slingerland and Fletcher (1903:69), gave an early, detailed account of the construction of the characteristic, longitudinally ribbed cocoon of *Bucculatrix*, and Jäckh (1955:118) has published a modern paper, with photographs, showing the construction. The "stockade hairs" are easily abraded and may escape notice.

Annette Braun, in her admirable monograph on the North American *Bucculatrix* (1963:180), placed *thurberiella* in "Section VIII", the ultimate section of her work, together with three other species. Of these she said:

Included in Section VIII are four species of our fauna, feeding in the larval state on members of the plant family Malvaceae. These species are characterized by unusual and unique features of the genitalia in both sexes. Chief of these are, in the male, the lobed harpes [valvae] and the tendency for the development of sclerotized plates on the sternite or of both sternite and tergite of the eighth abdominal segment; these

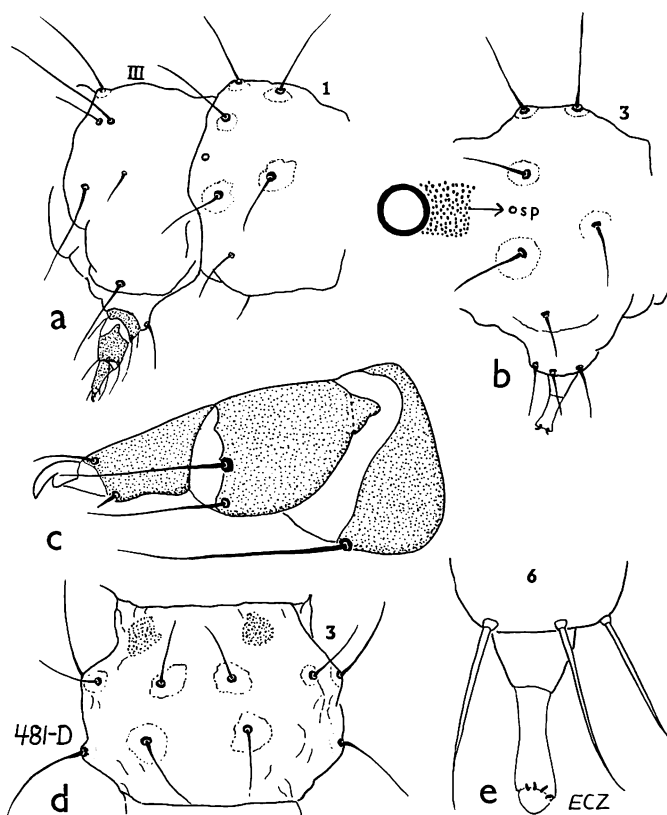


Figure 481-D—Further details of the larva of *Bucculatrix thurberiella* Busck. *a*, left lateral aspect of metathorax and first abdominal segment. *b*, left lateral aspect of third abdominal segment with a sketch of an enlarged area including the spiracle to show the nature of the dermal asperities. The irregular patterns formed by the dark colored asperities, although conspicuous, have not been shown in my drawings. *c*, a left prothoracic leg. *d*, dorsal aspect of third abdominal segment. *e*, a proleg of the sixth abdominal segment; note the elongate form.

plates may extend as free arms. In the female, the characteristic features are the position of the ostium at the posterior margin of the sclerotized basal half of segment 8, the development of a second pair of apophyses, those on the eighth segment, and perhaps most unique and distinctive, the presence of a dorso-lateral group of setae on a sclerotized area at the base of the membranous posterior half of segment 8. These characters are also present in the Mediterranean *Bucculatrix lavaterella* Millier. . . .

Some species of *Bucculatrix* have the third antennal segments of the males “notched” or distorted, but the third segments are simple in *thurberiella*, as noted in my illustration.

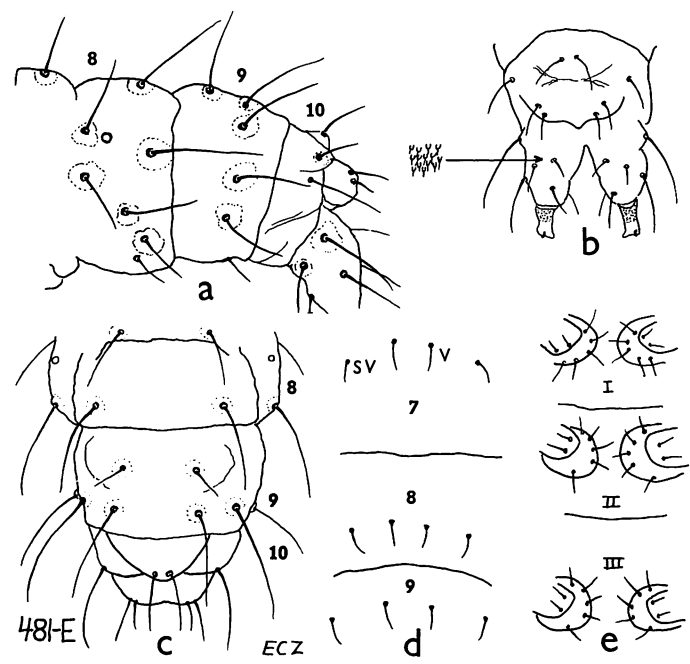


Figure 481-E—More details of the larva of *Bucculatrix thurberiella* Busck, *a*, left lateral aspect of abdominal segments 8, 9, and 10. *b*, caudal view of the abdominal apex with an enlargement of dermal spicules. *c*, dorsal aspect of abdominal segments 8, 9, and 10. *d*, ventral aspect of the three thoracic segments to show the arrangement of the bases of the legs. *a* to *c* drawn to same scale; *d* and *e* drawn to a larger scale.

Family **LYONETHIIDAE** Stainton

*Lyonetidae* Stainton, 1854:282. Sauvœur and Fologne, 1863:115. Spuler, 1898a:33.

*Lyonetiidae*: Anonymous, 1858:106.

*Lyonetina*: Herrich-Schäffer, 1857:58.

*Lyonetiina*: Wallengren, 1881:125.

*Lyonetianae*: Walsingham, 1891:127.

*Lyonetiadae*: Hampson, 1918b:387.

*Bedellidae* Meyrick, 1880a:133, 169.

*Cemiostomidae* Spuler, 1898a:33.

*Cemiostomatina*: Wallengren, 1881:125.

*Leucopterygidae* Heinrich, 1918:27. This is an unnecessary replacement name for *Cemiostomidae* and is incorrectly formed. It is based upon *Leucoptera* Hübner, 1818, which antedates *Cemiosstoma* Zeller, 1848, and should be *Leucopteridae*.

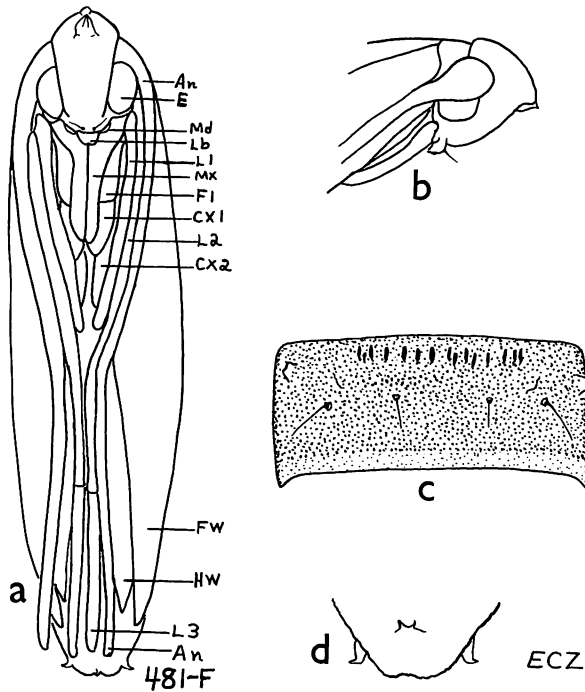


Figure 481-F—Details of the pupa of *Bucculatrix thurberiella* Busck. *a*, ventral aspect; length 3.0 mm.; Nanakuli, Oahu: An, antenna; CX1, CX2, pro- and mesocoxae; E, eye; F1, profemora; FW, forewing; HW, hindwing; Lb, labrum; L1, L2, L3, fore, middle and hindlegs; Md, mandible; MX, maxilla (proboscis); *b*, right lateral aspect of head and adjacent parts; *c*, enlarged dorsal aspect of third abdominal tergum showing subbasal denticles and the dermal asperities. *d*, enlarged dorsal aspect of the cauda.

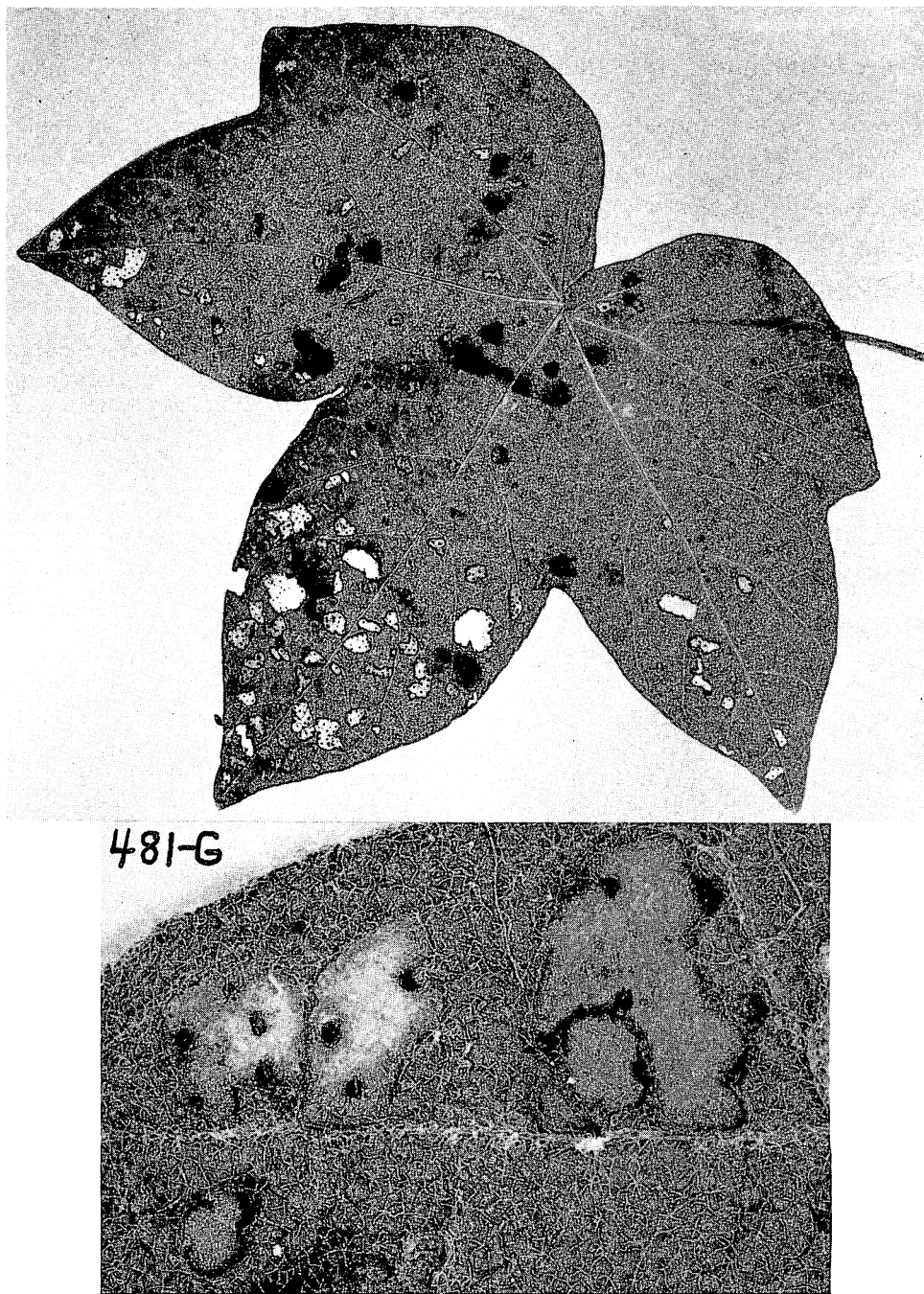


Figure 481-G—Leaf of *Gossypium tomentosum*, the native Hawaiian cotton, from Nanakuli, Oahu, showing typical damage caused by the larvae of *Bucculatrix thurberiella* Busck. The whole leaf is shown in natural size. The enlarged bottom figure shows the characteristic fecal pellets in the eaten areas. The larvae feed in a curled position and are longer than the lengths of their feeding areas. Specimen collected by J. W. Beardsley.

Our representatives (*Bedellia*) of this family have an unusually strongly developed squamose pecten on the basal segment of each antenna which resembles an eye-cap more than it does a typical pecten. On the Hawaiian species the maxillary palpi are vestigial. Perhaps the only groups in Hawaii with which the members of this family might easily be confused, principally because of the eye-cap-like antennal pectens, are the Opostegidae and the Bucculatricidae. They might also be confused on occasion with the Momphinae, but our representatives of the momphids are easily distinguished because they lack antennal pectens. The Lyonetiidae has been the "dumping ground" of many genera which do not belong to it, and its literature is in a highly confused state. In 1893:477, Meyrick restricted the group "to the smooth-headed genera with eyecaps". The larvae mine the leaves of both monocots and dicots.

### Genus **BEDELLIA** Stainton

*Bedellia* Stainton, 1849:23. Type-species: *Lyonetia somnulentella* Zeller, 1847d (= *Bedellia orpheella* Stainton, 1849, not 1846, as sometimes cited) (fig. 482). Klimesch, 1968:9, figures of the male and female genitalia.

The species assigned to *Bedellia* in Hawaii are utterly confused in collections and in literature. I regret very much that circumstances beyond my control prevent me from presenting here an adequate revision and proper interpretation of these tiny leafminers. I have superficially examined many more undescribed than described species, and it is obvious that many species occur in Hawaii. Much careful field work must be done on this group to ascertain the number of Hawaiian species, their habits, hostplants, and distributions. Without the opportunity to pursue the problem to a successful conclusion, all I can do here is to point out what little I know and leave the task of revision to future workers. Much of what may be said of the Hawaiian group now may be little more than conjecture.

Perkins and Swezey were aware of the confusion in Walsingham's treatment of the Hawaiian *Bedellia*, and Swezey (1913d:224–225) said:

*Bedellia minor* Busck, and *B. somnulentella* Z.—The larvae of these two species are said to mine the leaves of sweet potato and various other vines of the genus *Ipomoea*. I consider that the leaf miners in sweet potatoes and all other *Ipomoea* vines here are the same species, whatever it may be, whether it is the *minor* or *somnulentella* . . . or something else. Dr. Perkins thinks that there must have been an error in the determination of the specimens of *Bedellia* that Lord Walsingham had from him, for Walsingham has identified as *somnulentella* specimens which came from an elevation of 4000 feet, whereas Dr. Perkins says that there are no *Ipomoea* vines growing at that elevation. Some of the specimens that he determined as *minor*, came from an elevation of 4000 also, while others of them Dr. Perkins had bred from *Ipomoea* at lower elevations. More recently, Mr. Busck has determined specimens reared from sweet potato as *orchillella* [sic] Walsm.

The species of *Bedellia* are so similar and so difficult to separate, especially if not in perfect condition, that I now think that the specimens from 4000 feet elevation determined as Walsingham as *minor* and *somnulentella* belong to my species *oplismeniella*.

Without careful study, it is best not to accept the opinions that all of the *Ipomoea* miners are the same species or that some of the specimens Walsingham determined as *minor* and *somnulentella* are *oplismeniella*.



At the British Museum, I compared the Hawaiian *orchilella* Walsingham, including its genitalia, with the Eurasian type-species, *somnulentella*, and they are congeneric. Whether or not all of the species of this group in Hawaii should be considered to belong to a single genus is a question that remains to be answered. Bradley (1961:160) gave notes on *Bedellia somnulentella* and designated the lectotype. Jayewickreme (1940:82) has described and figured some features of *Bedellia somnulentella* in England. I have examined specimens of *minor* at the U.S. National Museum. It is different from any species I have seen from Hawaii—the male genital valvae are entirely rounded at the apices, and the female signa are distinctive. The species which I have examined from mines in sweetpotato leaves in Hawaii is *orchilella* Walsingham. The species *somnulentella* (Zeller) and *minor* Busck do not occur in Hawaii.

As noted in the foregoing quotation from Dr. Swezey, the adults of at least some of these tiny moths do not appear to display gross interspecific external differences. The genitalia, however, are distinctive, and the valvae of the males and the signa of the female bursa copulatrix display good characters. The pupae appear to have numerous characters which are useful for species separation, and it may be true that the species can be more easily differentiated by the pupae than by external differences in the adults. The pupae have distinctive ear-like protuberances on the pronotum. It is unfortunate that a complete collection of pupae has not been assembled.



Figure 482—*Bedellia*. Top, head and wing venation of a paratype of *struthionella* Walsingham; Kona, Hawaii (BM slide 2230) (drawings by Arthur Smith). Bottom, wing venation of *somnulentella* Zeller (= *orpheela* Stainton), the type-species of *Bedellia* (drawn by J. F. G. Clarke).

In Hawaii species of *Bedellia* have been reared from a sedge, grasses (*Panicum* and *Oplismenus*), *Dianella* (Liliaceae), *Boehmeria* (Urticaceae), and *Ipomoea* (Convolvulaceae). With such a wide range of hostplants already known, it would appear that many Hawaiian plants are attacked by these tiny leaf miners. Concentrated study in the field should be rewarded by many interesting discoveries.

See color plate 3, figure 6.

#### PRELIMINARY KEY TO THE NAMED SPECIES OF HAWAIIAN BEDELLIA

1. Forewing with conspicuous areas of yellow scales and areas of white scales in addition to brown speckling; from Kona, Hawaii 4,000 feet; figure 485.....  
.....**struthionella** Walsingham.  
Forewing without yellow and white maculae.....2
- 2(1). Forewing with purplish reflections; genitalia as in figures 486, 492; on *Boehmeria* on Oahu.....  
.....**boehmeriella** Swezey.  
Forewing with a common pepper-and-salt speckling and not purplish.....3
- 3(2). On sweetpotato and other Convolvulaceae; genitalia as in figures 487, 493.....**orchilella** Walsingham.  
On *Oplismenus* grass; genitalia as in figures 486, 494...  
.....**oplismeniella** Swezey.

**Bedellia boehmeriella** Swezey (figs. 484, moth; 486, male genitalia; 492, female genitalia).

*Bedellia boehmeriella* Swezey, 1912b:185.

Endemic. Oahu (type locality: in the mountains at the head of Manoa Valley).

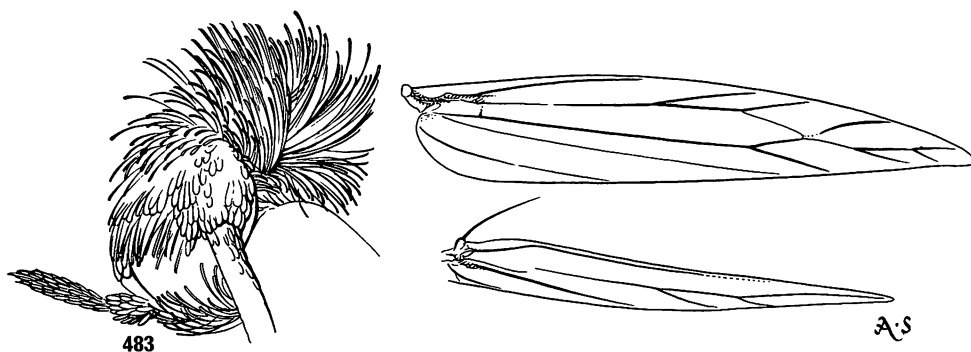


Figure 483—Head and wing venation of *Bedellia orchilella* Walsingham; paratype; Waianae Mts., Oahu (BM slide 2231).

Hostplant: *Boehmeria grandis* (= *stipularis*); the larvae mine the leaves.

The signum of the female bursa copulatrix is unlike that of any other species I have studied. It is in the form of a continuous, longitudinal, serrated tape. The male genitalia are also distinctive.

Dr. Swezey (1912*b*:186) said that the adults are distinct from the other species known to him because the forewings are purplish. Perhaps it would have been more accurate to say that the wings are tinged with purple. The basic color pattern appears not unlike the common pepper-and-salt speckled wings of most of the group. Dr. Swezey said, "I first noticed the work of this

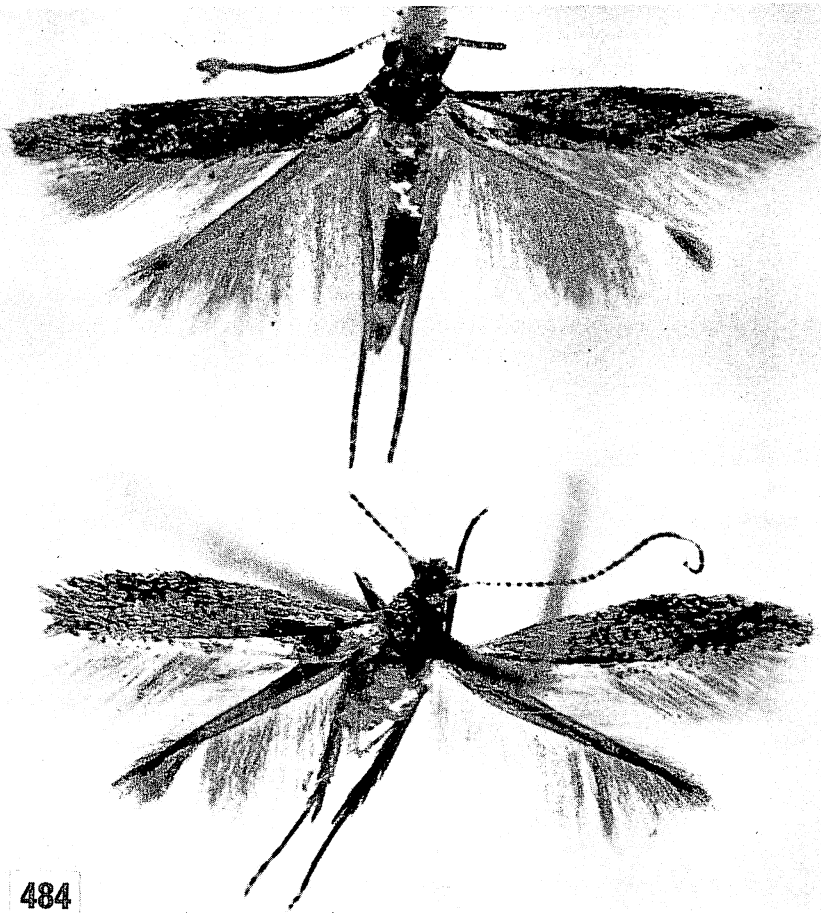


Figure 484—*Bedellia*. Top, *boehmeriella* Swezey, holotype; Manoa Valley, Oahu; forewing=3.5 mm., the diagonal lines are shadows along the folds. Bottom, *oplismeniella* Swezey, holotype; Mt. Tantalus, Oahu; forewing=3.5 mm.

Photographs of whole moths of this genus may be misleading. Most of the species have a rather similar pepper-and-salt speckling on the forewings, and most are closely similar in facies. They are difficult subjects to photograph.

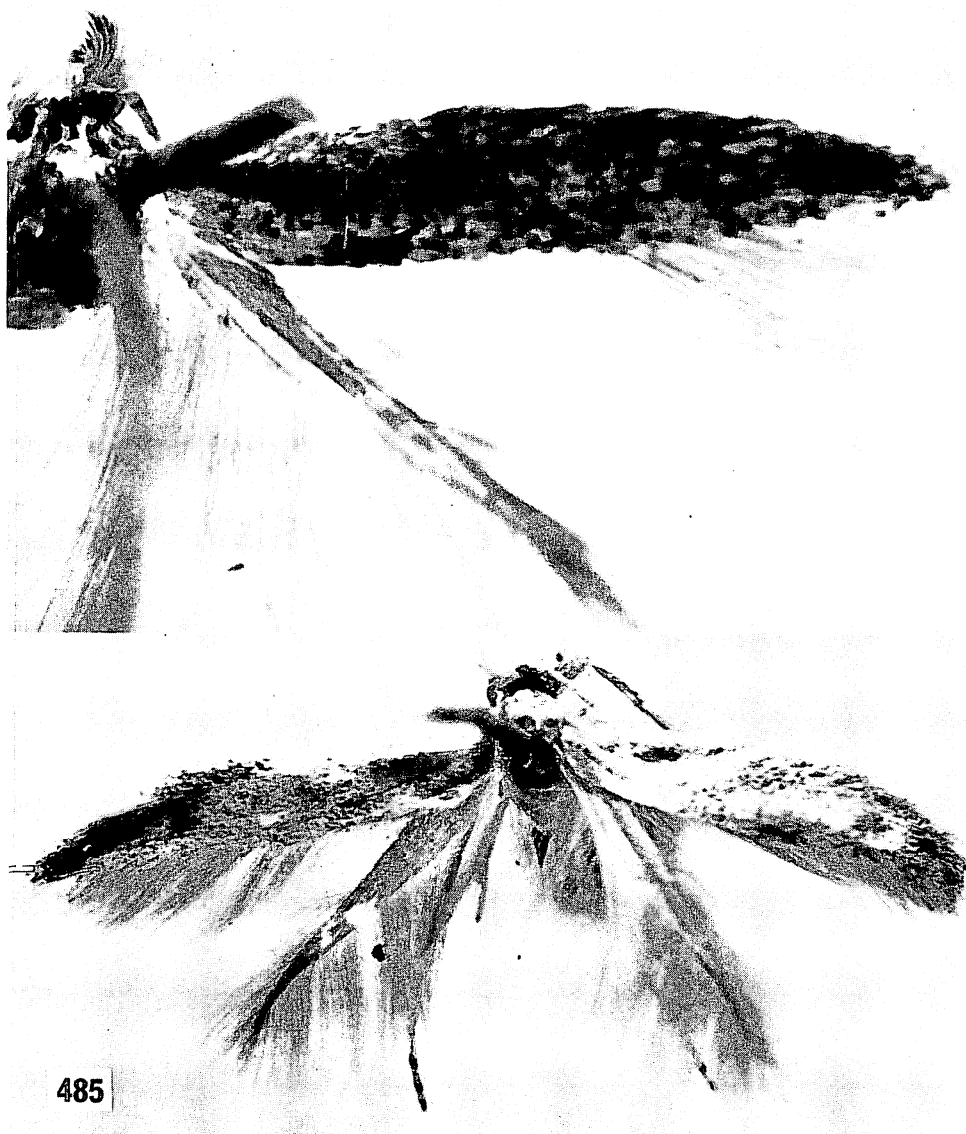


Figure 485—*Bedellia*. Top, *orchilella* Walsingham, holotype male; Waianae Mts., Oahu; forewing=3.0 mm. (BM slide 4064). Bottom, *struthionella* Walsingham, holotype male; Kona, Hawaii, 4,000 feet; forewing=4.0 mm. (BM slide 4063).

leaf-miner September 5, 1909, in the mountains at the head of Manoa Valley, and bred specimens from material collected that day. Since then I have observed it wherever I have seen its food-plant in the mountains of Oahu." More than one species has been confused by Dr. Swezey under this name, however. I have examined specimens collected by Swezey in the Waianae Mountains that have quite different genitalia. Further collecting and study are required to clarify the confusion. Dr. Swezey made the following observations on the early stages:

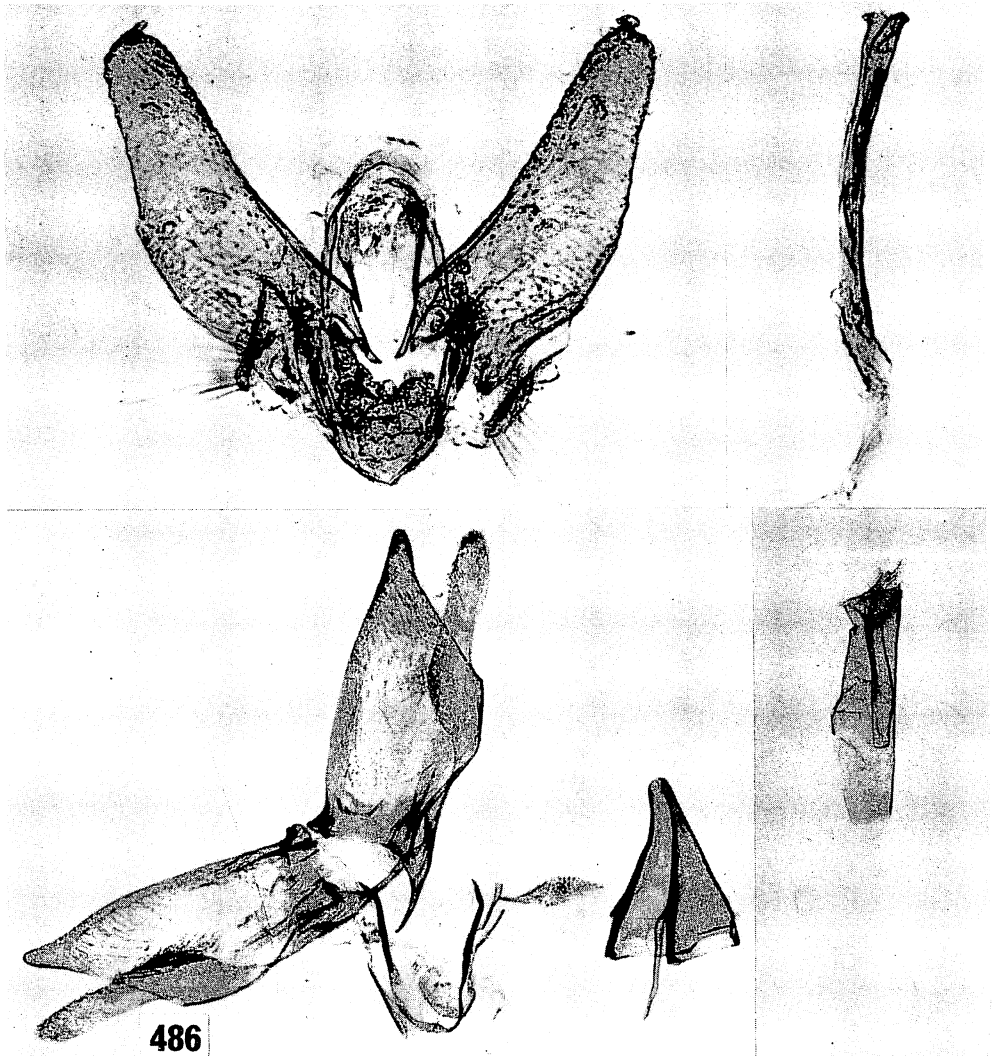


Figure 486—Male genitalia of *Bedellia*. Top, *boehmeriella* Swezey, holotype; head of Manoa Valley, Honolulu (slide Z-IX-3-61-5). Bottom, *oplismeniella* Swezey; Palolo, Oahu (slide Z-V-12-61-1). Note the great differences in the genital valvae.

The full-grown larva is a little over 6 mm., strongly constricted between segments, segment behind head large, head much retracted in it, remaining segments gradually narrowing to posterior end of body; pink on dorsal surface except head and following segment which are yellowish, yellowish below; eyes black; spiracles minute, circular, very pale brown; prolegs on segments 7–10. When full-grown the larva emerges from the leaf and pupates on the under side of the leaf beside a rib, especially in an axil at base, after having spun a few fibers of silk in which to fasten itself.

The pupa is 4.5 mm. long. Head triangularly pointed; a lateral projection behind each eye, curved a little anteriorly; a small longitudinal lateral curved projection on mesothorax; a much larger one on metathorax; a low median dorsal ridge on thorax; a lateral thin narrow flange along abdomen, containing the spiracles on its margin; no median dorsal ridge on abdomen; wing-sheaths extend nearly to tip of abdomen; antenna-sheaths extend a little beyond tip of abdomen; cremaster bifid with two widely diverging projections, each having 2 or 3 hooked bristles; all the dorsal setae are hooked into the few fibers of silk in which the pupa is suspended, ventral surface turned outward. Color yellowish, with a pink tinge on the back; projections on thorax, lateral flange of abdomen and eyes pale brownish; tips of antenna-sheaths black, also two short oblique black lines ventrally between anterior leg-sheaths and antenna-sheaths. One larva under observation produced a pupa which was very pink above and brown below. The adult emerged in 9 days.

***Bedellia oplismeniella*** Swezey (figs. 484, moth; 486, male genitalia; 494, female genitalia).

*Bedellia oplismeniella* Swezey, 1912b: 184.

Endemic. Oahu (type locality: Castle Trail, Pauoa side of Mt. Tantalus), Molokai?, Hawaii?

Hostplants: commonly mines the leaves of the grasses *Oplismenus compositus* (the type host) and *Panicum torridum*.

Parasite: *Euderus* (*Secodella*) *metallicus* (Ashmead).

This species resembles *Bedellia struthionella* Walsingham, and it is possible that the records concerning these two species may in part be confused. I have questioned the Molokai and Hawaii records for this reason. The specimens under this name in collections require further study.

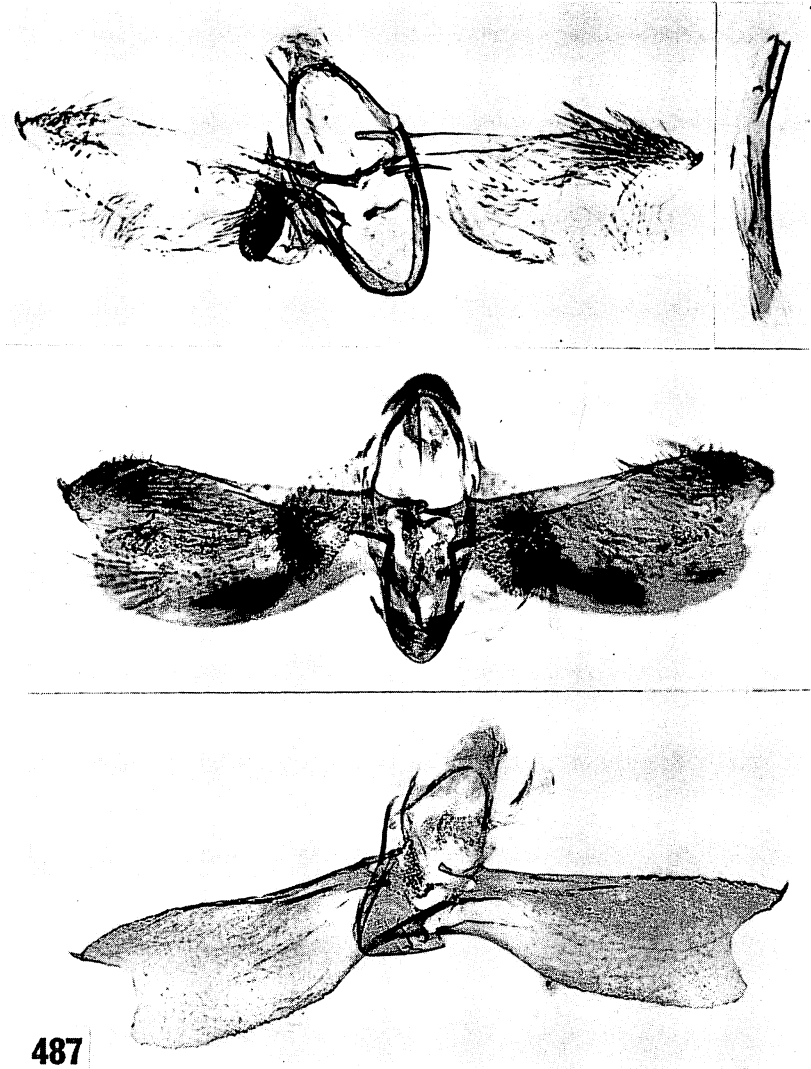
Dr. Swezey (1912b: 184) said "I cannot with certainty separate specimens of my species from the *Ipomoea* one [*orchilella*]; but, as my specimens are all bred from a grass, I have considered it a different species, particularly as the pupae have several differences. The pupa of the *Ipomoea* species has an elevated median dorsal ridge on the thorax, a median dorsal ridge on the abdomen, and the wing-sheaths are roughed with minute points; while in *oplismeniella*, the thorax has a low median dorsal ridge, median dorsal ridge lacking on the abdomen, and the wing-sheaths are not roughed with minute points."

Dr. Swezey often found the larvae abundant in its widespread hostplant, and he said (p. 185), "The mine is usually lengthwise in the leaf, widening as the larvae has grown in size." He described the larva and pupa as follows (p. 185):

The full-grown larva is about 5 mm. in length, pale green with a mid-dorsal purplish-red stripe, also some more or less lateral mottlings of the same color, especially anteriorly; head green, sutures, lateral edges and mouth-parts brown, eyes black; head retracted into second segment which is wider than following segments, green with some blackish dots on sides and posterior part; hairs pale. When full-grown, the larva emerges from the leaf, spins a few fibers beside the mid-rib of the leaf, at the base, or in some other partially secluded place; then pupates among these fibers without making a cocoon.

The pupa is about 4 mm. in length, pale yellowish, with several fuscous streaks ventrally, also two pairs of conspicuous blackish spots, eyes reddish brown; head with a compressed triangularly pointed projection in front, a large lateral projection behind each eye with sharp point directed anteriorly; thorax with low median dorsal ridge; abdomen with broad lateral flange on each side just on the line of spiracles so that the latter are just beneath its outer edge, no dorsal median ridge; setae "iii" [SD1] are situated on upper surface of this flange, they as well as setae "i" [D1] and "ii" [D2] are quite long and stout and hooked

into silk which the larva has spun on the surface of leaf; setae "j" and "ji" in a straight line; cremaster bilobed, a number of hooked bristles fastened into the silk by which pupa is suspended, dorsal side towards leaf; antenna-sheaths extend to apex of abdomen, wing-sheaths almost as far, not roughened with minute points as in the *Ipomoea* species [*orchilella*]. Pupa stage occupies 8 days.



487

Figure 487—*Bedellia orchilella* Walsingham, male genitalia. Top, holotype; Waianae Mts., Oahu (BM slide 4064). Middle, paratype of same (BM slide 2231) from same locality. Bottom, from a specimen from sweetpotato leaf from Pupukea, Oahu (slide Z-X-30-60). Note the hooked apices of the valvae on this species. Is the variation exhibited by these specimens more than individual?



488—Male genitalia of *Bedellia*. Top left, a paratype of *struthionella* Walsingham; Kona, 4,000 feet, Hawaii (BM slide 2230). Top right, the aedeagus of the holotype of the same species, also from Kona (BM slide 4063). Middle, "species 5"; Kona, 4,000 feet, Hawaii (BM slide 7024); partly decomposed. Bottom, "species 6", Waianae Mts., Oahu (BM slide 7029); this example was incorrectly determined as "*minor*" by Walsingham, 1907b:724.



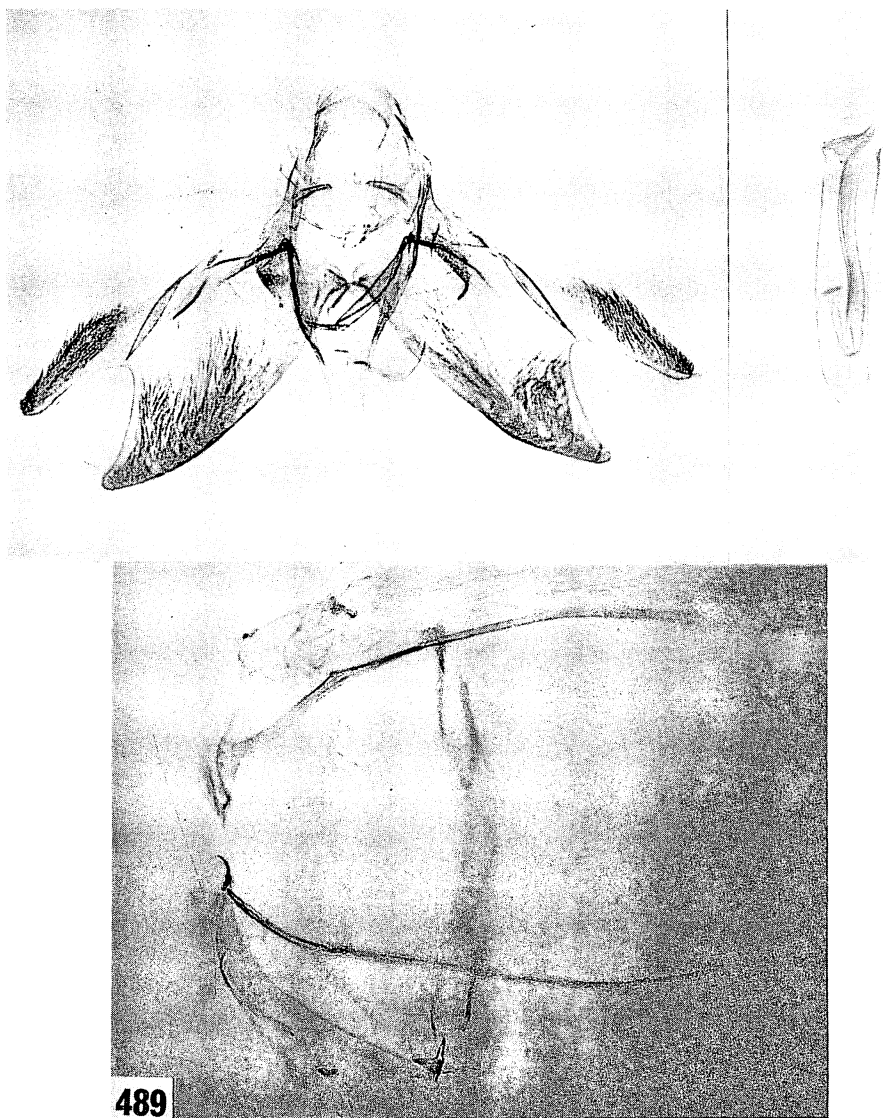
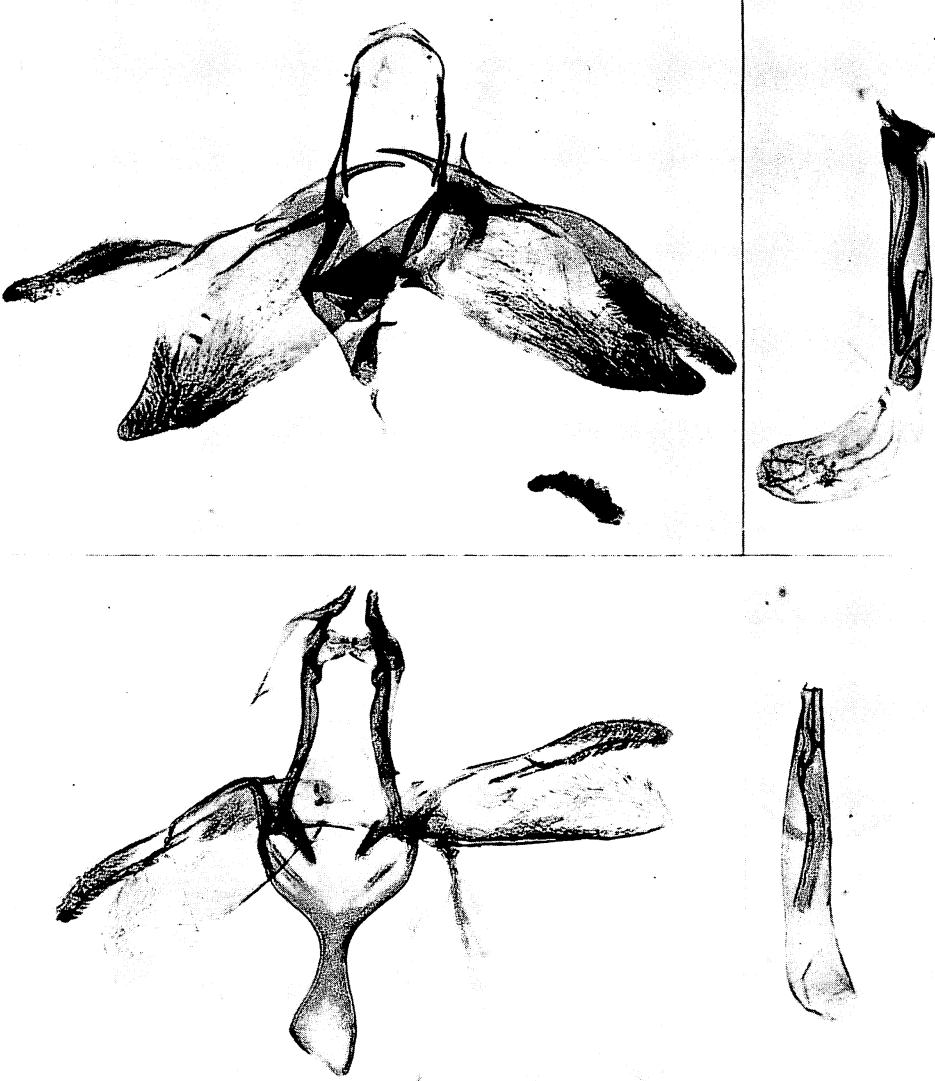


Figure 489—Male genitalia and base of abdomen of *Bedellia struthionella* Walsingham, paratype (BM slide 15881); Kona, 4,000 feet, Hawaii (Walsingham specimen 25416). Compare figure 490.



490

Figure 490—Male genitalia of *Bedellia* species. Top, *struthionella* Walsingham, paratype (BM slide 16294); Waianae Mts., Oahu. Bottom, new species 14 (BM slide 16295), formerly confused as paratype 4/4 of *orchilella* by Walsingham; Olaa, Hawaii (Walsingham specimen 28056). The caudal tergite of the abdomen adheres to the tegumen, thus giving the confusing appearance of an unusual uncus. Note the peculiar saccus—the cephalic end is artificially deformed.)

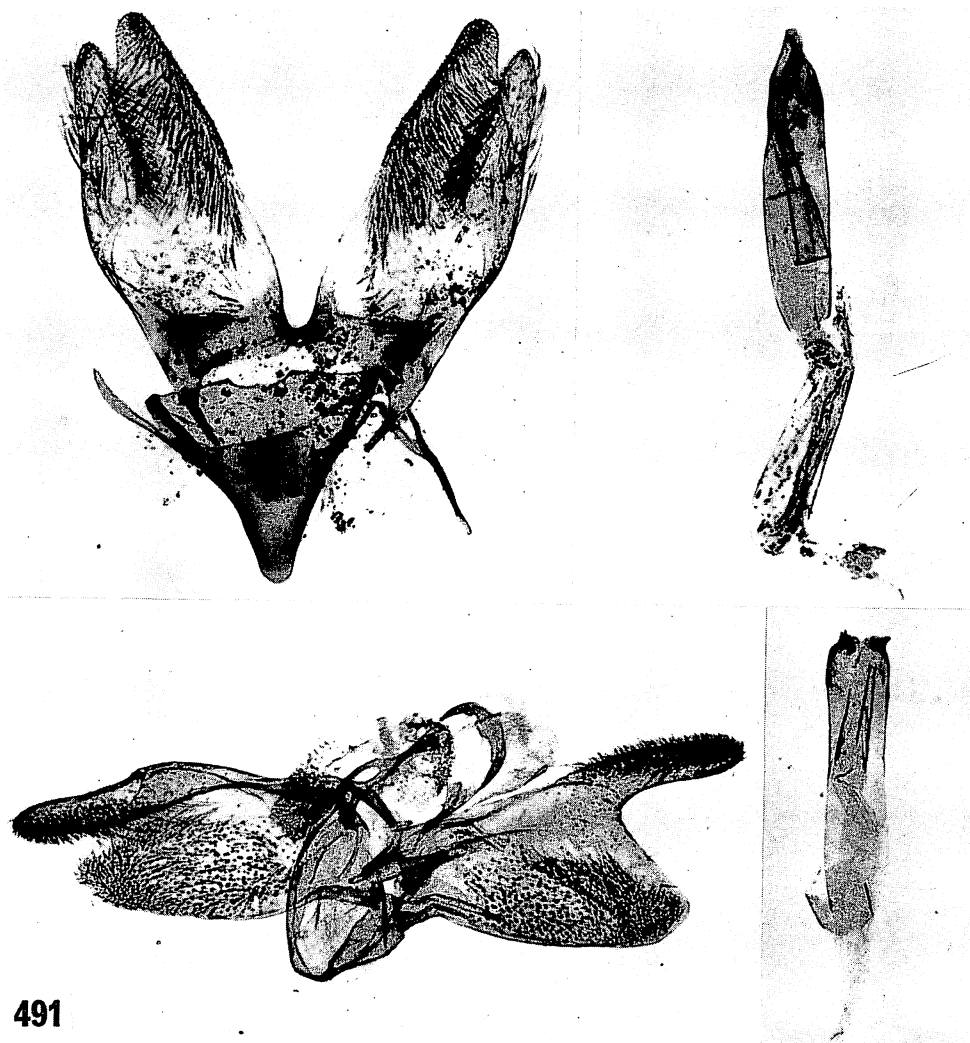
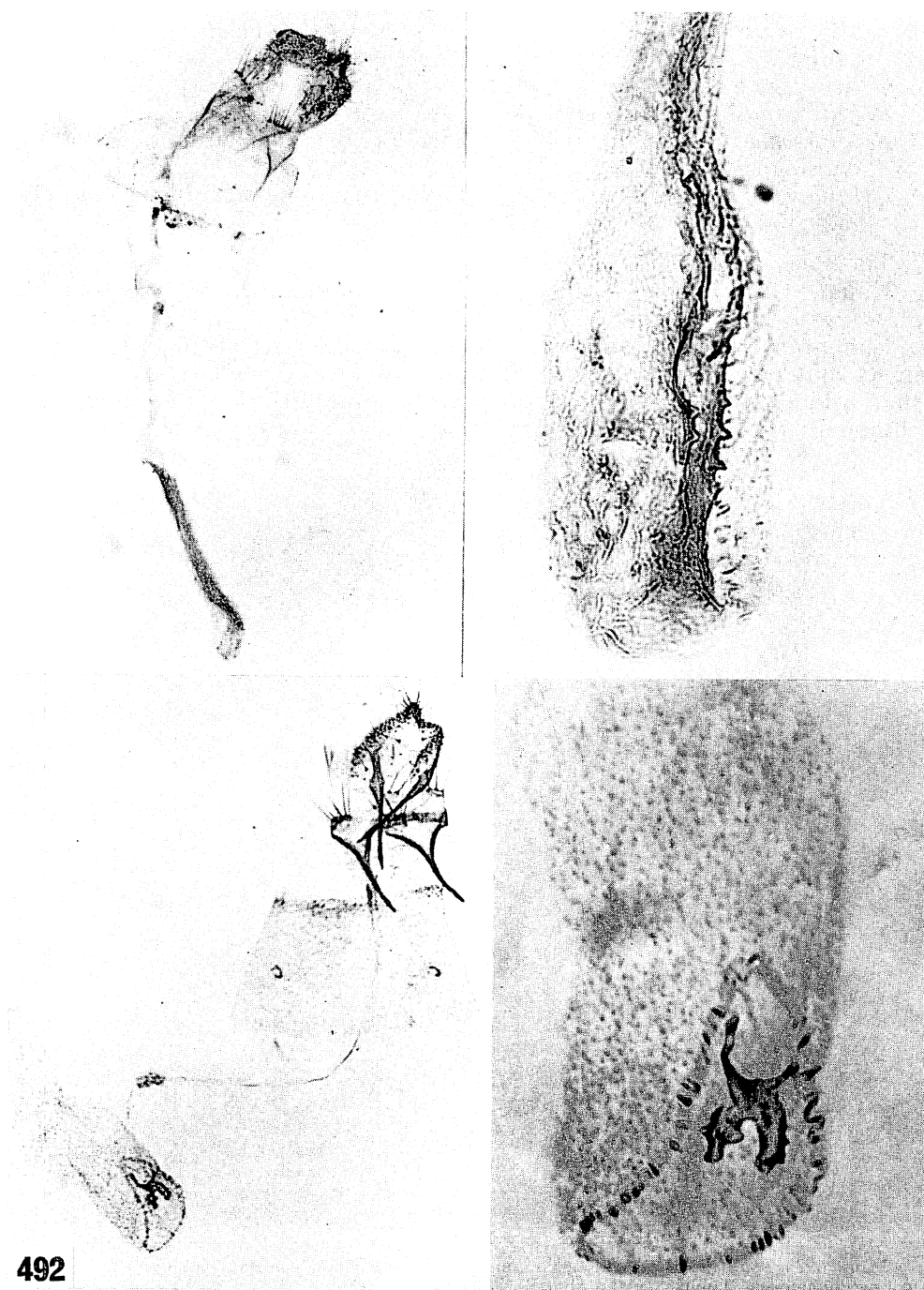


Figure 491—Male genitalia of *Bedellia*. Top, "species 7"; Molokai (BM slide 7072); from the series incorrectly determined as "*minor*" by Walsingham, 1907b: 724. Bottom, "species 12"; Mt. Kaala, Oahu; reared from *Boehmeria* (slide Z-V-13-61).



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Figure 492—Female genitalia of *Bedellia*. Top, paratype of *boehmeriella* Swezey; the enlarged bursa copulatrix is from a second paratype; above Manoa Valley, Oahu (both specimens on Busck slide 279). Bottom, "species 12"; Mt. Kaala, Oahu; reared from *Boehmeria* (slide Z-V-14-61). Note the great differences in the signa of these species.

***Bedellia orchilella*** Walsingham (figs. 11-A, f; 483, head, venation; 485, moth; 487, male genitalia; 493, female genitalia; 497, leaf mines; 498, larva, pupa).

*Bedellia orchilella* Walsingham, 1907b:725.

*Bedellia minor*, as an error of identification by some authors, including Walsingham, 1907b:724.

*Bedellia somnulentella*, as an error of identification by some authors. Walsingham, 1907b:723.

The sweetpotato leaf miner.

Kauai, Oahu (type locality: Waianae Mountains), Molokai, Maui, Hawaii.

Immigrant? This species has been considered an endemic Hawaiian insect, but I believe that it may be an immigrant. Its genitalia demonstrate that it does not belong to the same species group as the many certainly autochthonous Hawaiian *Bedellia* species. Its genitalia are closely similar to the



Figure 493—*Bedellia orchilella* Walsingham, parts of female genitalia of a specimen reared from a mine in a sweetpotato leaf; Pupukea, Oahu (slide Z-X-31-60).

widely dispersed species group to which belongs the well-known type-species, *Bedellia somnulentella* (Zeller). It is possible that *orchilella* will be found elsewhere in the Pacific or in Asia when the *Bedellia* of those areas are more adequately known.

Hostplants: *Ipomoea tuberculata*, sweetpotato and other species of *Ipomoea*.

Parasites: *Derostenus fullawayi* Crawford, *Apanteles bedelliae* Viereck (this braconid was purposely introduced to Hawaii to aid in the control of this moth, and it has been highly effective), *Euderus metallicus* (Ashmead) (this species often causes a high rate of parasitism), *Pnigalio* ("*Notanisomorphomyia*") *externa* (Timberlake).

The larvae of this leaf miner are often pests of significant importance to sweetpotatoes in Hawaii. The larval mines may cause the yellowing of the leaves of entire fields of sweetpotatoes. "The leaf-miner, after the stem borer, is perhaps the most destructive insect enemy of the sweet-potato vine. Its injuries are confined to the foliage, which as a result [of attack] presents a notched and withered appearance and bears traces of excrement. The newly hatched larvae penetrate the leaves and feed upon the green coloring matter. The leaves gradually lose their color and wither, and the leafstalks drop." (Chung, 1923:12.)

Dr. Swezey (1912b:184) said that the pupa "has an elevated median dorsal ridge on the thorax, a median dorsal ridge on the abdomen, and the wing-sheaths are roughened with minute points. . . ." It thus differed distinctly from the endemic Hawaiian *Bedellia* pupae known to him.

Much confusion exists regarding the name of this species as it has been used in literature. At various times it has erroneously determined as the species known in America as *Bedellia minor* Busck (see my comments above under the discussion of the genus) and the widely dispersed (including southern Europe) *Bedellia somnulentella* (Zeller). *Bedellia orchilella* resembles *somnulentella*, but it is specifically distinct. Pierce and Metcalfe, 1935:90, pl. 55, made a serious error, which will undoubtedly cause much confusion, when they said, "No signum". I have examined their slide mount, now in the British Museum, and it appears that the bursa copulatrix was accidentally removed and lost during dissection because the specimen is now without a bursa. I have examined the female genitalia of the lectotype of *somnulentella* (BM slide 5965), and it has two strong signa toward the caudal end of the bursa and a heavy U-shaped signum toward the cephalic end. It thus differs distinctly from *orchilella* which has two pairs of separate signa, as demonstrated in my figure.

Several species have been confused as *somnulentella*. Several names proposed in various parts of the world have proved to be synonyms, and others may also be synonyms. *Bedellia ipomoeae* Bradley, 1953:14, from Fiji, and *Bedellia mnesileuca* Meyrick, 1928b:397, from Australia, were shown by Bradley, 1961:160-161, to be synonyms of *somnulentella*. Szöcs, 1967:231, and Klimesch, 1968:9, give details on *somnulentella* and other species. Klimesch illustrates the male and female genitalia of *somnulentella*.



Figure 494—*Bedellia oplismeniella* Swezey, details from the female abdomen. Top left, ovipositor and associated areas. Top right, the base of the abdomen; one of the sclerotized basal processes has been broken away. Bottom, the signa and bursa copulatrix; Mt. Kaala, Oahu; reared from *Panicum kaalense* (slide Z-V-12-61-2).

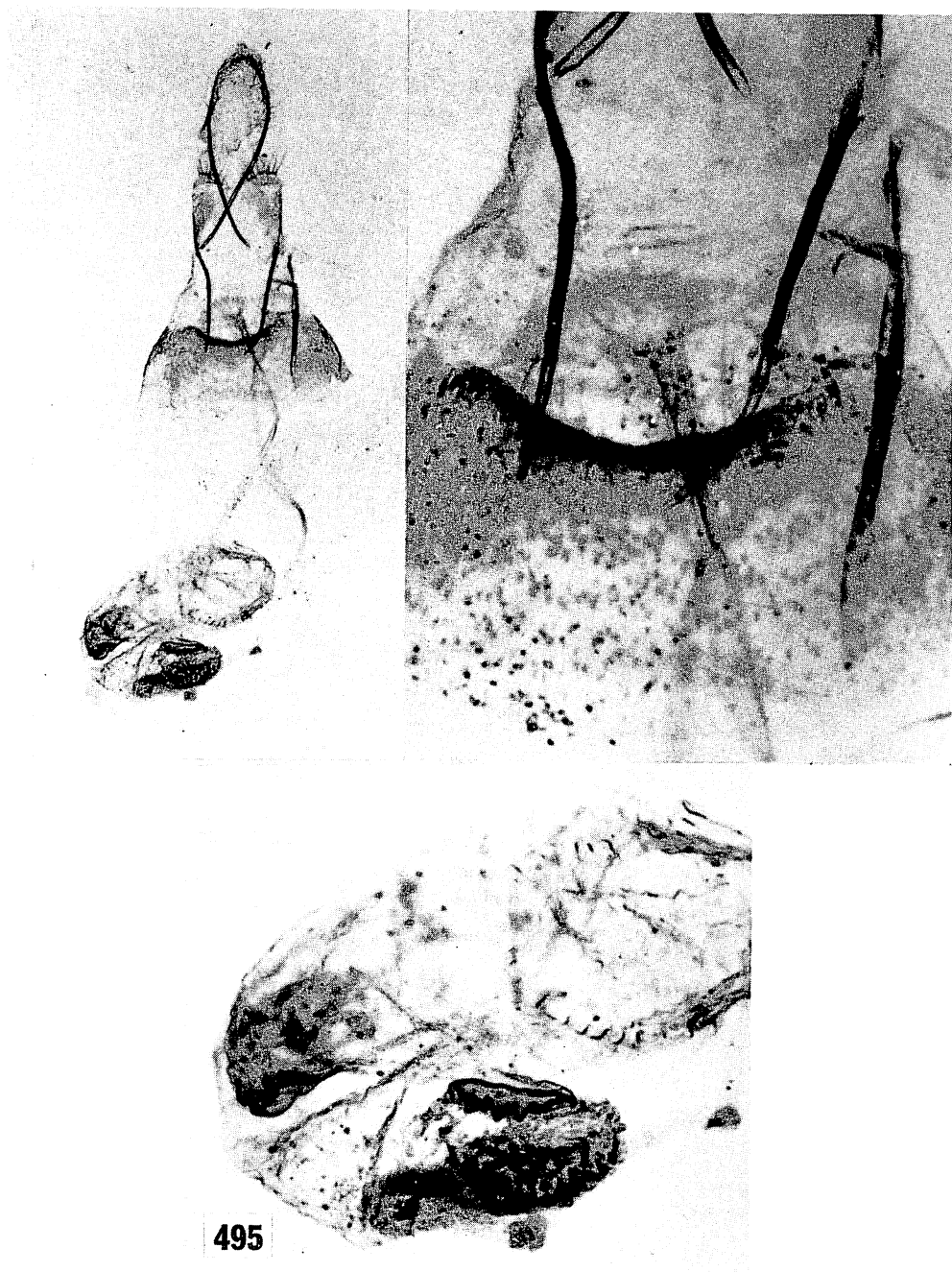


Figure 495—*Bedellia*. Female genitalia of a specimen from Kona, Hawaii, 4,000 feet (BM slide 7028), incorrectly determined as "*minor*" by Walsingham, 1907b:724.



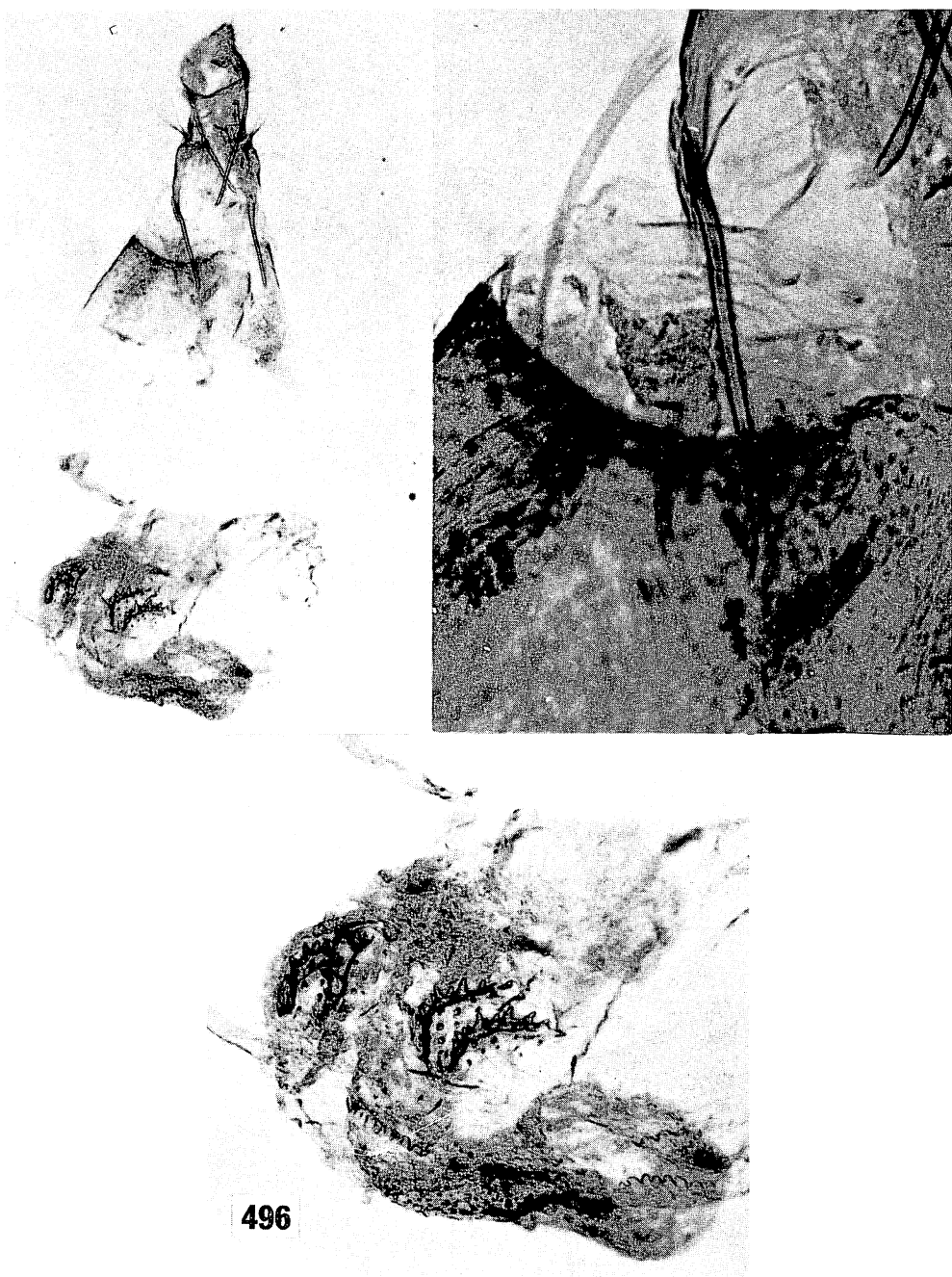
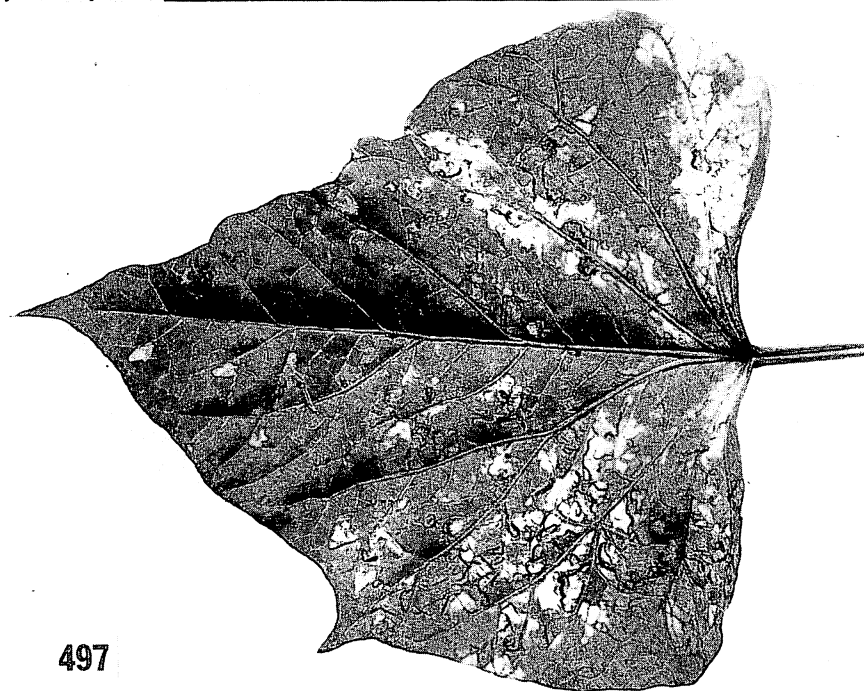


Figure 496—*Bedellia*. Genitalia of a female of species 6 from Waianae Mts., Oahu (BM slide 7030) from the series of specimens incorrectly determined as *minor* by Walsingham, 1907b: 724; this specimen was labeled as a “caenotype” by Walsingham.



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Figure 497—Sweetpotato leaves showing damage done by the leaf-mining larvae of *Bedellia orchilella* Walsingham; Oahu. (University of Hawaii photographs.)

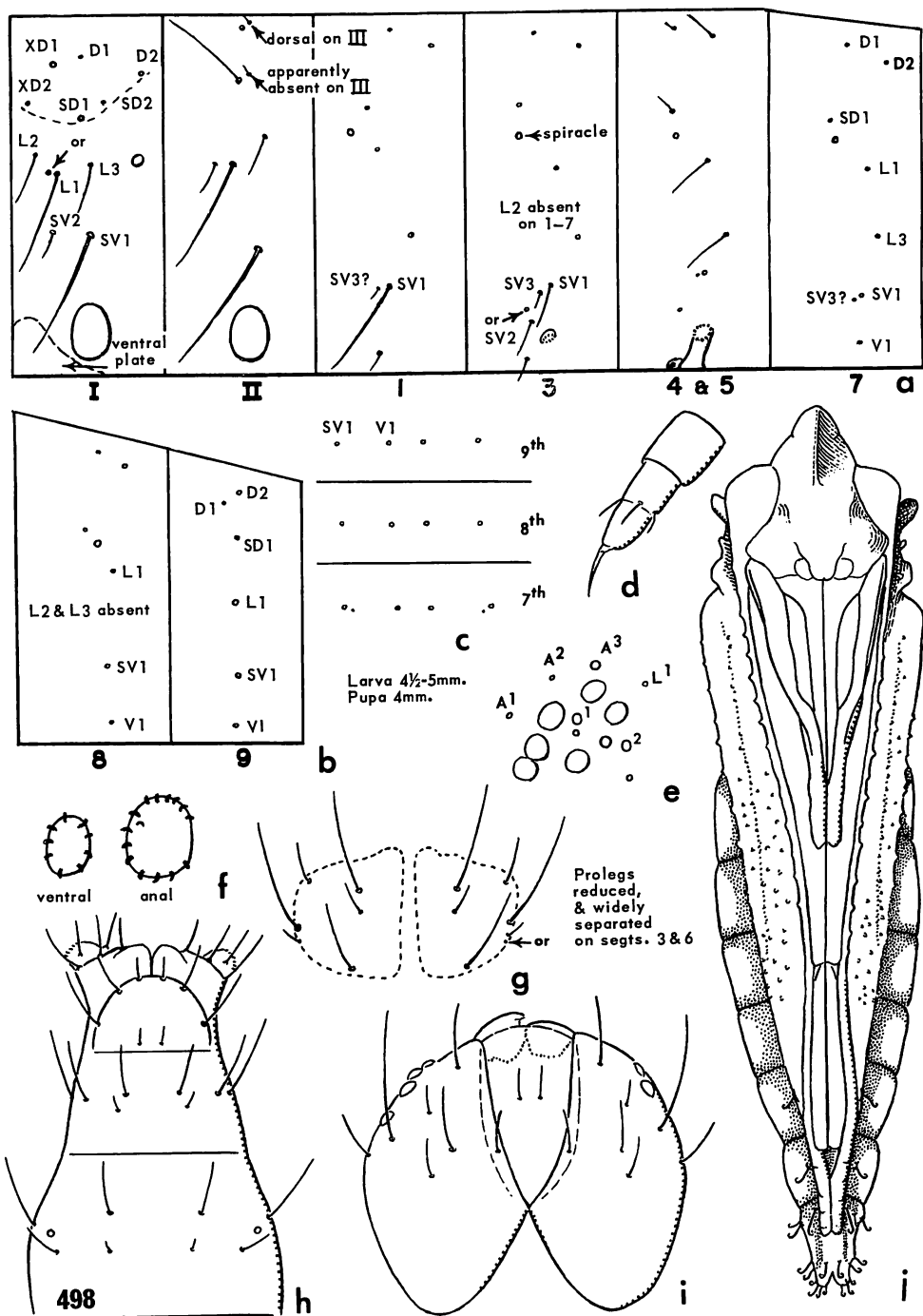


Figure 498—Details of the larva and pupa of *Bedellia orchilella* Walsingham. *a*, setal map of the pro- and mesothorax and abdominal segments 1, 3, 4, 5, and 7; *b*, setal map of abdominal segments 8 and 9; *c*, ventral and subventral setae on abdominal segments 7, 8, and 9; *d*, a thoracic leg; *e*, ocelli and associated setae; *f*, proleg crochets; *g*, prothoracic shield; *h*, dorsal aspect of abdominal segments 8 to 10; *i*, frontal aspect of head; *j*, ventral aspect of pupa. (Drawn especially for this text by Margaret MacKay.)

**Bedellia struthionella** Walsingham (figs. 482, head, venation; 485, moth; 488, 489, 490, male genitalia).

*Bedellia struthionella* Walsingham, 1907*b*: 725.

Endemic. Oahu, Hawaii (type locality: Kona, 4,000 to 5,000 feet).

Hostplant: I have examined material that may be this species that was reared by Dr. Swezey from *Panicum torridum* on Oahu. He said (1913*d*:225) that *struthionella* “must be a miner in some native tree, but I have not yet discovered its food plant.” I do not know why Dr. Swezey presumed that this was not a grass miner. The male genitalia are closely similar to those of Swezey’s *oplismeniella*. It is possible that this is a widely dispersed species in Hawaii, but evidently a confused cluster of species associated with *struthionella* awaits study.

**Bedellia species 5** (fig. 488, male genitalia).

*Bedellia somnulentella*, in the sense of Walsingham, 1907*b*: 723, pl. 25, fig. 28, not of Zeller (BM slide 7024).

Endemic. Hawaii (Kona, 4,000 feet).

Hostplant: unknown.

Walsingham, in *Fauna Hawaiiensis*, reported that Perkins had taken at Kona, 4,000 feet, “Two large specimens which are certainly not *minor*, Busck, I name with some doubt *somnulentella* Z.” The upper lobes of the male genital valvae each terminate in a thornlike process. The genitalia are otherwise of the basic *struthionella* kind.

**Bedellia species 6** (figs. 488, male genitalia; 496, female genitalia).

*Bedellia minor*, in the sense of Walsingham, 1907*b*: 724, in part, not of Busck, (BM slides 7029, male; 7030, female).

Endemic. Oahu (Waianae Mountains).

Hostplant: unknown.

Walsingham placed 24 specimens from Oahu, Molokai, and Hawaii under the name *minor* Busck in *Fauna Hawaiiensis*. None of these is the American *minor*, and there appear to be three species mixed under this name in the Walsingham series. I confine “species 6” to the specimens collected by Dr. Perkins in the Waianae Mountains. I am not certain that Walsingham is speaking of this species when he says, “Larva mining *Ipomoea*. Bred in Oahu from larvae mining Convolvulus leaves. Larvae whitish. Pupa on leaves in web. Common (Perkins).” The male genitalia I have examined indicate a species near *struthionella* which is a grass miner. It might be that Walsingham’s *Fauna Hawaiiensis* series also contained some specimens of the *Ipomoea*-mining *orchilella*, and, if so, that would account for the host reference made in the quotation from Perkins’ field notes.

**Bedellia species 7** (fig. 491, male genitalia).

*Bedellia minor*, in the sense of Walsingham, 1907*b*: 724, in part, not of Busck (BM genitalia slide 7027).

Endemic. Molokai.

Hostplant: unknown.

The pair of specimens in the *Fauna Hawaiiensis* collection from sea level on Molokai represent one, or possibly two species that differ from "species 6". The male genitalia indicate a species in the *struthionella* complex.

**Bedellia species 8.**

*Bedellia minor*, in the sense of Walsingham, 1907b:724, in part, not of Busck.

Endemic. Hawaii (Kona, 4,000 feet).

Hostplant: unknown.

This is a third species from the series which Walsingham placed originally under the name *minor*. The genitalia indicate that this is another species of the *struthionella* complex.

**Bedellia species 9.**

Endemic. Molokai (Kamiloloa).

Hostplant: *Panicum torridum*.

Dr. Swezey (*Proc. Hawaiian Ent. Soc.* 6:419, 1927) reared what he considered to be a new species from grass which he collected at Kamiloloa. I have not studied the genitalia of this form.

**Bedellia species 10.**

Endemic. Oahu (Mt. Kaala).

Hostplant: *Panicum kaalense*.

This species, reared by Dr. Swezey, has distinctive genitalia.

**Bedellia species 11.**

Endemic. Hawaii (Kohala Mountains).

Hostplant: sedge.

The only species known to me to have been reared from a sedge (by Dr. Swezey); it is new with clearly distinct male genitalia.

**Bedellia species 12** (fig. 491, male genitalia; 492, female genitalia).

Endemic. Oahu (Mt. Kaala).

Hostplant: *Boehmeria*.

Moths reared by Dr. Swezey from *Boehmeria* on Mt. Kaala and determined by him to be *boehmeriella* have very different male (slide Z-V-13-61) and female (slide Z-V-14-61) genitalia from true *boehmeriella* from the type locality in the Koolau Mountains and represent a new species.

**Bedellia species 13.**

Endemic. Kauai (Kokee).

Hostplant: *Dianella*.

Dr. Swezey reared this new species from mines in *Dianella* (Liliaceae) (see Swezey, 1954:67). This is the only record of a *Bedellia* attacking a member of the lily family in Hawaii. I have not examined the genitalia of this species and cannot comment upon its relationships.

**Bedellia species 14** (fig. 490, male genitalia).

Endemic. Hawaii (Olaa).

Hostplant: unknown.

This species, collected by Perkins and listed as Walsingham's specimen 28056, was wrongly considered a paratype of *orchilella* by Walsingham. It has an unusual saccus, as the illustration demonstrates (B.M. slide 16295).

## Superfamily **YPONOMEUTOIDEA** (Stephens)

*Yponomeutidae* Stephens, 1829:48.

*Yponomeutoidea*: Mosher, 1916:32, 96. Forbes, 1923:37, 335.

### Family **YPONOMEUTIDAE** Stephens

*Yponomeutidae* Stephens, 1829:48. Rebel, in Staudinger and Rebel, 1901:131.

Forbes, 1923:337. McDunnough, 1939:89. Brues, Melander and Carpenter, 1954:258. T. B. Fletcher, 1928*b*, Indian fauna. Friese, 1960:1; 1962, Palaearctic fauna.

*Hyponomeutidae*: Sodovsky, 1837:94; he said "*Yponomeuta*, richtiger [properly]: *Hyponomeuta*". Stainton, 1854:53. Anonymous, 1858:81. Sauveur and Fologne, 1863:101. Staudinger and Wocke, 1871:277. Spuler, 1898*a*:34. Walsingham, 1907*b*:508. Meyrick, 1913*c*:135; 1914*c*:3; 1928*d*:725.

*Yponomeutidi*: Guenée, 1845*b*:103.

*Hyponomeutina*: Herrich-Schäffer, 1857:58.

*Hyponomeutinae*: Walsingham, 1890:144.

*Ypsolophidi* Guenée, 1845*b*:97.

*Orthotaelidae* Herrich-Schäffer, 1857:58.

*Hypsilophidae*: Hampson, 1918*b*:387.

*Hypselophidae*: Brues, Melander and Carpenter, 1954:258, misspelling.

*Altevidae* Mosher, 1916:17.

*Plutellidi* Guenée, 1854*b*:101.

*Plutellinae*: Walsingham, 1890:144.

*Plutellidae*: *auctorum*.

*Acrolepidae*: *auctorum*. Spuler, 1898*a*:35.

*Acrolepianae*: Walsingham, 1890:144.

The spellings *Yponomeuta* and *Yponomeutidae* are based evidently upon incorrect transliteration, and *Hyponomeuta* and *Hyponomeutidae* would be better forms. The International Code of Zoological Nomenclature does not permit changing of names because of incorrect transliteration, but it might have been better to have accepted the very early correction of the spelling by Sodovsky in 1837, as noted above.

The classification of the moths assigned here is confused. I have decided to accept the merging of the Plutellidae into the Yponomeutidae instead of considering that there are two families represented as so many workers have believed. I have also accepted the inclusion of *Acrolepia* within the Yponomeutidae instead of treating that group as a member of a separate family

called Acrolepidae as do some authors. Clarke (1955:24) stated that the "Hyponomeutidae and Plutellidae . . . are inseparable, as indicated by structures of both immature and adult stages." Some workers continue to divide the group into several "families" without clearly defining such supposed families. *Prays* is a more divergent group, and it and *Acrolepia* and *Plutella* (the genera represented in Hawaii) might be placed in separate tribes or perhaps subfamilies within the Yponomeutidae.

In the Yponomeutidae the proboscis is not squamose (it is minutely pilose but is called naked). This character assists in the separation of the yponomeutids from the gelechioids with which they might be associated. All of the Hawaiian species have "pectens" of long hair on the anal vein areas of the hindwings.

## KEY TO THE GENERA OF YPONOMEUTIDAE IN HAWAII

### A—ADULTS

1. Ocelli absent; maxillary palpi rudimentary . . . . . **Prays**.  
Ocelli present; maxillary palpi developed, squamose  
and conspicuous . . . . . 2
- 2(1). Second segment of labial palpus with the squamae  
projecting strongly below and beyond the terminal  
segment, as in figure 504; hindwing with veins 3 and  
4 separate from the cell, as in figure 504 . . . . . **Plutella**.  
Second segment of labial palpus without a distal  
expansion of the squamae, but as in figure 512; hind-  
wing with veins 3 and 4 stalked, as in figure 512 . . . .  
. . . . . **Acrolepia**.

### B—LARVAE

1. Crochets of the abdominal prolegs arranged in double  
series; larvae of known Hawaiian species on *Pelea*  
or *Fagara* (= *Xanthoxylum*) . . . . . **Prays**.  
Crochets of abdominal prolegs arranged either in  
single rows (figure 509) or with only a short extra  
transverse internal row of a few crochets enclosed  
within the single external row (figure 53); the  
Hawaiian species on crucifers, onions and related  
plants or on *Nothocestrum* . . . . . 2
- 2(1). Spiracles of the abdomen each with the seta next  
above it (seta SDI) enclosed by a common pina-  
culum (sclerotized area); ventral prolegs short and  
stout . . . . . **Acrolepia**.  
Spiracles of the abdomen and the seta just above each  
spiracle not enclosed by a common pinaculum;  
ventral prolegs long and slender . . . . . **Plutella**.

Genus **PRAYS** Hübner

*Prays* Hübner, 1825 (1816–1826):413. Type-species: *Prays (coenobitella)* Hübner = *curtisella* Donovan. Werner, 1958:50, figs. 52, 53, 62, 63, larva. Friese, 1960:24.

*Prays* is an Old World group with species recorded from Eurasia and Africa to Australia and parts of the Pacific. It would appear, however, that more than one genus may be included under the name *Prays*. The taxonomic position of *Prays* is uncertain. Some workers exclude it from the Yponomeutidae. Some have suggested that it be placed in the Scythrididae, but that suggestion is untenable. The genitalia are peculiar, and the genus is isolated.

It had been assumed that there was only one variable, widespread foreign species of *Prays* in Hawaii. These studies have shown the true situation to be

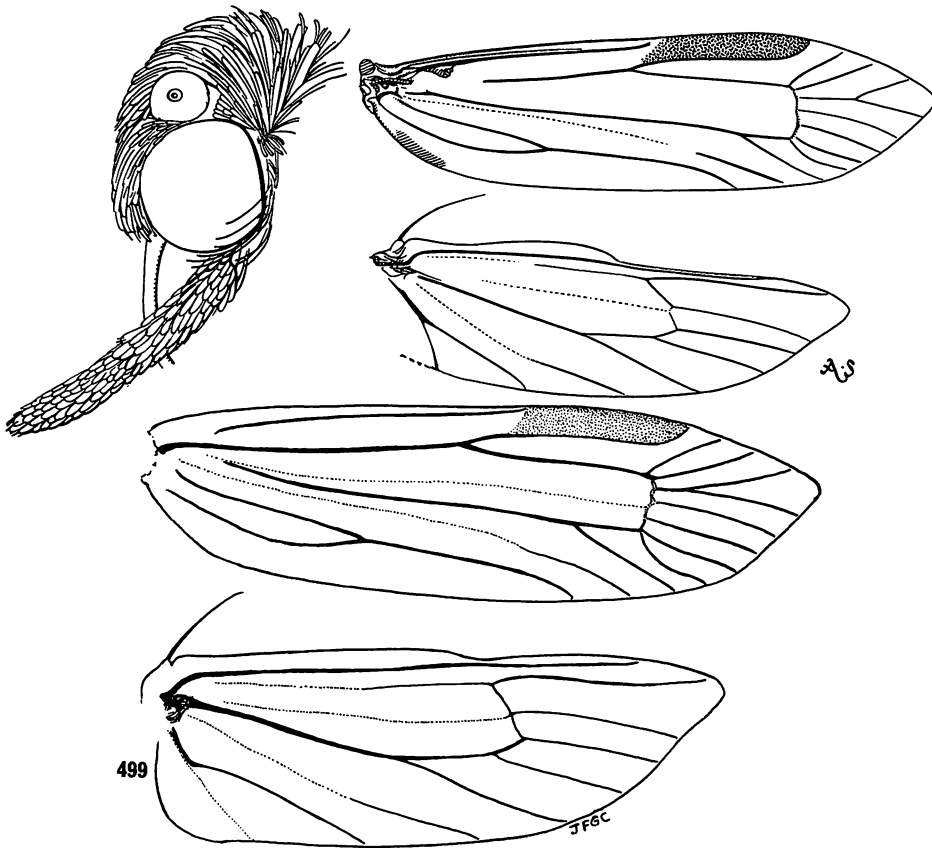


Figure 499—*Prays*. Top, *fulvocanella* Walsingham, holotype (BM slide 4171); Kaholuamano, Kauai. There are no ocelli and the proboscis is not squamose. The labial palpi are probably usually held more horizontally in life. Bottom, wing venation of *curtisella* Donovan, the type-species.



quite the contrary—examinations of the genitalia have revealed the presence of a series of endemic Hawaiian species. Furthermore, I am not positive that the Hawaiian species are true *Prays*. The type of the genus and other non-Hawaiian species which I have been able to examine have the uncus divided (in the type-species it is apically concave with what appear to be the socii developed as armlike structures), but the uncus of all the Hawaiian species examined is long, slender, entire, and of a different character from that of the type-species. Except for this feature, however, the Hawaiian species appear to agree with *Prays*, although my studies may not have been adequate. The male genitalia are very distinctive in the Hawaiian fauna, and they do not approach the form found in any other group of moths in Hawaii.

Perkins (1913:clxvi) said that *Prays* are common insects “often disturbed from the branches of trees. It is a true forest insect and almost certainly endemic.” Perkins’ observations are correct, and many new endemic species remain to be described.

There are two well-known agricultural pest species of *Prays*. One is the destructive olive moth, *Prays oleella* (Fabricius), and it has been called the second most important pest of olives in some Mediterranean areas (see Silvestri, 1908:83; 1943:121–136, figs. 150–167). The second species, the widespread *Prays citri* Millière, is known in some places as the “citrus rind borer”, and it has been the subject of study in Europe and the Philippines. It is a well-known

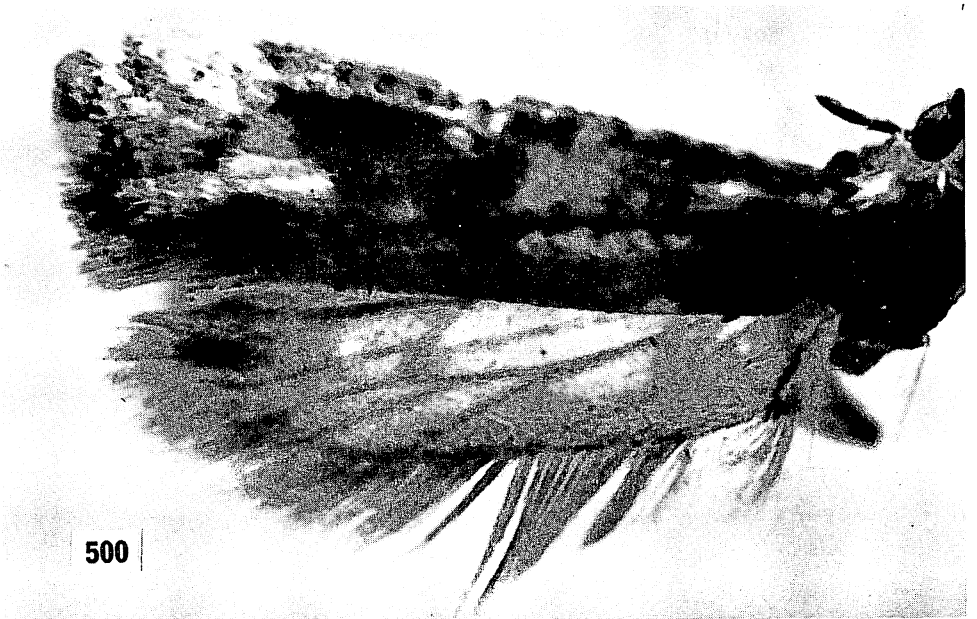


Figure 500—*Prays fulvocanella* Walsingham, holotype male (BM slide 4171); Kaholuamano, 4,000 feet, Kauai. A poor photograph.

pest of citrus in the entire Mediterranean region and ranges eastward to Australia and Japan and supposedly as far east as Samoa. A large body of literature has been published on these pests; see, for example, Silvestri, 1943: 136–139, figs. 168–172, and Balachowsky, 1966:926. See also Arambourg in Balachowsky, 1966:181–198, for illustrated discussions of the two species.

*Prays* pupate in cocoons of silk mesh similar to those of *Plutella*, and the larvae have long setae.

**Prays fulvocanella** Walsingham (figs. 499, head, wing venation; 500, moth; 501, male, female genitalia; 502, male genitalia; col. pl. 3:7).

*Prays fulvocanellus* Walsingham, 1907b:652, 735, pl. 25, fig. 8.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant. Unknown, but it may be *Pelea* (= *Platydesma*) or *Fagara* (= *Xanthoxylum*) *hawaiiensis*; see the note below.

Although this species has been recorded from Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii, I have restricted it here to the type island of Kauai. I have examined the male genitalia of paratypes from the Waianae Mountains, Oahu; Lanai, 2,000 feet; and Kilauea, Hawaii, and they represent three distinct new species. I have not examined male specimens from Molokai or Maui, but specimens from those islands are also believed to represent new species.

Walsingham had 42 specimens before him when he described the species. He erroneously considered them all to represent one species which, he said, “varies considerably in size and in the amount of brown suffusion.”

Dr. Swezey reared specimens of *Prays* from the flowers of *Fagara* (= *Xanthoxylum*) and buds and seeds of *Pelea*. These records probably apply to several new species.

**Prays new species 1**, from Kauai (fig. 503, pupa).

A single example of this species was reared from a seed of *Pelea* (*Platydesma*) collected by C. J. Davis and Donald Sugawa at Kumuwela. Mr. Davis told me that the fruits were “heavily infested”.

**Prays new species 2**, from Oahu.

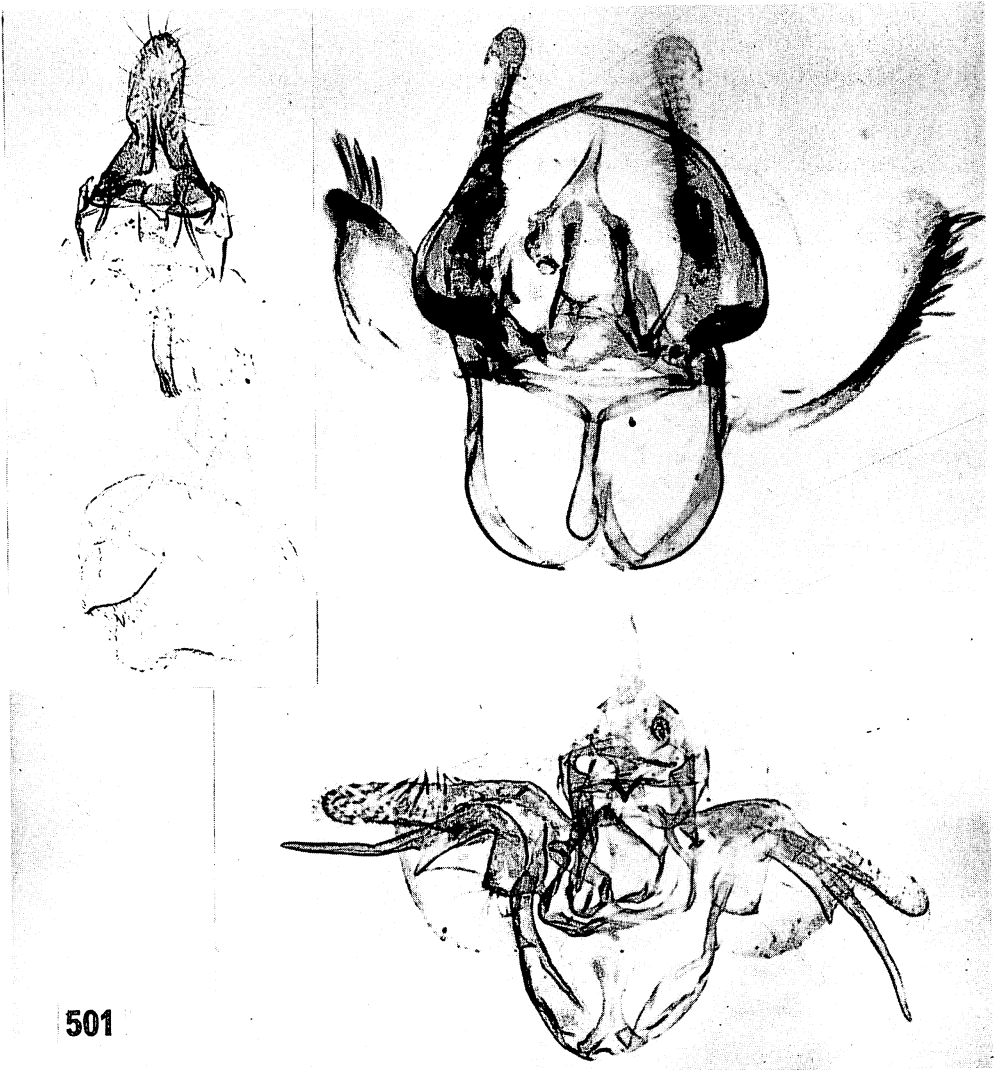
**Prays new species 3**, from Molokai.

**Prays new species 4**, from Maui.

**Prays new species 5**, from Lanai.

**Prays new species 6**, from Hawaii.

Larvae taken from *Pelea* on Hawaii and now in the U.S. National Museum may be of this species.



501

Figure 501—*Prays*. Top left, female genitalia of a paratype of *fulvocanella* Walsingham (Busck slide 142; Walsingham specimen 27882); I am not absolutely certain that this is *fulvocanella*, but it may be. Top right, male genitalia of the holotype of *fulvocanella* (BM slide 4171); see figure 502 of this specimen after remounting. Bottom, male genitalia of a new species, formerly considered as a paratype of *fulvocanella*; Kauai (Busck slide 141). Note that the appearances of the two mounts differ because the bottom specimen is spread open.

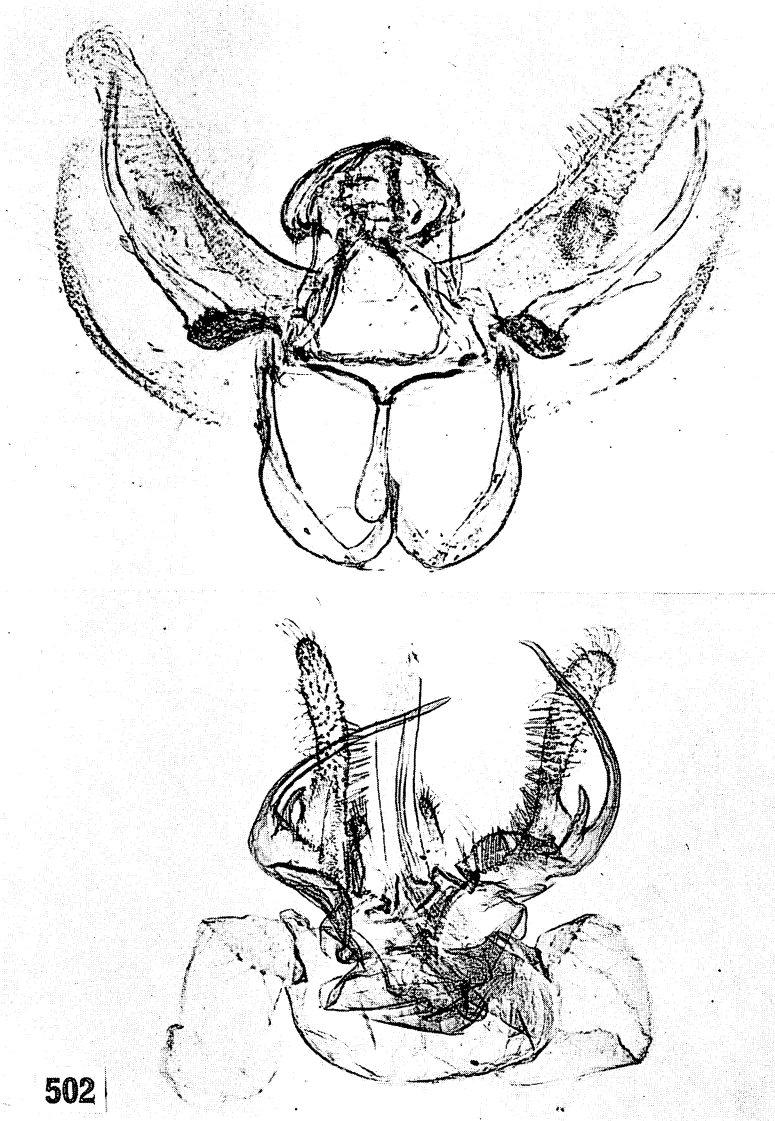


Figure 502—Male genitalia of *Prays*. Top, the not entirely satisfactory remount of the genitalia of the holotype of *fulvocanella* Walsingham (BM slide 4171); Kaholuamano, 4,000 feet, Kauai. Compare figure 501 which shows this specimen before it was remounted. Bottom, from a new species from Oahu, aedeagus in situ (Busck slide 139).

Genus **PLUTELLA** Schrank

*Plutella* Schrank, 1802:169. Type-species: (*Cerostoma maculipennis* Curtis)  
= *Phalaena Tinea xylostella* Linnaeus.

Our knowledge of *Plutella* in Hawaii is unsatisfactory, and we do not know how many species occur here. In addition to the imported, widely distributed, European pest species known as the diamond-back moth, *Plutella xylostella* (= *maculipennis*), one distinctive endemic species has been described. The existence of endemic *Plutella* in the Hawaiian fauna is surprising. Dr. Swezey reared a number of series of specimens which may represent additional allied endemic forms, but until the moths are studied critically it is impossible to say much more about them. I had hoped to be able to study the Swezey collections in careful detail when I was working on this group several years ago, but when I requested them from Honolulu it was reported that they could not be found. However, after my manuscript was completed and nearly ready to be submitted to the Press, the Hawaiian insect collections at the Sugar Planters' Experiment Station were given to the Hawaiian State Department of Agriculture, and through the kind cooperation of C. J. Davis and George Funasaki I have recently been able to make a brief preliminary study of several specimens of *Plutella* from series reared from *Capparis* by Dr. Swezey. One series of specimens is from the Ewa Coral Plain, Oahu, the second series is from Diamond Head, Oahu, and the third is from Kailua and Napoopoo, Hawaii. From external appearances these series appear to represent three or, possibly, four species. Surprisingly, however, their male genitalia are con-

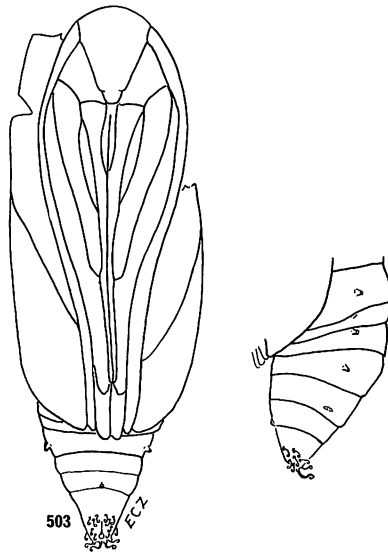


Figure 503—Sketches of a cast skin (incomplete) of a pupa of *Prays*, new species 1; Kumuwela, Kauai, ex *Pelea*. The abdomen is movable between segments 4, 5, and 6.

fusingly similar, and without further detailed study I cannot express an opinion regarding their status. It is possible that a series of sibling species is involved in the Hawaiian *Plutella*. It must be left for some future worker to elucidate the problems of the Hawaiian *Plutella*.

The adults of *Plutella* rest with their antennae extended horizontally in front of their heads.

The two described species in Hawaii are easily distinguished by the color patterns of the forewings and by their genitalia, as the illustrations demonstrate.

#### KEY TO THE DESCRIBED SPECIES OF PLUTELLA IN HAWAII

1. Forewings with a large, conspicuous, pale macula near middle of costa, and with a pale vitta along posterior margin extending diagonally across the wing to reach costa near apex; aedeagus strongly sinuous, male and female genitalia as in figure 505. . . . **capparidis** Swezey.
2. Forewings without any pale maculae on costal margin and the pale vitta along posterior margin is confined to the posterior margin; aedeagus straight and needle-like, male and female genitalia as in figure 508. . . . .  
 . . . . . **xylostella** (Linnaeus).

**Plutella capparidis** Swezey (fig. 505, moth, male, female genitalia).

*Plutella capparidis* Swezey, 1920b:383, figured.

Endemic. Oahu (type locality: Ewa Coral Plain).

Hostplant: *Capparis sandwichiana*.

Parasite: *Chelonus* (*Microchelonus*) *blackburni* Cameron; parasitism may be heavy.

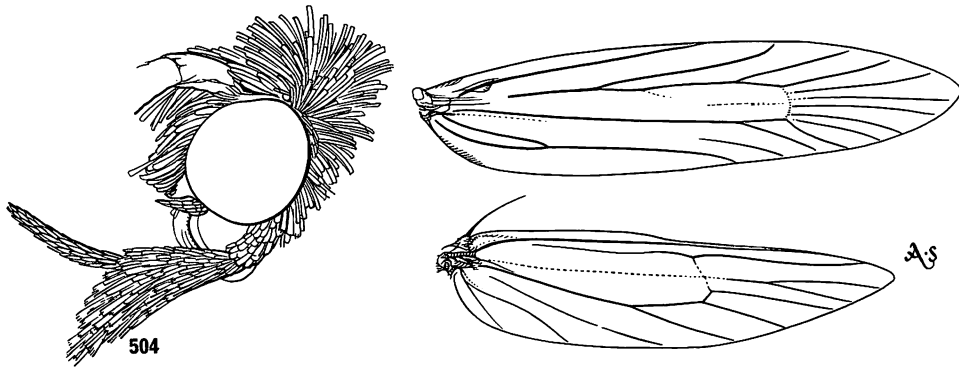


Figure 504—Head and wing venation of *Plutella xylostella* (Linnaeus) (BM slide 5193); Hawaiian specimens. The type-species of *Plutella*.

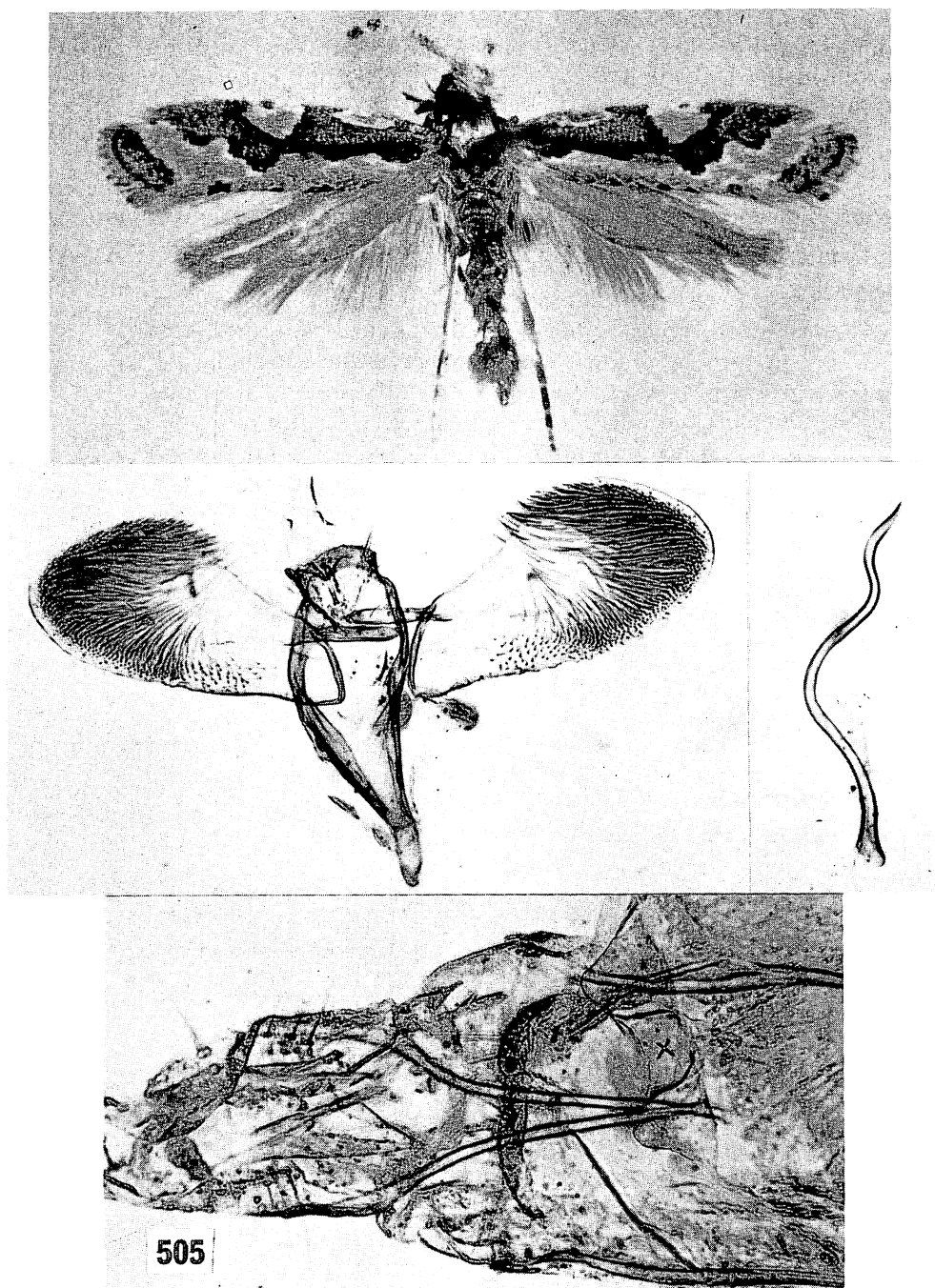


Figure 505—*Plutella capparidis* Swezey. Top, the holotype; forewing length 4 mm.; Ewa Plain. Middle, male genitalia, with aedeagus at right, of a paratype from the same locality (slide Z-XII-19-62-16). Note the conspicuously distinct aedeagus as compared with that of *xylostella* on figure 508. Bottom, part of the female genitalia of a paratype from the same place; ostium marked by "X" (slide Z-XII-19-62-17).

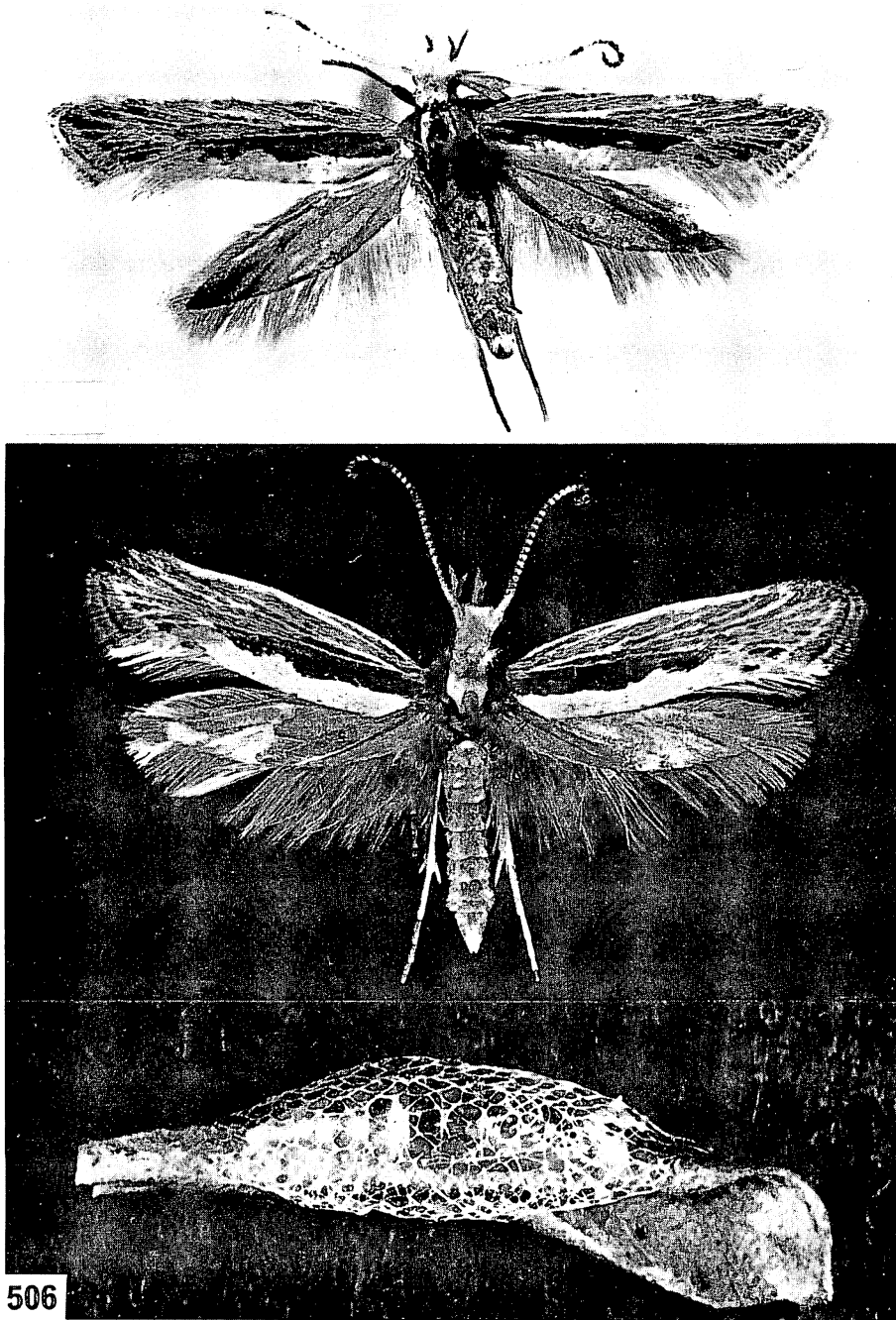


Figure 506—*Plutella xylostella* (Linnaeus). Top, a specimen reared from cauliflower; Manoa, Honolulu; forewing 6 mm. Middle, a specimen of the color form called *albovenosa* by Walsingham; forewing length 5.5 mm.; Quarantine Island, Oahu. Bottom, a cocoon of the same form reared from *Lepidium* at Kailua, Oahu.



The light green larvae feed mostly on the surface of the leaves, eating one epidermis and the parenchyma and leaving the other epidermis, which shows as dead spots in the leaves. Occasionally the larvae have a tendency to mine within the leaf. Usually they are exposed, but sometimes covered by a slight web. The cocoon is made on the surface of the leaf. It is not so distinctly of an open network structure as is usual with *Plutella*, tho there is a tendency for it to be of fine network with a thin outer covering. It is denser than usual for *Plutella*, but thin enough so that the pupa can be made out inside. (Swezey, 1920b:383-384.)

This species may represent a remnant of a lowland Hawaiian fauna which has been nearly exterminated. Further study of the male genitalia is suggested. Is the specimen I have illustrated normal?

***Plutella xylostella*** (Linnaeus) (figs. 504, head, wing venation; 506, moth, cocoon; 507, male genitalia; 508, male, female genitalia; 509, larva; 510, larval damage; 511, pupa).

*Phalaena Tinea xylostella* Linnaeus, 1758:538.

*Cerostoma maculipennis* Curtis, 1832 (1824-1839): p. 2 of explanation of pl. 420.

*Plutella maculipennis* (Curtis) Walsingham and Durrant, 1897:173. Synonymy by Bradley, 1966b:219.

*Plutella albovenosa* Walsingham, 1907b:653, pl. 25, fig. 11. **New synonym.** For detailed synonymy, see Walsingham, 1907b:652.

Fullaway, 1915:46, biology in Hawaii. Mosher, 1916:98, fig. 84, pupa. Marsh, 1917:1-9, pls. 1-2, biology in Colorado; figures of larva, pupa, adult, and damage. Hardy, 1938:343-372, figs. 1-10, pl. 9; biological control in England. Silvestri, 1943:165-168, figs. 202-205. Sharplin, 1963, fig. 60; wing base sclerites; Mortimer, 1965:84-86, figs. 17, 18, alimentary canal. Réal, in Balachowsky, 1966:219-229, figs. 100-103.

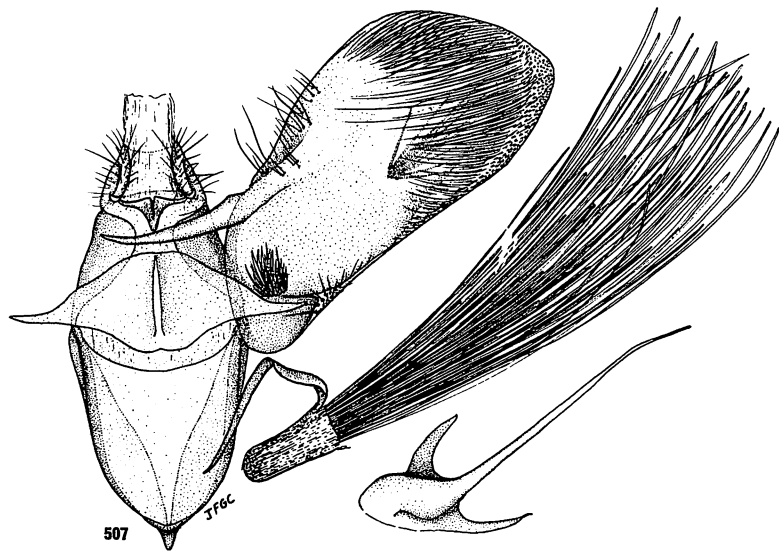


Figure 507—Male genitalia of *Plutella xylostella* (Linnaeus).

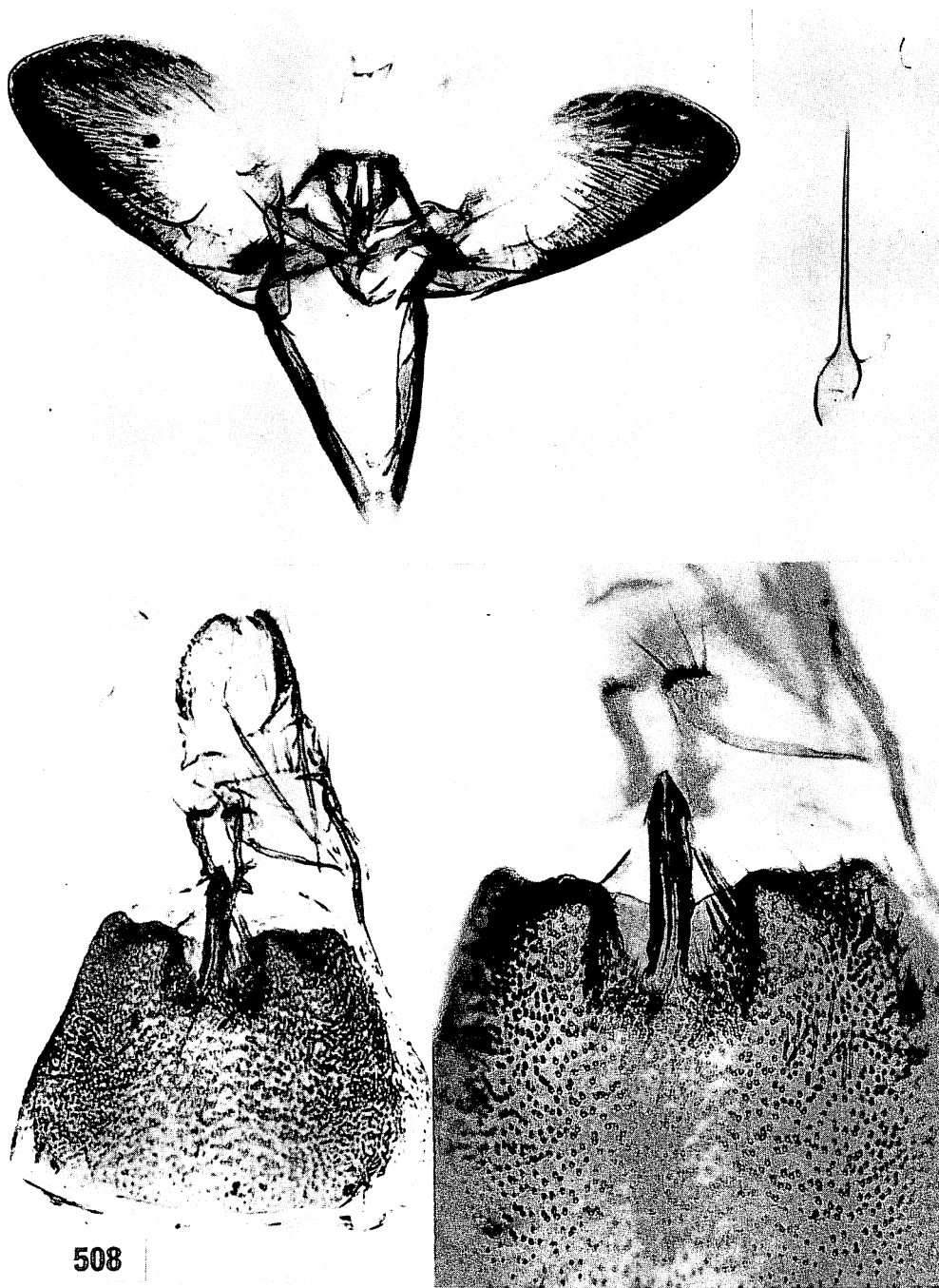


Figure 508—*Plutella xylostella* (Linnaeus). Top, male genitalia from the holotype of the synonymous *albovenosa* Walsingham (BM slide 2150); Kona, 4,000 feet, Hawaii. Note the dense tuft of setae (appearing as a black mass) at the base of each valva; this is not present on *capparidis*. Bottom, part of the female genitalia of an English specimen (BM slide 8141); Merton, Norfolk.

The diamond-back moth.

Kure (Ocean), Wake, Midway, Laysan, Pearl and Hermes Reef, Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. A widespread economic pest. First recorded in Hawaii by Walsingham in 1907<sup>b</sup>:652 from specimens collected as early as 1892 by Perkins. J. E. Hardy published a map showing the world distribution of the species in 1938:346. The moth was found on remote Pitcairn Island as early as June 1, 1883.

Hostplants (as recorded in Hawaii): *Alyssum*, broccoli, cabbage and other related cultivated cruciferous plants, *Capparis sandwichiana*, *Lepidium*, turnip.

Parasites: *Horogenes polynesiale* (Cameron), *Tetrastichus* near *sokolowskii* Kurjdmov (purposely introduced from Nairobi, Africa, to assist in the control of this moth). There are many other parasites of the moth known elsewhere, and J. E. Hardy gave a list of over 40 parasites together with an extended discussion of parasitism in England (1938:343).

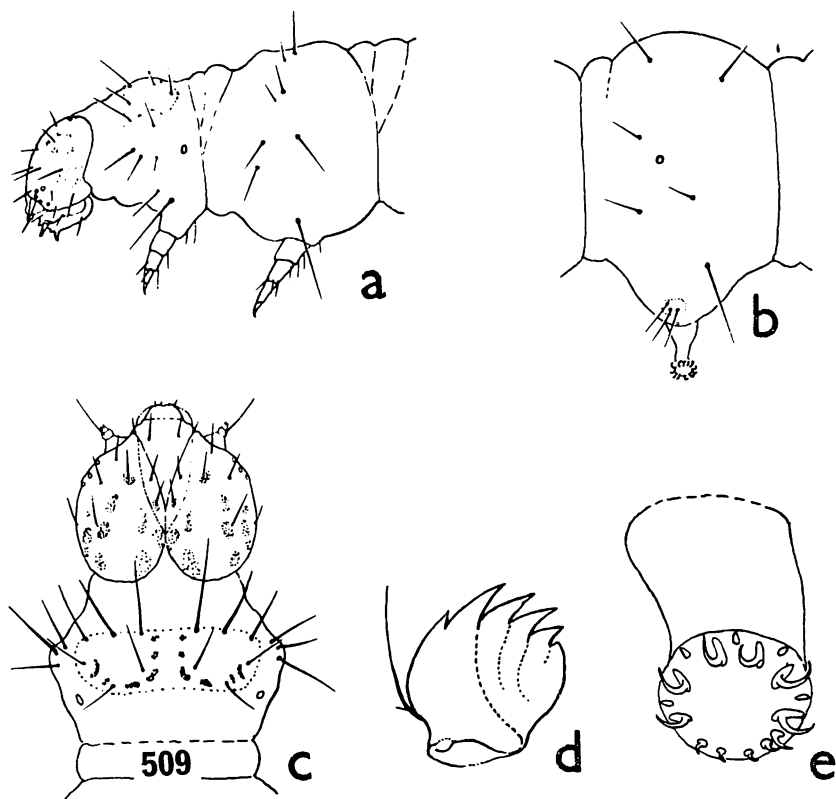


Figure 509—Details of the larva of *Plutella xylostella* (Linnaeus) (rearranged from Peterson, 1962). Mature larva about 9.5 mm. long. *a*, left lateral aspect of head, pro- and mesothorax; *b*, left lateral aspect of fourth abdominal segment; *c*, dorsal aspect of head and prothorax; *d*, right mandible, mesal aspect; *e*, right proleg of the third abdominal segment. Note the unusually long proleg.

This is a serious pest of crucifers and has often caused trouble to cabbage crops in Hawaii where it is referred to as "the cabbage moth".

Dr. Swezey reared a series of specimens from broccoli which included specimens of both the usual form and the form with the white wing veins that Walsingham considered a separate species and named *albovenosa*. The latter name represents only a color form and not a species, and I have placed it in synonymy.

Bridwell (1920:316) reported finding the *albovenosa* form feeding on *Capparis sandwichiana* and said, "the young larva [mines] under the cuticle of the green fruits, while the older larva burrows in its fleshy walls, emerging to spin a characteristic *Plutella* cocoon."

Sakimura [*Proc. Hawaiian Ent. Soc.* 19(1):21, 1965] reported continuous severe damage to the ornamental herb *Alyssum* in Honolulu.

The following notes are abstracted from Fullaway (1915:46-48): The eggs are deposited singly in large numbers on the leaves, usually in the hollow

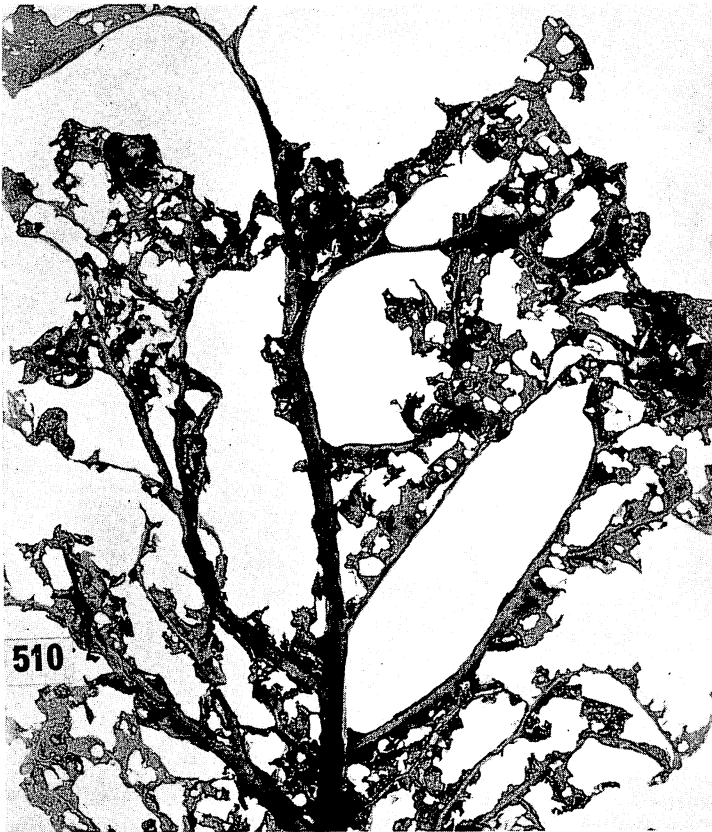


Figure 510—A leaf of broccoli showing extensive damage done by larvae of *Plutella xylostella* (Linnaeus); Honolulu. (University of Hawaii photograph.)

alongside a vein. They are flat, oval, lemon-yellow, with an iridescent, roughened surface. The incubation period is about four days. The larval period is about ten days. The larvae damage the plants mostly by their attacks on the leaves, and when the caterpillars are numerous the plants quickly may become riddled with holes. They are most injurious to thin-leaved plants and seedlings, and they cause little damage to mature cabbage leaves. If the larva is disturbed, it will usually wriggle away with lively contortions and, suspended by a silken thread, drop from the leaf. The pupa is enclosed in an unusual, loosely woven, wide-meshed cocoon spun on a leaf. The pupal stage is about six to eight days.

Jayewickreme (1940:70) described some features of the larva, and Mortimer (1965:84) has described the alimentary canal of the adult. For a general discussion of the species outside of Hawaii, see Réal in Balachowski (1966: 218–229).

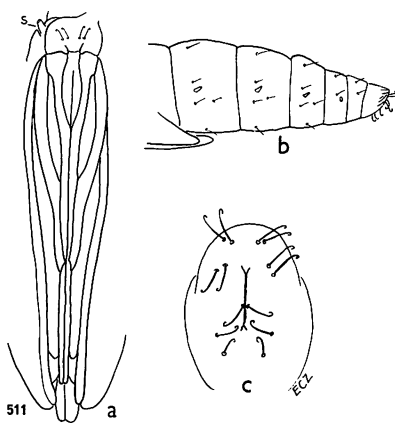


Figure 511—Details of a broken, cast skin of the pupa of *Plutella xylostella* (Linnaeus). *a*, ventral aspect showing the arrangement of the appendages (mesothoracic spiracle at *S*); *b*, left lateral aspect of the five caudal abdominal segments; *c*, ventro-caudal aspect of the tenth abdominal segment. Note the strongly protuberant spiracles on this species. From an English specimen.

Genus **ACROLEPIA** Curtis

*Acrolepia* Curtis, 1838 (1824–1839): no. 679. Type-species: (*Acrolepia autumnitella* Curtis, 1838 (1824–1839): pl. 679) = *Tortrix pygmeana* Haworth, 1811 (1803–1828): 439. Fig. 512, wing venation.

Numerous species from the Old and the New Worlds have been assigned to *Acrolepia*, but the assemblage requires revisional study. It would appear that the Hawaiian group is Holarctic in origin.

Considerable difference of opinion exists in literature regarding where to place *Acrolepia*. Some authors have believed it to belong to the Tineidae, others consider it to belong to a separate family, the Acrolepiidae, while others have assigned it to the Yponomeutidae, to the Plutellidae, or to the Argyroresthiidae. Eyer (1924:315) said, "Acrolepia resembles the reduced Tineids, Ischnosia and Meesia, and unless further examination of the European species reveals a different type of genitalia it may be regarded as one of the saccus-bearing Tineidae. The family shows no close affinity with the Plutellidae,

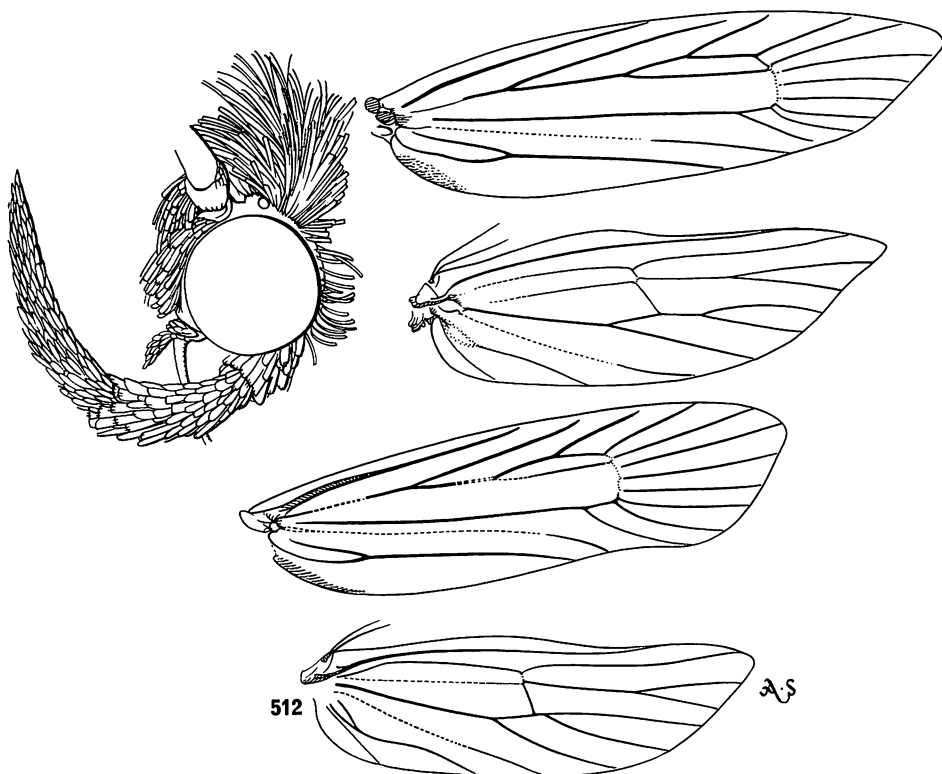


Figure 512—Top, head and wing venation of *Acrolepia assectella* (Zeller) specimens from France (BM slide 5138). Bottom, wing venation of *Acrolepia beardsleyi* Zimmerman, paratype (slide Z-IX-29-65-1); Ulupalakua, Maui. Note the close agreement in most details of the European and Hawaiian species, and compare the type-species on figure 513.

where some authors have placed them.” Eyer’s opinion has not been generally accepted, and there is much resemblance to the Yponomeutidae where it is retained in this text.

Our knowledge of *Acrolepia* in Hawaii is fragmentary. It is probable that many species exist in Hawaii. Only three endemic species have previously been recorded in the Islands, and two of these are known only from the holotypes. Difficult though it is to comprehend, Dr. Perkins collected only one specimen during all the years of his extensive Hawaiian work. A fourth endemic species is described below, and a pest species has been accidentally introduced.

The endemic Hawaiian species, whose hostplants are known, have been reared from blotch mines in the leaves of *Nothocestrum*, an endemic genus of trees belonging to the Solanaceae. The larvae of these native species emerge from their mines to spin cocoons of dense, pale silk on the leaf surfaces. The shape of the cocoons which I have seen resembles an overturned boat.

The valvae of the male genitalia bear long setae toward their bases, and when these setae are removed, as is easily done in the dissecting process, rows of conspicuous setal sockets remain.

Long after my work on *Acrolepia* was completed, I saw Gaedike’s paper “Revision der paläarktischen Acrolepiidae”, 1970. In that paper Gaedike

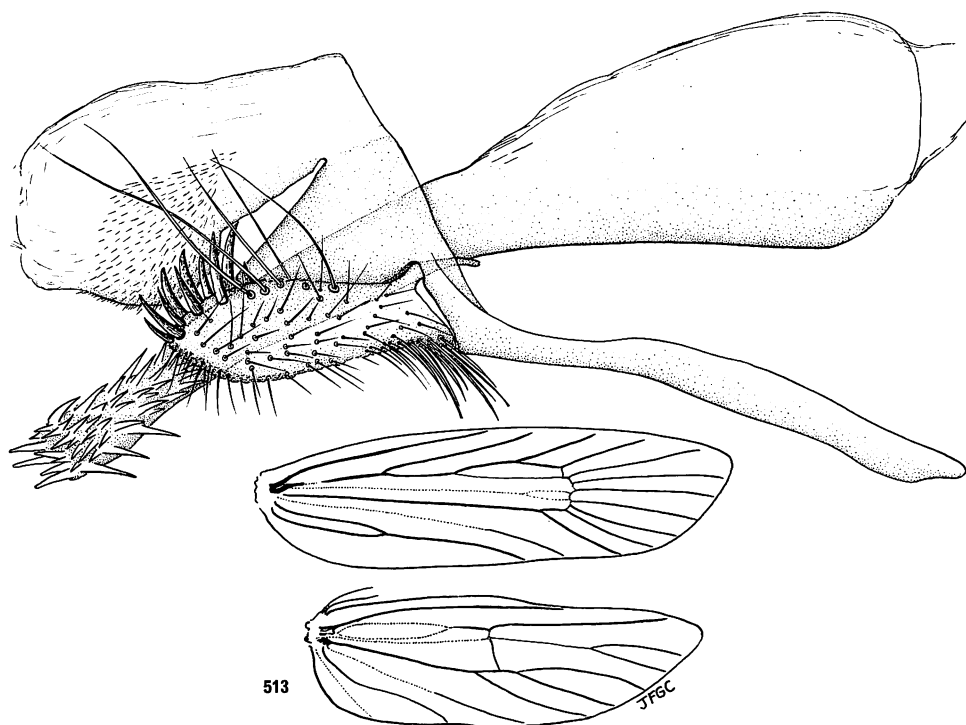


Figure 513—Male genitalia and wing venation of *Acrolepia pygmaeana* (Haworth), the type-species of *Acrolepia*.

divides the Palearctic species into three genera: *Digitivalva*, *Acrolepiopsis* and *Acrolepia*, the two former being newly established genera. *Acrolepiopsis* was erected to include *assectella* (Zeller), the onion leafminer that occurs in Hawaii. I have not accepted Gaedike's system, because it is untenable for non-Eurasian species.

See color plate 3, figure 8.

#### KEY TO THE SPECIES OF ACROLEPIA IN HAWAII

1. Forewings with two prominent pale or white maculae on posterior margin within basal half, neither of which extends much costad of plica . . . . . 2  
 Forewings without such isolated maculae, but with a broad, pale, whitish or greenish grey fascia (with darker included areas) which extends entirely across the wing just basad of middle and with or without a usually less pronounced pale fascia farther basad . . . . 3
- 2(1). Forewing pattern as in figure 514, without a distinct white macula at end of cell; hindwings pale fuscous; genitalia as in figure 520; Oahu, Hawaii (and other islands?) . . . . . **assectella** (Zeller).  
 Forewing pattern as in figure 517, with much canary yellow background scaling and with a distinct white macula at end of cell; hindwing dark fuscous; Oahu . . . . . **nothocestri** Busck.
- 3(1). Maui species; forewing pattern as in figure 516; male genital valvae with the basal area which bears long setae prolonged mesad, thus making each valva sub-L-shaped, as in figure 518. . . **beardsleyi** Zimmerman.  
 Kauai and Molokai species with male genital valvae without such mesal projections but shaped as in figure 518. . . . . 4
- 4(3). Forewing pattern as in figure 515; valvae of male genitalia attenuated distad and much narrower at apex than at base, as in figure 518; Molokai . . . . . **aureonigrella** Walsingham.  
 Forewing with pattern as in figure 514; valvae of male genitalia sub-semicircular in outline and shaped as in figure 518; Kauai. . . . . **aiea** Swezey.

**Acrolepia aiea** Swezey (figs. 514, moth; 518c, male genital valva; 519, male genitalia).

*Acrolepia aiea* Swezey, 1933b:303.

Endemic. Kauai (type locality: Kumuwela).

Hostplant: *Nothoctrum latifolium* ("aiea").



This species is known only from the male holotype which was reared from a leaf mine.

The male genital valvae are more broadly rounded at their apices than are those of *nothocestri* or *aureonigrella*, and they lack the internal basal prolongation of *beardsleyi*. Dr. Swezey considered the holotype to be "undersized from lack of food", but this may not be true.

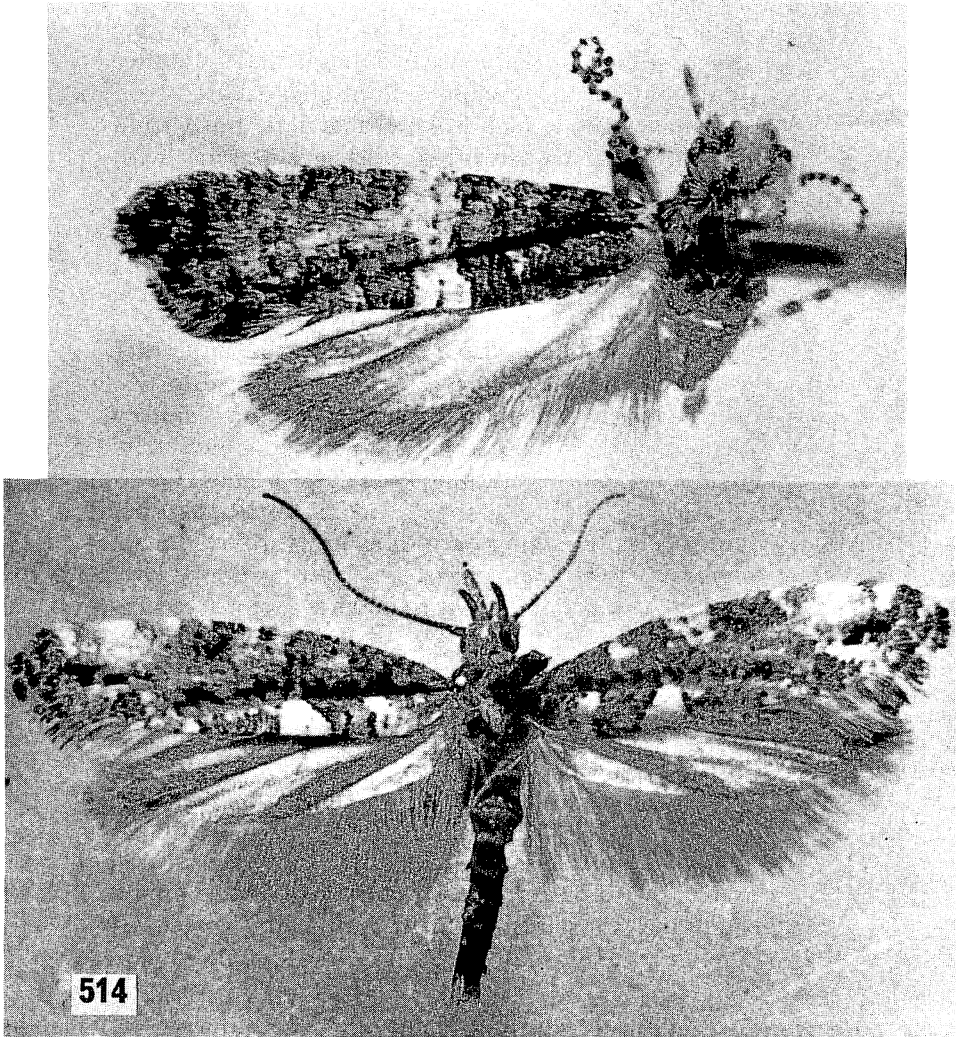


Figure 514—*Acrolepia* species. Top, *aiea* Swezey, holotype male; Kamuwela, Kauai; forewing 4 mm. Bottom, *assectella* (Zeller); France; forewing 6 mm.

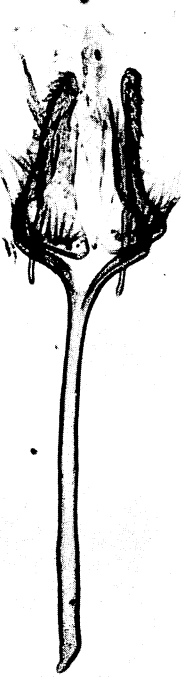
**515**

Figure 515—*Acrolepia aureonigrella* Walsingham, holotype male (BM slide 4393); Molokai, over 3,000 feet; forewing 5.5 mm.; aedeagus at bottom right. Note the long saccus on this species as compared with that of *nothocestri* in figure 519.

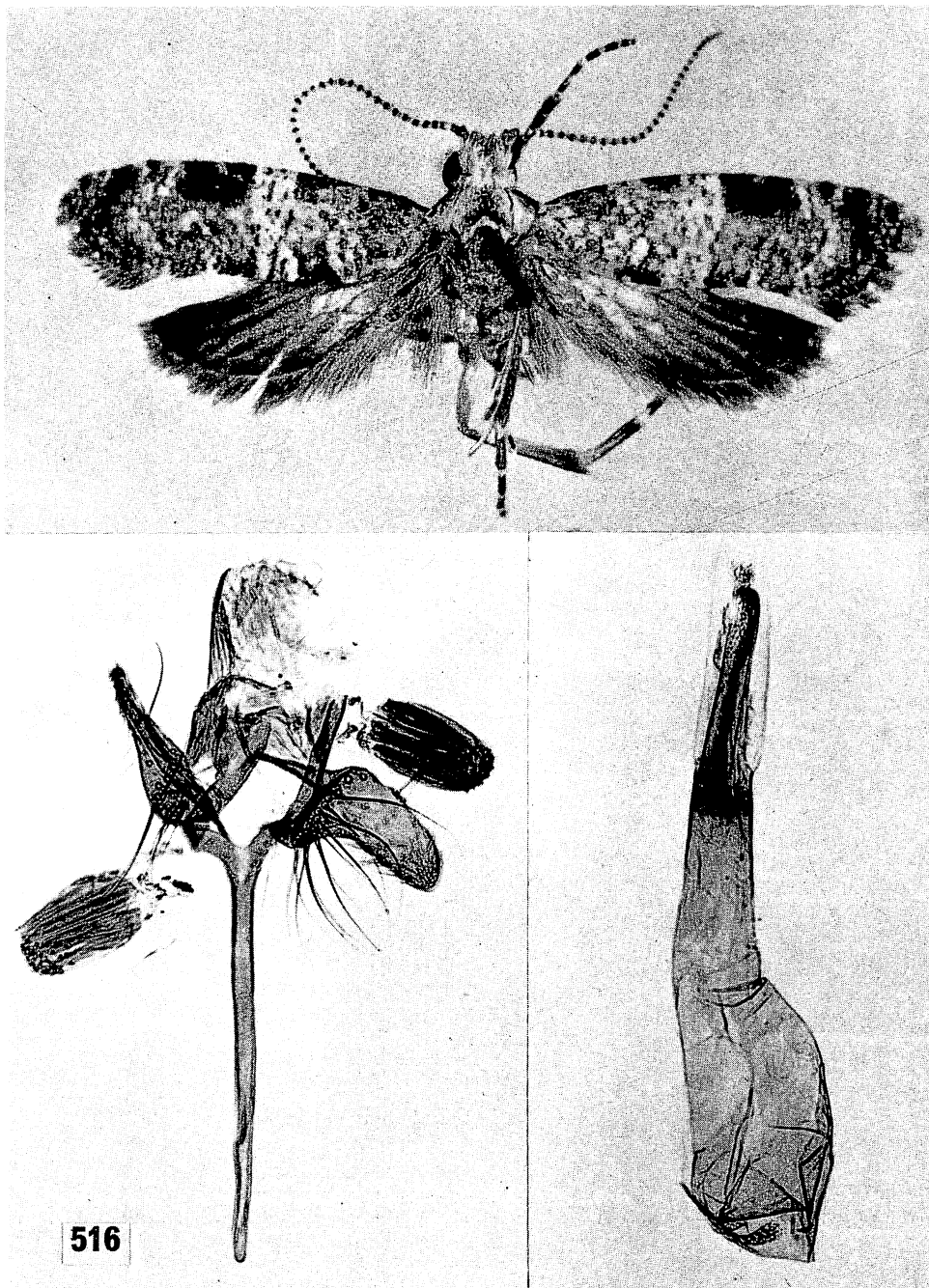


Figure 516—*Acrolepia beardsleyi* Zimmerman, holotype male (slide Z-IX-29-65-A); expanse 10 mm.; Ulupalakua, Maui. The aedeagus is at the same magnification as the remainder of the genitalia.

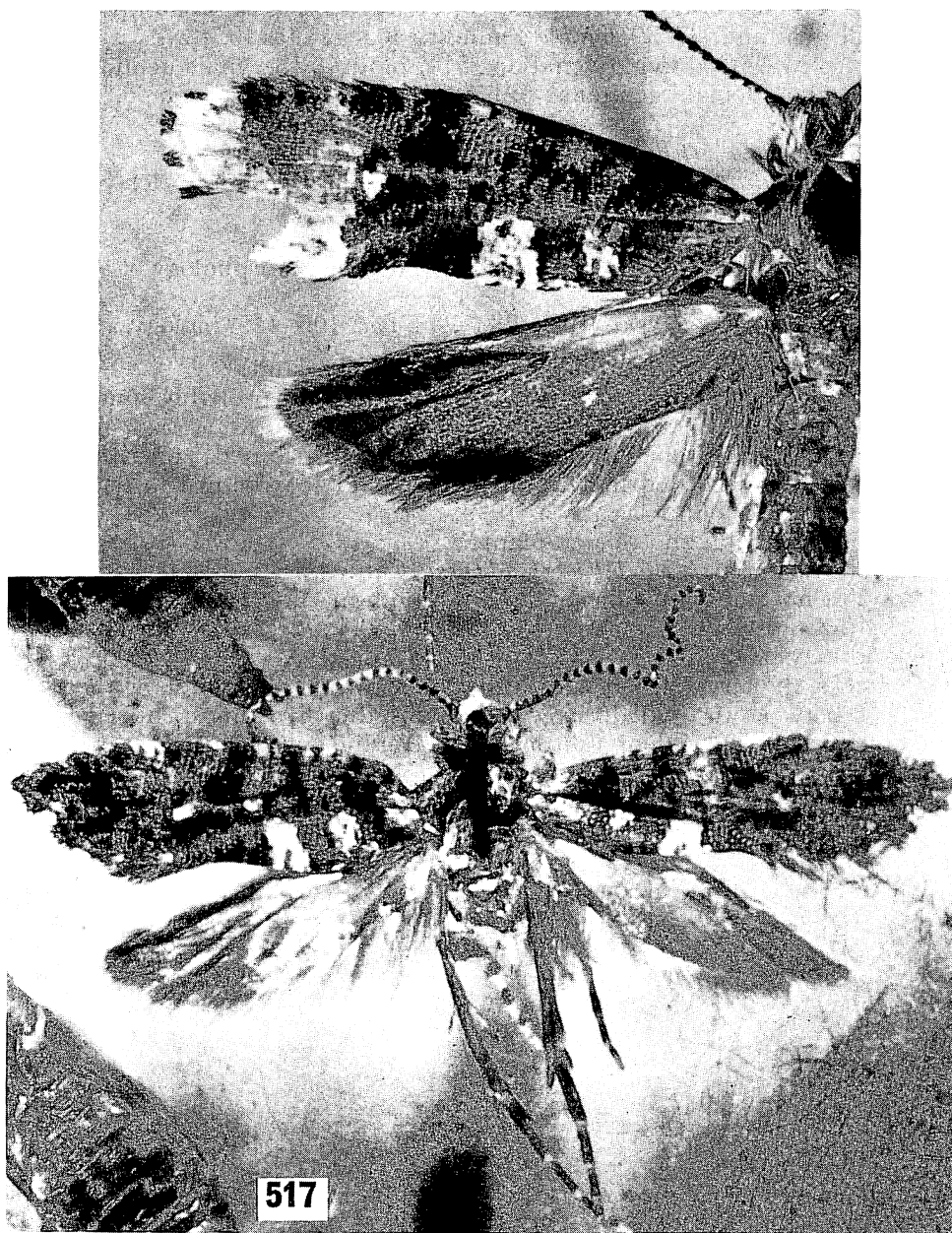


Figure 517—Top, *Acrolepia nothocestri* Busck, holotype female (in U.S. National Museum); Mt. Olympus, Oahu. Bottom, a male of the same species demonstrating a different color pattern (slide Z-1-19-62-2); Mt. Olympus, Oahu.

**Acrolepia assectella** (Zeller) (figs. 10, 11, 12, 13, 23, 24, anatomy; 31, 35, male genitalia; 37, 39, female genitalia; 40, egg; 45, 46, 48, 49, 51, 53, 54, larva; 512, head, wing venation; 514, moth; 518e, male genital valva; 520, male, female genitalia; 521, pupa; 522, pupa, cocoon; 523, larval damage).

*Roeslerstammia Assectella* Zeller, 1839:203.

*Acrolepia betulella* Curtis, 1838 (1824–1839), no. 679. Herrich-Schäffer, 1851 (1843–1856), pl. 50, fig. 345.

Silvestri, 1943:172–173, figs. 210–211.

Frediani, 1954:187–249, figs. 1–36, pl. 1, detailed morphology of all stages and biology.

Labeyrie, in Balachowsky, 1966:233–249, figs. 105–115, biology.

The onion leaf miner (called the leek moth in England).

Oahu, Hawaii (new record by Klaus Sattler), and probably some of the other islands.

Immigrant. A European species now widely distributed; described from Germany. First recorded in Hawaii in 1944, but it is known to have been established in Honolulu as early as 1939.

Hostplants: onion and related plants.

Parasite: *Chelonus Microchelonus blackburni* (Cameron).

I do not have a detailed account of the moth in Hawaii, but the following information abstracted from Jary and Rolfe, 1945, regarding the species in England may be of interest to workers in Hawaii.

On leeks, the larvae usually work their way toward the middle of the plant and feed between the folded leaves. On onions, they live almost entirely inside the hollow leaves, and there is little evidence of the formation of mines. About three weeks after hatching the caterpillars spin delicate openwork cocoons on

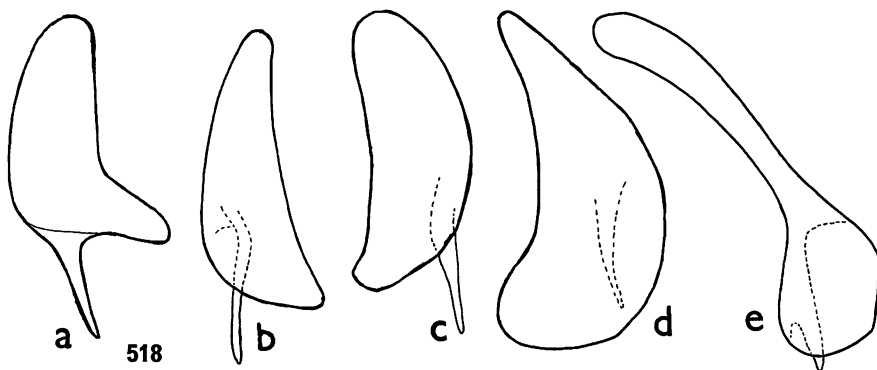


Figure 518—Outline sketches of the male genital valvae of *Acrolepia* species. The setae and setal sockets are omitted. The outlines will vary somewhat according to the way the specimens are oriented in the mounting medium. *a*, *beardsleyi* Zimmerman, holotype; *b*, *aureonigrella* Walsingham, holotype; *c*, *aiea* Swezey, holotype; *d*, *nothoestri* Busck; *e*, *assectella* (Zeller), from a European specimen.

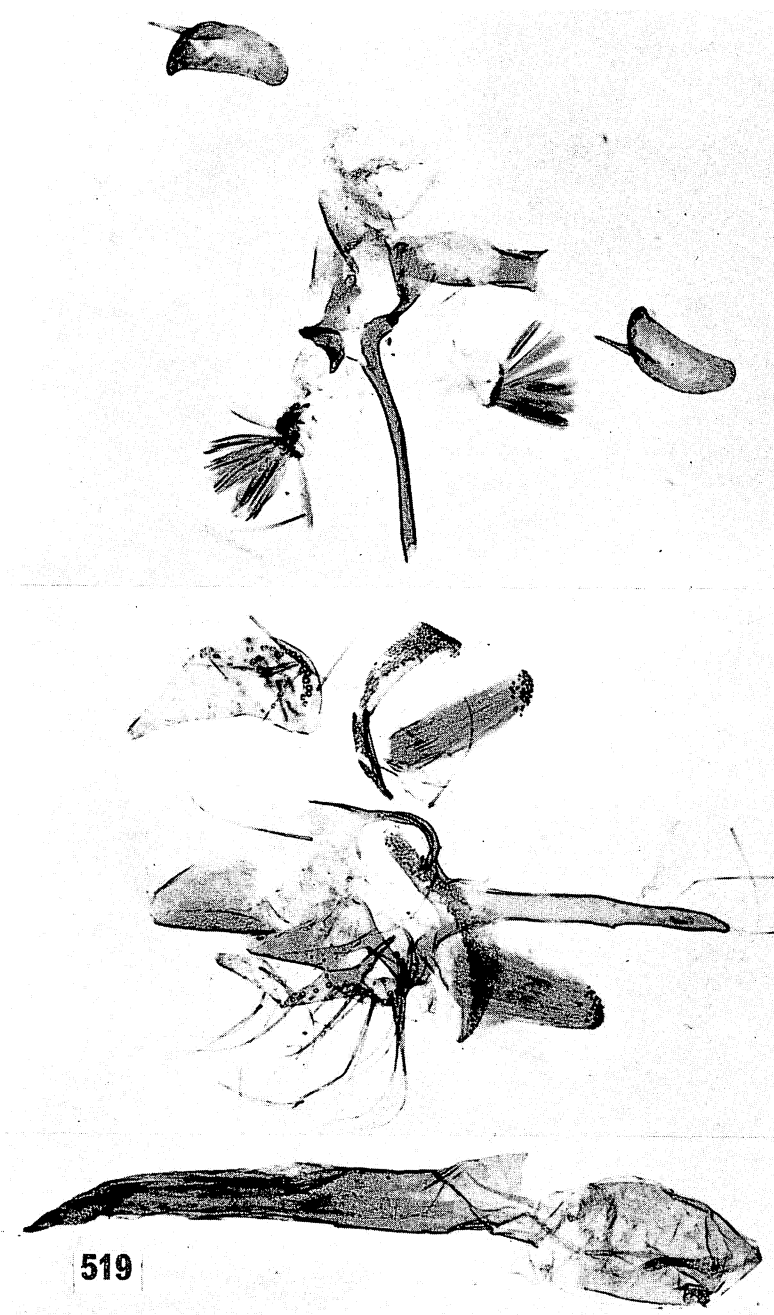


Figure 519—Male genitalia of *Acrolepia*. Top, *aiea* Swezey, holotype (slide Z-I-19-61-1); Kamuwela, Kauai; aedeagus and apex of saccus broken. Middle and bottom, *nothocestri* Busck (slide Z-I-19-61-2); Mt. Olympus, Oahu. Note the scent fans and the differences in the shapes of the isolated valvae.



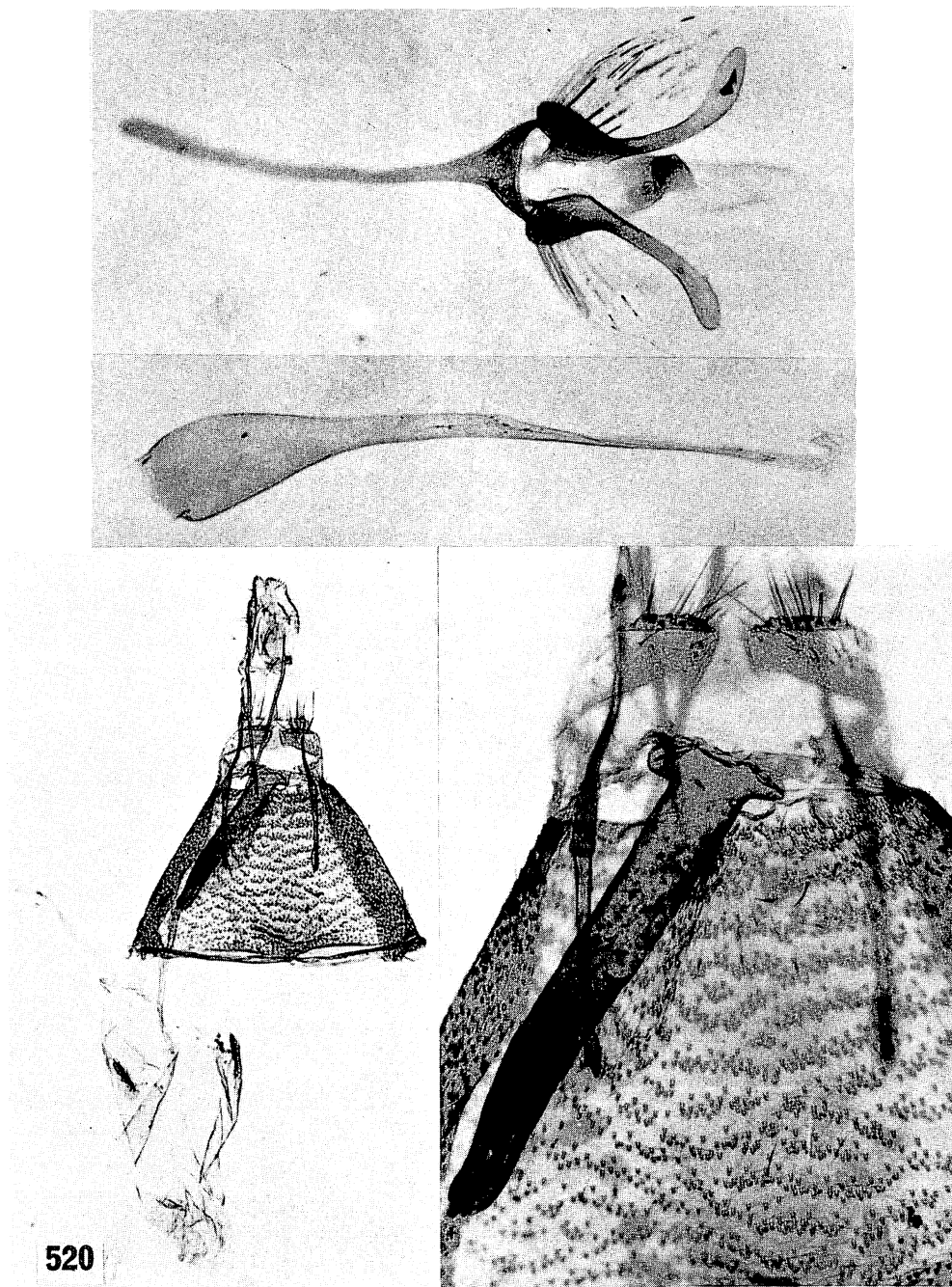


Figure 520—*Acrolepia assectella* (Zeller), male genitalia (BM slide 5191) and female genitalia (BM slide 5138) from French specimens. The dark spots on either side of the bursa copulatrix are signa. The scent fans are longer on this species than they are on the Hawaiian species; compare figure 519.

dead leaves of the hostplant or on other material. The most serious damage occurs on leeks. The young caterpillars bore in from the upper surface of the leaves, forming elongated mines which appear white—the green material having been devoured, only the white upper and lower skins of the leaf remain. As the leaves grow, the mines split open, forming elongated holes, thus giving the plants a very ragged appearance. The larger caterpillars seem to feed chiefly among the folded leaves in the center of the plant and through these they bore in all directions, producing a shot-hole effect which is seen as the leaves unfold. Following the damage done by the caterpillars, extensive rotting often occurs, partly due to secondary attacks by other insects, and the plants may almost completely die away.

In onions, the small caterpillars, after slight mining, usually penetrate near the tips and feed inside the hollow leaves. Holes may be eaten through to the exterior again, but more commonly the areas attacked from inside show as pale spots, somewhat similar to the appearance caused by mildew. Sometimes, as foliage is dying off, the caterpillars bore into the onion bulb near the leaf bases, thus allowing entry of bulb-rotting organisms. Severe injury may be caused to seed heads of onion and leek. Caterpillars bore through the flowering

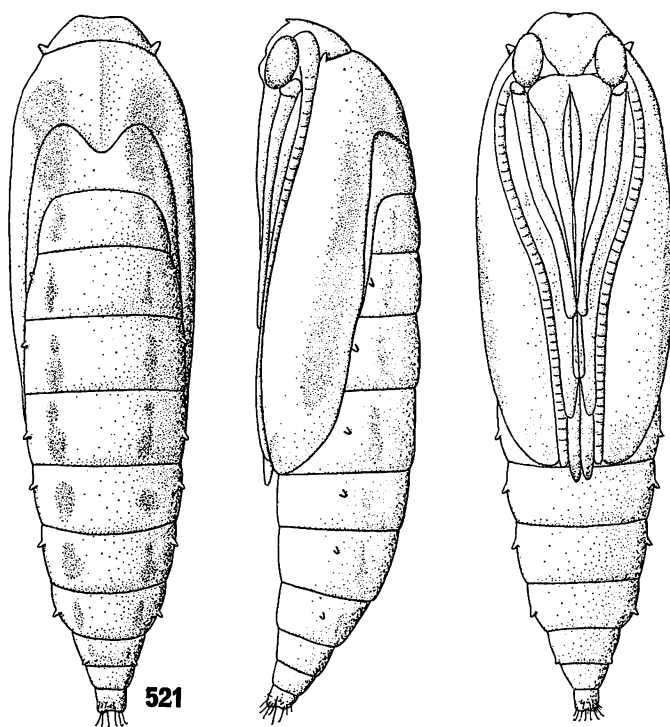


Figure 521—The pupa of *Acrolepia assectella* (Zeller) in dorsal, lateral, and ventral aspects. (After Frediani, 1954.)



shoot, usually near the head, and work upward into the fleshy tip from which the flower stalks arise. Their feeding in this region causes the flower stalks to become loose, so that the whole head, or a large part of it, may fall away. If the flower stalks are lifted and the tip of the stem examined, a quantity of green frass may be seen. This is often the first indication that the caterpillars are feeding within the seed head. The formation of seed may be almost entirely prevented by the attacks of the larvae.

Frediani, 1954, has published a detailed, well-illustrated account of the morphology of the egg, larva, pupa, and adult and an account of its biology and some of its parasites in Italy. See also Labeyrie in Balachowski, 1966:233-249, for a detailed, illustrated, general discussion.

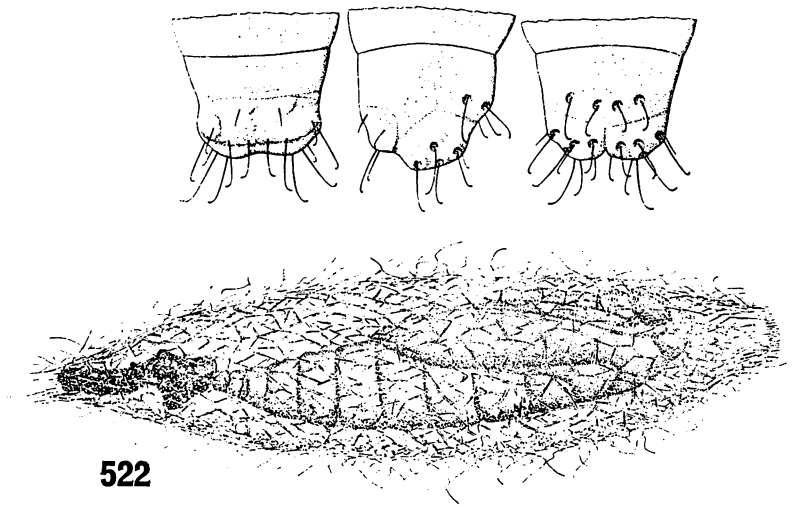


Figure 522—*Acrolepia assectella* (Zeller). Top, dorsal, lateral, and ventral aspect of the apex of a pupa. Bottom, a pupa in its cocoon of silk net. (After Frediani, 1954.)



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Figure 523—A section of a green-onion stem showing evidence of attack by the larvae of *Acrolepia assectella* (Zeller); Honolulu. (University of Hawaii photograph.)

**Acrolepia aureonigrella** Walsingham (figs. 515, moth, male genitalia; 518*b*, male genital valva).

*Acrolepia aureonigrella* Walsingham, 1907*b*:727.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: undetermined, but presumed to be *Nothocestrum*.

This moth is known only from the male holotype in the British Museum. It is one of the very few species included in Walsingham's *Fauna Hawaiiensis* monograph that he did not illustrate.

**Acrolepia beardsleyi** Zimmerman, **new species** (figs. 512, wing venation; 516, moth, male genitalia; 518, *a*, male genital valva; 524, female genitalia; 525, 526, pupa, cocoon).

Male and female. Alar expanse about 9 to 10 mm. Head mostly creamy white with a small patch of black scales rising from the dorsal edge of each

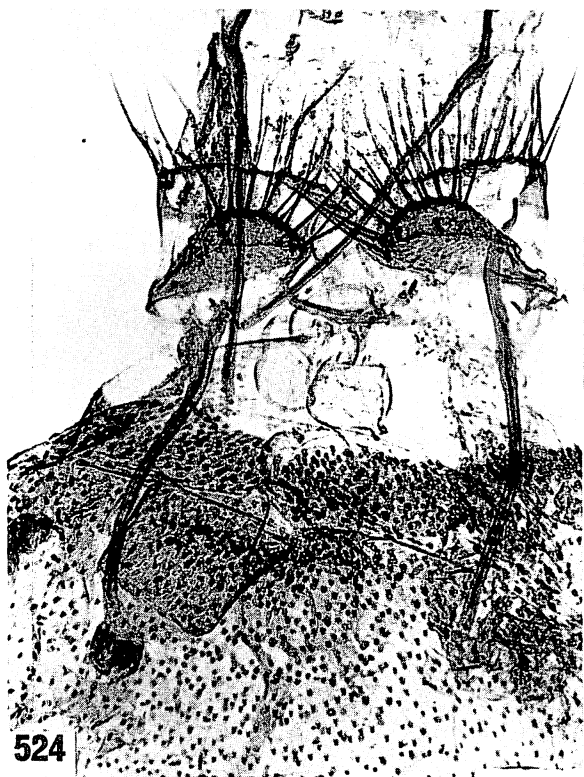


Figure 524—*Acrolepia beardsleyi* Zimmerman, female genitalia; paratype (slide Z-IX-29-65-C); Ulupalakua, Maui.

eye caudad of the ocelli and usually with some dark squamae in front of the antennal insertions. Antennae with first segment white mixed with fuscous to black distad, remaining segments white basad and black distad and forming a strongly developed alternating black and white pattern. Maxillary palpi with a few dark squamae at base of terminal segment. Labial palpi with alternating bands of white and black; basal segment white basad and black distad; middle segment mostly broadly black basad and distad, white at middle and white tipped; terminal segment white at base, middle, and extreme apex with prominent black fasciae between. Thorax mostly creamy white but with variable medio-dorsal infuscation and sometimes with some medial ochraceous squamae; tegulae prominently fuscous basad. Forewings patterned as illustrated, variable and difficult to describe, with a mixture of white, ochraceous, and fuscous to black squamae; the basal almost one-half is mostly white with patches of ochraceous and mostly transverse lines of fuscous, but with the white squamae forming a broad submedial fascia which extends entirely across the wing and with a fuscous or black macula basad of this on costa and another opposite to the costal macula on the posterior margin and a less distinct dark macula near base of costa; distad of the prominent submedial white fascia the background scaling is extensively ochraceous with variable inclusions of white and black with a dominant black costal macula adjoining the white submedial fascia (and opposite this the extent of the black scaling may be variable along the posterior margin of the wing) and with extensive subapical black scaling tending to be arranged in narrow fasciae (or it may be broken into variable

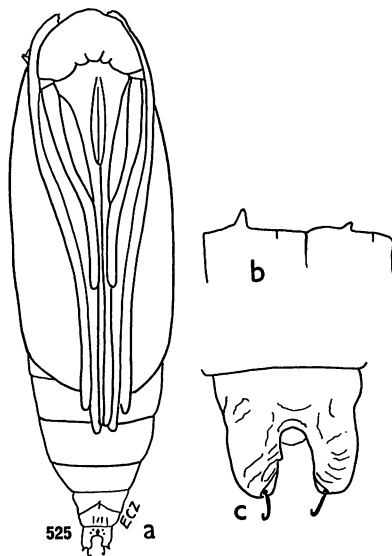


Figure 525—Details of the pupa of *Acrolepia beardsleyi* Zimmerman; paratype; Ulupalakua, Hawaii; ex *Nothoecstrum*. Length 5 mm. *a*, ventral aspect of cast skin; *b*, spiracles of right sides of fifth and sixth abdominal segments as seen from left side; *c*, enlarged view of dorsal aspect of the cauda.

maculae); terminal cilia ochraceous with a few included white maculae; undersides of forewings dark fuscous except caudad of vein 1 where it is noticeably paler where it overlaps the hindwings. Hindwings fuscous over all, including fringes. Abdomen fuscous dorsad with the segments laterad and ventrad fuscous basad and white distad. Legs white and black; externally the coxae and femora of the forelegs are mostly black and the tibiae are black and white; the middle legs have more white on the coxae, femora, and tibiae; the hind legs have the coxae white with fuscous apices, the femora are mostly white with a touch of fuscous at extreme base only and the tibiae are paler



Figure 526—*Acrolepia beadsleyi* Zimmerman. Left, a cocoon; length 5 mm. Right, ventral aspect of a pupal case; length 4 mm. Both specimens from Ulupalakua, Maui, from larvae from mines in leaves of *Nothocestrum*, collected by J. W. Beardsley.

fuscous; all of the tarsi are black strongly annulated with white. Genitalia as illustrated.

Holotype male, allotype female, and three paratypes in Bishop Museum and one paratype in the British Museum (Natural History).

Endemic. Maui (type locality: Ulupalakua).

Hostplant: *Nothocestrum* ("aiea").

The type series was reared from larvae found mining the leaves of the hostplant by J. W. Beardsley who collected them on May 17, 1965. I take pleasure in naming this beautiful little moth after Dr. Beardsley as an expression of thanks for the assistance he has given me during the writing of this text.

This species is much like *aureonigrella* and *aiea*, but the color patterns and the genitalia differ. The cocoon (figured) is made of white to pale brown silk. The pupa (figured) has mostly conical and strongly protuberant spiracles, those of the fifth abdominal segment are especially elongated. The abdomen ends in two heavy protuberances (as figured), each of which bears a single long apical seta and a short ventrolateral thornlike process. The wings extend onto the base of the fifth abdominal sternite, the antennae reach to beyond the middle, the proboscis reaches to the apex and the hind legs extend just over the caudal margin of the fifth abdominal sternite. The pupa lacks dorsal setae or protuberances.

***Acrolepia nothoestri* Busck** (figs. 517, moths; 518*d*, male genital valva; 519, male genitalia; 527, female genitalia).

*Acrolepia nothoestri* Busck, 1914*b*: 106.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Nothocestrum longifolium* ("aiea").

Several specimens of this species were reared from leaf mines by Dr. Swezey over half a century ago. I do not know that it has been collected since. The holotype is in the U.S. National Museum.

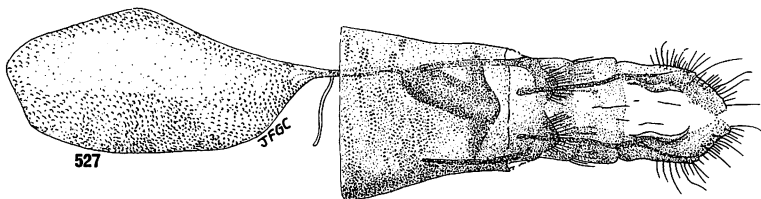


Figure 527—Female genitalia of *Acrolepia nothoestri* Busck, holotype; on a USNM slide.

Family **SCHRECKENSTEINIIDAE** (Fletcher)*Schreckensteiniadae* T. B. Fletcher, 1929:iii.*Schreckensteiniidae*: Kloet and Hincks, 1945:132.

Fletcher erected his “Schreckensteiniadae” as a replacement name for Heliodinidae Heinemann and Wocke, in Heinemann, 1876:518, evidently because he considered *Heliodines* a synonym of *Chrysoesthia*, and in his erroneous opinion *Heliodines* was thus not available for use in forming the family name. Thus, the name Schreckensteiniidae was proposed to include the heliodinids as well as *Schreckensteinia*.

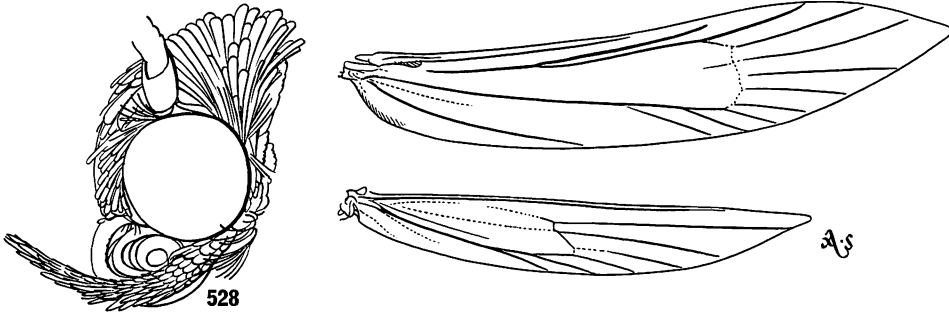


Figure 528—Head and wing venation of *Schreckensteinia festaliella* Hübner (wings on BM slide 14292); European specimens. The frenulum has been broken off.

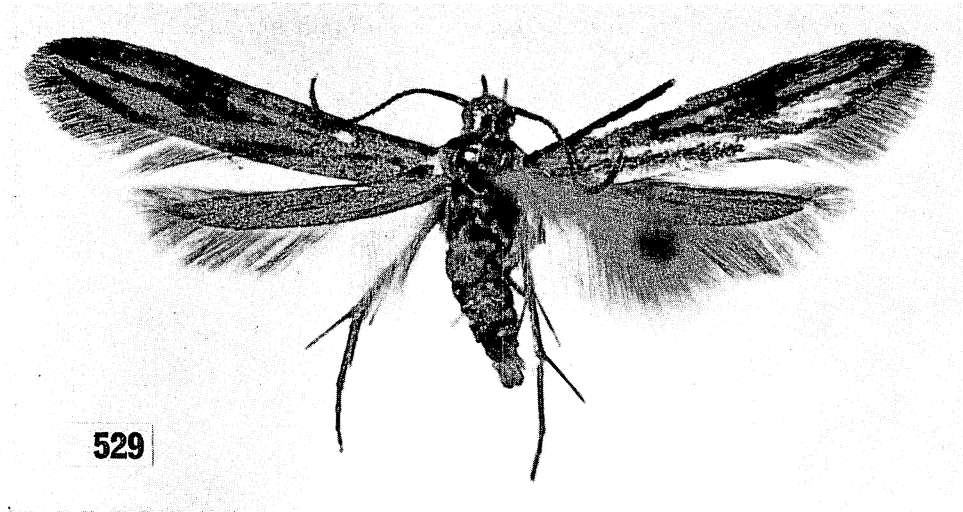


Figure 529—*Schreckensteinia festaliella* Hübner; Danby, New York. There is a pinhole in the left forewing near the curve of the antenna, and the costa of the right forewing is torn. (USNM photograph.)

This family group is represented in Hawaii by a purposely introduced *Schreckensteinia*. The genus has been placed by various authors in the Heliodinidae or Chauliodidae or the Schreckensteiniidae without careful study. It has so many characters in common with the Epermeniidae that it would appear logical to keep it associated with that group where it was placed by Spuler, 1910 (1901–1910):433. However, the European *Epermenia illigerella* and *chaerophyllella* have only two setae in the prespiracular L group on the prothorax, whereas there are three setae on *Schreckensteinia*. Forbes, 1923, and Peterson, 1962 (possibly following Forbes), confusingly state that there are three prothoracic L setae on *Epermenia*. Are the Forbes and Peterson statements based upon an error of observation, or was their material incorrectly identified? Forbes, 1923, fig. 211, illustrates the details of the larva of what he called *Epermenia illigerella*, but his setal map does not agree with English specimens of *illigerella* which I have examined. The two setae of the prothoracic L group is an unusual character in the Microlepidoptera—it is found in the Pyralidae, Carposinidae, and in some Pterophoridae. I consider the family status of *Schreckensteinia* subject to question, and I leave it tentatively assigned to its own family while noting its apparent affinity to the Epermeniidae.

The following combination of characters will serve to separate the single representative of the family now in Hawaii from the other families at present in the fauna: head smooth scaled; ocelli absent; chaetosemata absent; proboscis developed, “naked” (minutely pilose); labial palpi moderate, smooth scaled, rather slender, curved upward, without erect bristles; maxillary palpi rudimentary; antennae shorter than forewings, first segment moderate, lacking a pecten. Wing shape and venation as illustrated. Hind tibiae with numerous, suberect, stiff, dorsal spines, an apical whorl of stiff spines and with protruding apical spines on basal tarsal segments; hind legs held obliquely elevated when at rest. Genitalia as illustrated. The “spiny” larvae feed externally on leaves, and the cocoon is an open network of silken mesh typical of the yponomeutoids.

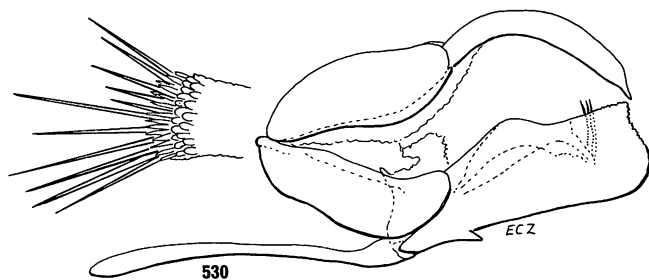


Figure 530—*Schreckensteinia festaliella* Hübner. Left, apex of a left metatibia, dorsal view to illustrate the stiff bristles. Right, a sketch of the male genitalia from the left side; setae and aedeagus omitted; southern Mendocino County, California (BM slide 14289).

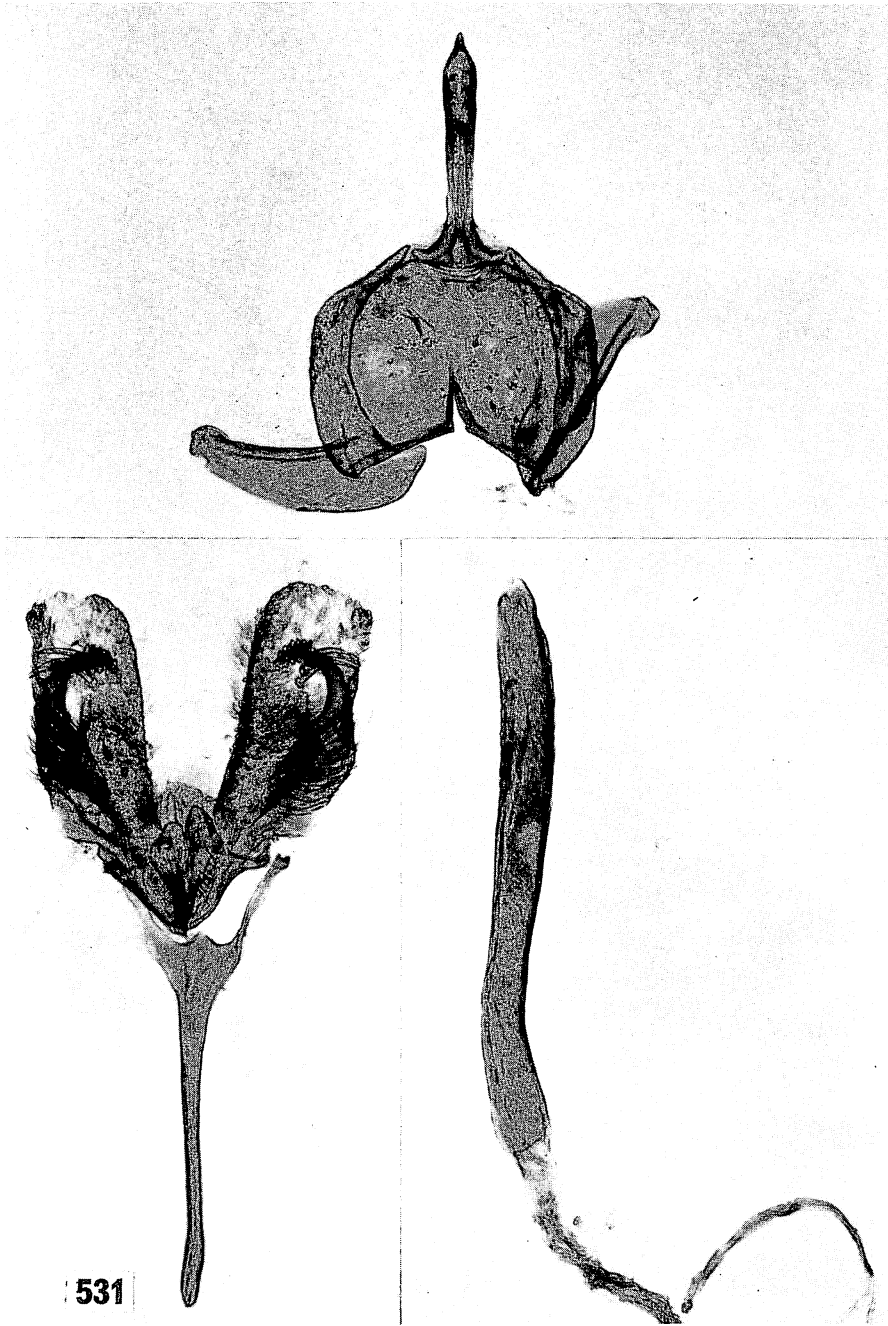
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Figure 531—*Schreckensteinia festaliella* Hübner, male genitalia. Top, tegumen and uncus; bottom left, saccus and valvae; right, aedeagus; southern Mendocino County, California (BM slide 14289).





Figure 532—*Schreckensteinia festaliella* Hübner. Top, female genitalia (ends of apophyses broken off); right, ostium. Bottom, abdominal pelt; southern Mendocino County, California (BM slide 14290).



Figure 533—*Schreckensteinia festaliella* Hübner. Top, a moth on a blackberry flower (numerous adults are attracted to the flowers). Bottom, blackberry leaves damaged by the larvae. Kokee, Kauai. (Photographs by C. J. Davis.)

Genus **SCHRECKENSTEINIA** Hübner

*Schreckensteinia* Hübner, 1825 (1816–1826):419.

*Chrysocorys* Curtis, 1833:191.

Type-species (for both generic names): *Schreckensteinia festaliella* Hübner.

This is a genus of few species endemic to North and South America. The species introduced to Hawaii apparently was accidentally imported to Europe at an early date, and it is now widespread there. It is possible, however, that it may be a Holarctic species with a very wide natural distribution.

In his diagnosis in *Genera Insectorum*, Meyrick (1914:25) erroneously stated that the ocelli are present in this genus.

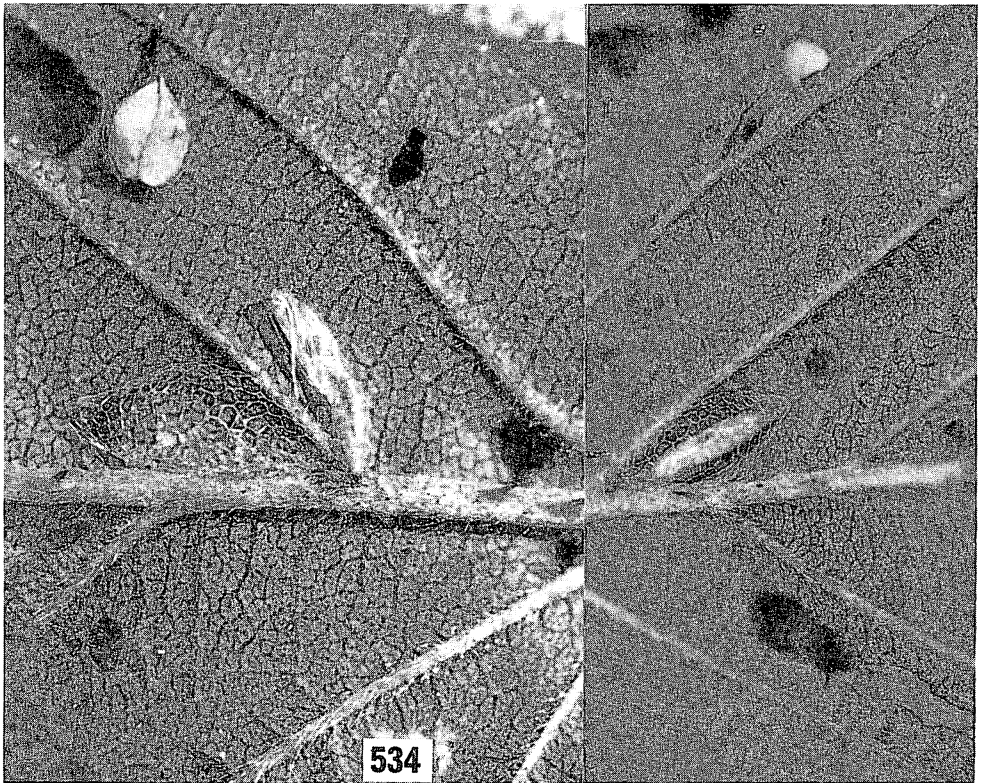


Figure 534—*Schreckensteinia festaliella* Hübner. Left, net cocoon and pupal case; right, pupa within its net cocoon; on blackberry leaves; Kokee, Kauai. (Photographs by C. J. Davis.)

**Schreckensteinia festaliella** Hübner (figs. 528, head, wing venation; 529, moth; 530, leg, male genitalia; 531, male genitalia; 532, female genitalia, abdomen; 533, moth, larval damage; 534, pupa, cocoon; 535, larva; 536, pupa).

*Schreckensteinia festaliella* Hübner, 1818–1819, pl. 67, fig. 449.

*Chrysocorys festaliella* (Hübner) Curtis, 1833:191.

*Tinea (Metallicae) scissella* Haworth, 1828(1803–1828):580.

*Elachista montandonella* Duponchel, 1838:553, pl. 309, fig. 11.

The blackberry skeletonizer.

Kauai, Maui, Hawaii.

Purposely introduced from Santa Barbara, California. Widely dispersed in the United States and in Europe. The Hawaiian Department of Agriculture introduced the moth in 1963 to assist in the control of foreign blackberries which have become weed pests. Davis and Krauss (1965:89) reported it established at Kokee, Kauai, in February, 1964, and at Olinda, Maui, in July, 1964. It was first released on Maui in October, 1963, on Kauai in November, 1963, and on Hawaii in August, 1966.

Hostplant: *Rubus* species (blackberries).

The eggs stand erect on the host. The very distinctive larvae are mostly green with brownish heads, and they feed on the undersides of the leaves and skeletonize them. Their most distinctive character is their peculiar dorsal setae which have expanded apices, and the D1 and D2 setae on each side of the abdominal tergites arise from a common pinaculum as in figure 535.

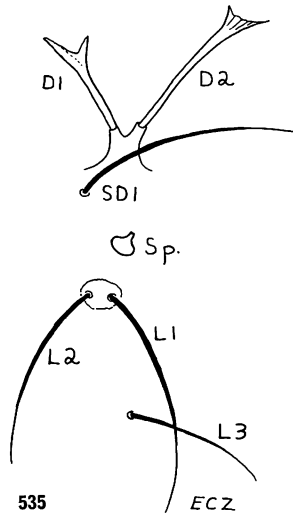


Figure 535—*Schreckensteinia festaliella* Hübner. Dorsal, subdorsal, and lateral setae and the spiracle of the sixth abdominal segment of the larva, left aspect; Waiakamoi, Maui, ex blackberry. No other moth larva now known in the Hawaiian fauna has such dorsal setae—they are immediately diagnostic of this species.

No other larvae now in the Hawaiian fauna has such setae. The pupa, enclosed in a beautiful silken network cocoon, is as in figures 534 and 536. Noteworthy are the protuberant spiracles, exposed labial palpi, exposed profemora, the apically widely separated antennae, the thorn-like processes on some of the abdominal tergites, and the strong dorsal setae (some of which are hooked as are those on the sternites).

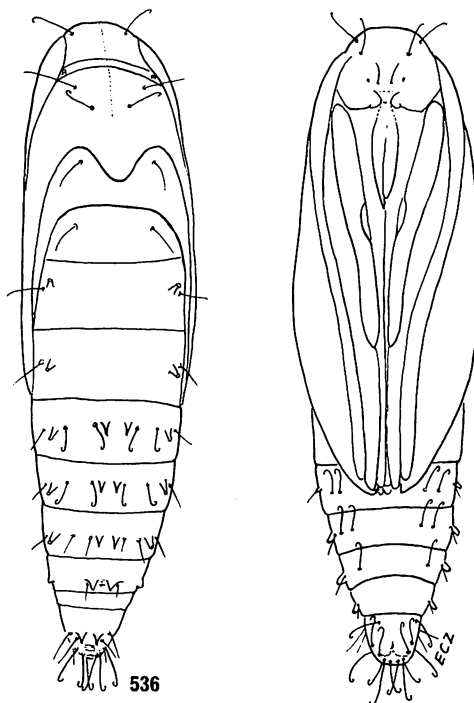


Figure 536—*Schreckensteinia festaliella* Hübner. Dorsal and ventral aspects of a pupa; Waiakamoi, Maui; length 5 mm.

## Superfamily **ALUCITOIDEA** (Linnaeus)

*Alucitae* Linnaeus, 1758:496, in part. Scopoli, 1763:256, in part.

*Alucitides* Leach, 1815:135, in part.

*Carposinoidea* Diakonoff, 1961:124. D. R. Davis, 1969:1.

*Copromorphoidea* Meyrick, 1928d:599. Common, 1970:826.

It appears unusual that lepidopterists have for so long failed to associate the families of this group, and I agree with Meyrick, 1928d:25, 599, and Common, 1970:826, who place them together. The Copromorphidae have many characters in common with the carposinids which they closely resemble. In the hindwing, vein 5 is absent in the carposinids but present in the copromorphids. The deeply cleft-winged species of Alucitidae, however, seem at first far removed, but when one studies them in detail, taking note of the fact that the larvae are closely similar to those of the other families, and ignoring for a while the distraction of the cleft wings, one must agree with the association. One also gathers a different impression when one examines the few known species of Alucitidae that do not have deeply cleft wings.

As noted in more detail below, the larvae of the Alucitoidea can be separated from the Tortricioidea, Tineoidea, Yponomeutoidea (except, so far as I now know, some of the unusual and confusing Epermeniidae which have only two prespiracular setae on the prothorax instead of the normal three setae), and the Gelechioidea because they have only two L setae in the prespiracular group on the prothorax and which character they share with the Pyraloidea and some of the Pterophoroidea.

The proboscis of true pyralids is squamose. The Pterophoridae, however, have a so-called "naked" proboscis (minutely pilose and not squamose) as do the Thyrididae, which do not occur in Hawaii. Although presently associated with the pyralids, these families are not correctly placed. In contrast to the typical pyralids, the Alucitoidea have naked proboscides and they lack the abdominal tympana of the pyralids. The maxillary palpi are greatly reduced or obsolete in most species, but some species of Alucitidae have moderately developed maxillary palpi. Such genera as the shallowly cleft-winged *Hexeretmis* Meyrick from South America and *Triscaedecia* Hampson from Ceylon have well-developed or large maxillary palpi. Chaetosemata are absent. None of the Hawaiian species have ocelli, but ocelli are present on many, but not all, species of Alucitidae. Ocelli are well developed on the shallowly cleft-winged genera *Hexeretmis* and *Triscaedecia* mentioned above. One or two veins are usually lost from the hindwings.

The carposinids and copromorphids have cubital or cubital and anal vein "pectens" of long hair on the hindwings, and many of the species have patches of raised scales on the forewings. Although most of the fully split-winged species of Alucitidae do not display easily distinguishable cubital hair "pectens" on the hindwings, or evidently lack them, some do have modified "pectens". *Triscaedecia*, the shallowly cleft-winged genus from Ceylon, and an unidentified Brazilian genus, which also has nearly entire wings, have well-developed "pectens". I have not seen any Alucitidae with the kind of raised scale patches of the forewings that are present on the Carposinidae and some Copromorphidae.

Three families are now included in the Alucitoidea: Carposinidae, Copromorphidae, and Alucitidae. Of these, only the Carposinidae are represented in the endemic Hawaiian fauna, and one evidently foreign species of Alucitidae appears to have been accidentally introduced.

Family **CARPOSINIDAE** Walsingham

*Tortricidae* subfamily *Carposinae* Walsingham, 1897a:59.

*Carposinidae*: Walsingham, 1907b:654. Meyrick, 1882a; 1910c:142, redescription, key to Australian genera; 1913d:13, catalog; 1922b, *Genera Insectorum*, key to genera. Diakonoff, 1954a:118, key to genera. Hannemann, 1964. D. R. Davis, 1969, American revision.

Included in *Depressariinae* of the *Gelechiidae* by Spuler, 1898a:30.

This is a peculiar family. Its members were long associated with the *Gelechiidae* until they were referred to the tortricoids. The moths have certain features that recall the pyraloids, tineoids, gelechioids, and tortricoids. The status of the family has always been enigmatical. Meyrick differed considerably over the years in his opinion regarding the position and relationships of the family, and in 1922b:1-2, he said: "The group is so clearly delimited by structural characters (especially the peculiar neurcation of the hindwings) and usually by aspect, that no difficulty arises in recognizing it; the difficulty is rather to ascertain to what it is most allied, since there is no obvious affinity to any other existing form. *Carposina* was regarded by European entomologists for 30 years as an abnormal member of the *Gelechiadae*, but this is untenable. In 1881, having become acquainted with some of the Australian forms, I referred the group to the *Tortricina*, which is certainly so far correct. It

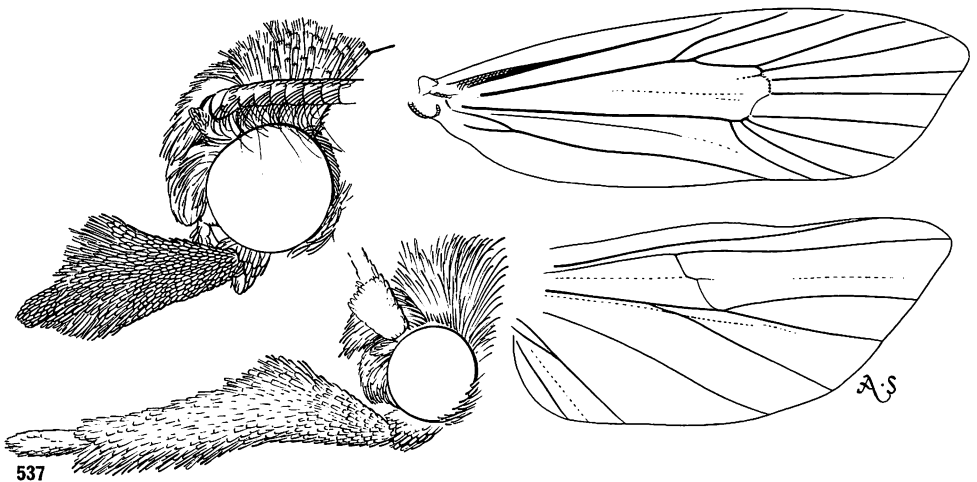


Figure 537—Heads and wing venation of *Carposina olivaceonitens* (Walsingham). Top left, head of the male holotype. The other head and the wings are from the female allotype. Kauai, 3,000 to 4,000 feet, Kauai (BM slide 5028). There is considerable variation in the development of the labial palpi in the Hawaiian *Carposina*, and not all species are similar to this species. Note the great sexual difference demonstrated here.

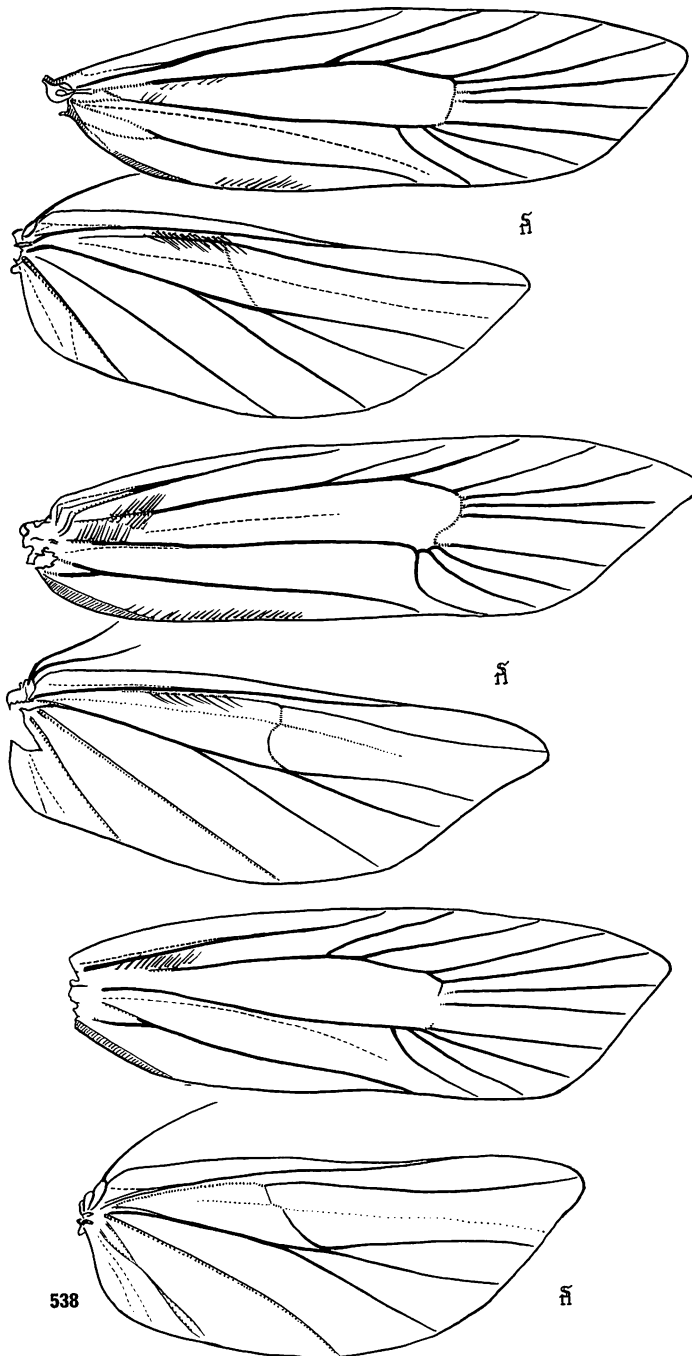


Figure 538—Wing venations of *Carposina*. Top, *divaricata* (Walsingham), paratype (BM slide 14311); Kauai, 3,000 to 4,000 feet. Middle, *gracillima* (Walsingham), paratype (BM slide 14310); Kaholuamano, 4,000 feet, Kauai. Bottom, *nigromaculata* (Walsingham) (BM slide 14312); northwest Koolau Mts., Oahu.



approaches the *Phaloniadae* somewhat in form and more particularly in neuration of forewings, and also in the internal feeding habits of the larvae, but differs widely in neuration of hindwings. . . .” In 1927<sub>c</sub>, in his *Insects of Samoa* report, Meyrick separated the Carposinidae widely from the tortricids and placed them after the cosmopterigids which are gelechioid. In the revised edition of his British “Handbook”, 1928<sub>d</sub>:25, 599, he demonstrated their

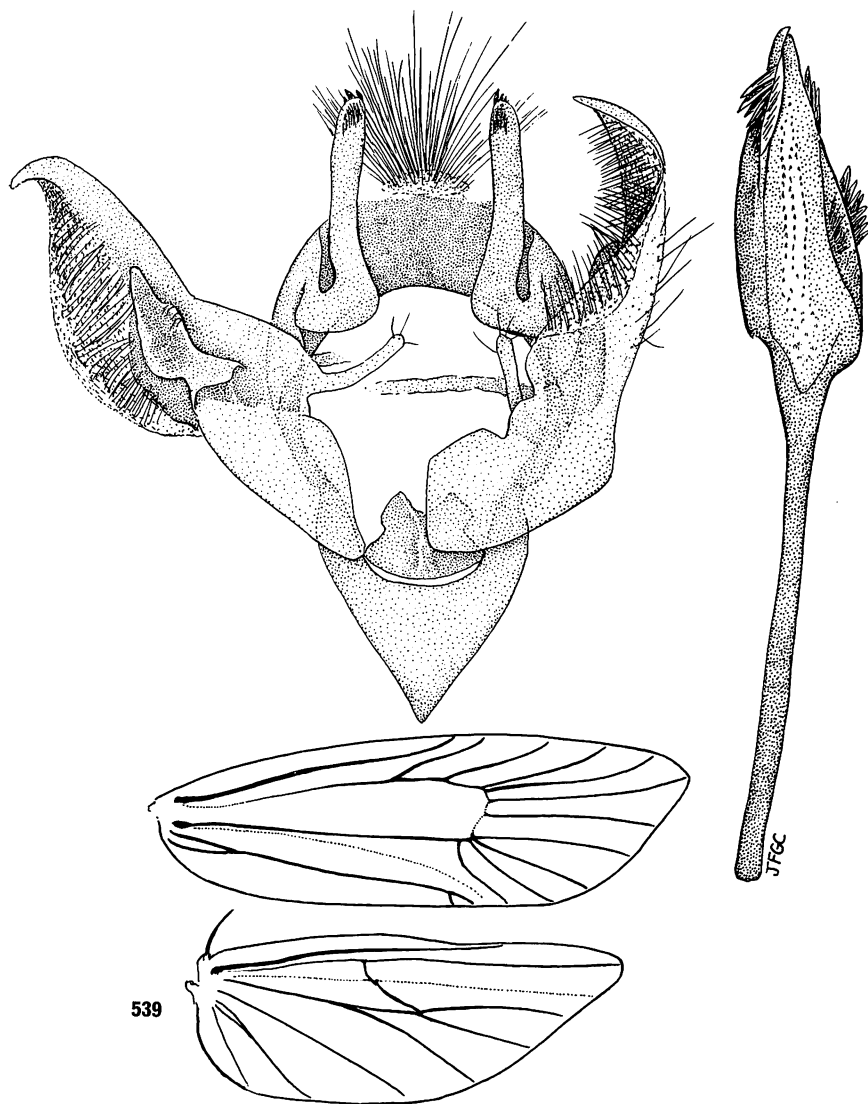


Figure 539—Male genitalia and wing venation of *Carposina berberidella* Herrich-Schäffer, the type-species of *Carposina*. See also figure 558.

affinity with the Copromorphidae and Alucitidae. But, as has been pointed out to me by Ian Common, his comments seem generally to have been overlooked.

In 1907:34, Busck said that *Carposina* "belongs to a very abnormal group of the subfamily Phaloniidae. . . ." In 1908a:135, he suggested that the group should be elevated to family rank, but Walsingham had already done this in *Fauna Hawaiiensis* in 1907b:654.

In 1954a:115, Diakonoff said, "This family forms a natural and very distinct group, and stands isolated. In consequence of the last mentioned fact it has been subject to frequent rearrangements in the system, and was moved back and forth between the groups 'Tortricina' and 'Tineina'. It seems advisable for the time being to let it keep an intermediate position between these two groups." In 1961:124, Diakonoff said that the "Carposinidae. . . for a long time has been tossed to and [fro] between the *Tortricoidea* and the *Gelechioidea*. It represents a very old group and its similarity with the two above mentioned superfamilies must be purely superficial. Such great differences as a decadent

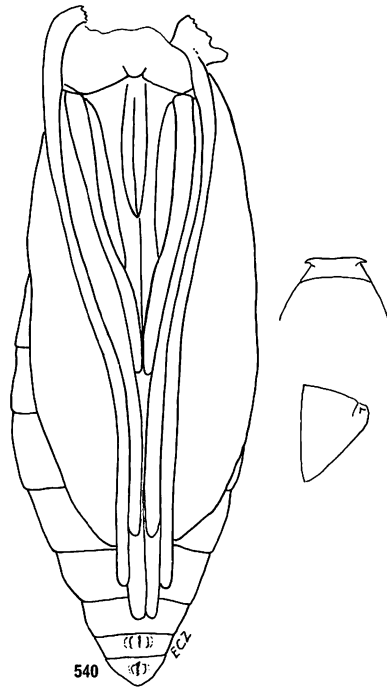


Figure 540—Details of *Carposina* pupae. Left, ventral aspect of a cast, shriveled skin of a specimen determined by Dr. Swezey as *graminicolor* (Walsingham); Kilauea, Hawaii, ex *Osmanthus* fruits; length 6 mm. Right, dorsal and lateral aspects of the cauda of a specimen determined by Swezey as *subumbrata* (Walsingham) collected at "Hillebrand's Glen". The cauda is similar to that of the specimen used for the figure at the left.

and constant neuration of the hind wing, without vein 6, the most peculiar genitalia in the two sexes, with a unique aedeagus and often well developed tineoid saccus (which is an archaic character), and the presence of only two setae on the praestigmal prothoracic shield of the larva show that the group basically differs from both the leafrollers and the *Gelechioidea*. I now propose a new superfamily, *Carposinoidea*, for this family."

D. R. Davis, in his 1969 revision of the American fauna, followed Diakonoff in using Carposinoidea. Common, in his 1970 work on the Australian fauna, followed Meyrick's 1928d use of Copromorphoidea.

Perhaps we may fairly conclude that the carposinids have not yet been adequately studied and that more parts of their anatomy should be investigated. But, of course, this criticism may be directed at the classification of the Lepidoptera in general. The minutely pilose (naked) vestiture of the proboscis agrees with the tineoids, tortricoids, yponomeutoids, pterophoroids, and alucitoids and contrasts sharply with the squamose proboscis of the gelechioids and pyraloids. The vestiture of the lower part of the face differs significantly from the tortricids, because the squamae are directed ventrad as they are in the gelechioids (and most moths) whereas all of the tortricids which I have seen have the squamae of the face directed dorsad. Some tineoids also have dorsally directed vestiture on the face. I have studied the pupa of *Carposina*, and it is very different from that of the tortricoids. It lacks the typical dorsal abdominal spines of the tortricoids and tineoids. None of the Hawaiian larvae has been illustrated or described. Forbes, 1923:514, gives a setal map of the larva of an American species of *Carposina*. The known larvae of the Carposinidae may be separated easily from those of the Tortricidae and most other Microlepidoptera as follows:

1. Prespiracular L setal group on prothorax with only two setae. . . . . **Carposinidae.**
2. Prespiracular L group of setae on prothorax with three setae. . . . . **Tortricidae.**

The moths of the Hawaiian species resemble *Scoparia* and *Eudonia* (= *Eudoria*) in facies, and some Hawaiian species may be confused with Hawaiian *Eudonia* if examined superficially. (NOTE: In my Volume 8 on the Hawaiian Pyraloidea, I used *Scoparia* in the wide sense for what should best be segregated as *Eudonia*.) The adults of *Carposina* often rest on tree trunks much as do those of *Eudonia*, and they are often collected together. Some Hawaiian species parallel the color patterns of our *Eudonia* in an interesting way, and *Hypomocoma* in the Cosmopteriginae is also involved in the color pattern complex.

The moths have characteristic patches or conspicuous tufts of raised scales on the forewings which vary in development between the species. Ocelli and chaetosemata are absent. The proboscis is minutely pubescent and *not* squamose. The labial palpi are sexually dimorphic and are usually much longer in the females than in the males. Maxillary palpi are absent. The hindwings of the Hawaiian species have only six veins, because veins 5 and 6 are missing, and there is a variably developed fringe of long hairs along the basal part of the posterior margin of the cell and a more strongly developed brush of long

hairs along the basal part of vein 1b. The cilia on the undersides of the antennae of the males are very long and fine. The shaggy antennae thus contrast sharply with the plain antennae of the females. The hairy antennae and the usually much shorter palpi of the males are characters that render easy the separation of the sexes of *Carposina*.

The Carposinidae is a small family—when Meyrick treated them in *Genera Insectorum* in 1922*b*, he listed only eight genera and 128 species then known in the world. It is obvious from a cursory examination that the classification of the family is in a poor state, and little reliance can be placed on the supposed geographical distribution of the genera as they are now constituted. Most of the species, however, occur in Indo-Pacific regions. Only a few species are known from North and South America (see D. R. Davis, 1969), and only one genus, *Carposina*, is recorded from Europe and Africa. The most diversified contemporary fauna appears to be in Australia, and the group is extensively developed from southeast Asia to Australia.

Some species of extra-Hawaiian Carposinidae are of economic importance. Some are pests of soft fruits such as apples, pears, plums, and peaches and also of berries and roses. *Heterocrossa adreptella* (Walker) is known in New Zealand as “the raspberry bud moth”, and its larvae mine the shoots and unopened buds of raspberry and blackberry.

#### Genus **CARPOSINA** Herrich-Schäffer

*Carposina* Herrich-Schäffer, 1855 (1843–1856):38. Type-species: *Carposina berberidella* Herrich-Schäffer (southeast Europe to Asia Minor). Fernald, 1908:34, type designation. Busck, 1907:34, expanded description. Meyrick, 1922*b*, in *Genera Insectorum*. (Figure 539, 558, wing venation, male genitalia.)

See color plate 4, figures 1–5.

*Heterocrossa* Meyrick, 1882*b*:178, has wrongly been used for the Hawaiian species of *Carposina*. It was described to include *Epischnia neurophorella* Meyrick, from Australia, *Paramorpha adreptella* (Walker) Meyrick, and *Heterocrossa gonosemana* Meyrick from New Zealand. Meyrick did not designate a type-species for his genus, but Walsingham, 1907*b*:654, designated *Gelechia adreptella* Walker as the type-species (see my figure 557). In *Genera Insectorum* (1922*b*:5), Meyrick listed *Enopa* Walker (1866:1738, type-species *Enopa medilla* Walker, Australia), *Oistophora* Meyrick (1881*c*:699, with the same type-species) and *Heterocrossa* as synonyms of *Carposina*. I do not believe that *Enopa* and *Heterocrossa* are synonyms of *Carposina* because their genitalia are distinctive. *Heterocrossa* has a New Zealand species as its type, and it would appear that *Heterocrossa* may be used for the New Zealand species that agree with its type species, unless it can be demonstrated that *Heterocrossa* is a synonym of some other genus. Philpott (1928*c*:477) published a key and illustrations of 10 of the New Zealand species. *Heterocrossa* (see my figure 557) and *Enopa* have a long, slender, and well-developed uncus, and I consider the genitalia generically distinct from *Carposina*. The genitalia of *Paramorpha* represent another group allied to *Heterocrossa* and *Enopa*. *Paramorpha* also has a well-developed uncus, although it is shorter than in typical *Heterocrossa* and *Enopa*.

The Hawaiian and Australia–New Zealand species of Carposinidae have had different ancestral origins and are not closely allied. The source of the Hawaiian *Carposina* is unknown, but I believe that it is Boreal.

There are, as I recognize them here, 39 described, and many undescribed, *Carposina* species in Hawaii. Although the genus is also listed as occurring in Australia, New Zealand, Indonesia, Malaya, Japan, India, Asia Minor, southeast Europe, Africa, Madagascar, Madeira, North, Central, and South America, the Hawaiian assemblage is the largest known concentration of species in any one region. In *Genera Insectorum*, Meyrick listed 87 species known in the world in 1922 and of these 37 were Hawaiian. These data are meaningless, however, because Meyrick combined *Enopa* and *Heterocrossa* with *Carposina*. It should not be assumed that all of the extra-Hawaiian species now listed in *Carposina* are correctly placed in that genus. There are only four species of *Carposina* recorded from America north of Mexico. Diakonoff listed only one species in New Guinea in 1954a: 138. Some of the Hawaiian *Carposina* agree closely with the type-species of *Carposina* in genitalia and in wing venation. (Compare figures 539 and 558 of *berberidella*, the type species, with 538 and 558 of *divaricata* and the Hawaiian *achroana*, for example.)

*Carposina* is a wonderful group in Hawaii, and it deserves extended, concentrated, careful study. It has received comparatively little attention in Hawaii, and considerable confusion exists in literature and in the identification of specimens in collections. The material available for examination has been inadequate for the purposes of this introductory study. Many of the specimens seen are in poor condition, and some, including types, have lost their abdomens. Several species are known from only one sex. Many of the specimens were very fat when collected, and the body oil, which has come to the body surfaces, tends to spoil the appearance of some specimens in collections. Many species contain green scaling. Because green tends to fade, many of the descriptive notes of color made from old specimens may be misleading when compared with fresh material.

Walsingham listed 33 species and 2 “varieties” in *Fauna Hawaiiensis* in 1907b. I treat the supposed varieties as species here, thus making 35 listed in *Fauna Hawaiiensis*. I believe, however, that several of the names are synonyms, but I have not had an opportunity to prove the synonymy. Since 1907, when *Fauna Hawaiiensis* was issued, only five species have been added to the Hawaiian list, and they were all described by Meyrick in 1913c. I have seen several new species, and I believe that it is possible that there may be 100 or more species in Hawaii.

I regret most deeply that I have not been given the opportunity to study this genus with the care which it deserves. A completely new revisionary study, with adequate, fresh material at hand, is urgently needed. Many of my illustrations are inadequate, and it has often been impossible to obtain good photographs from the limited material available for study. Some of the old specimens were attacked by mold or were partly decomposed before drying, and it is impossible to make good microscope preparations from such material. Because of the complexity of the genitalia, various parts should have been drawn separately during the dissection processes. I leave this fascinating group in an unsatisfactory condition.

The genitalia of many of the species display excellent specific differences, as the accompanying illustrations demonstrate. The genitalia show that several species groups have evolved in Hawaii, and these may indicate potential origins of new genera.

It is difficult to make photogenic preparations of many of the male genitalia, and more than one microscope slide preparation should be made of each species where necessary and possible. It is often difficult to spread the genitalia for proper display of the parts, and sometimes it is necessary to cut the genitalia open or to tear them to display many of their characters. Figure 558 of *achroana* shows a satisfactory preparation with most of the structures displayed adequately. An examination of the other figures will show that many of the dissections and mounts are inadequate for our purposes, and they should have been remounted.

In the male genitalia the uncus is obsolete, but it appears to be represented by a small protuberance in some species. Socii appear to be absent. The gnathus arms (or what is called the gnathus) range in development from rudimentary to long and conspicuous. The anellus lobes differ between the species as do the shapes and armature of the valvae. The saccus ranges from very short to long and attenuated. The aedeagus is unusual and unlike that of any other Hawaiian genus.

The ostium of the female displays a variety of forms. The bursa copulatrix usually bears a pair of characteristic, two-pronged signa, as illustrated. No signa were found in some species such as *gemmata*. The signa are within the caudal third of the bursa in most species, but in some they are near the middle, and in others they are at the cephalic end of the bursa. The spermatophore is a very long, wire-like structure which may be as long as the entire bursa copulatrix and its ductus. Considerable difficulty was encountered in making microscope slide preparations of some of the females because their abdomens had been decomposed.

In his "Introduction" to *Fauna Hawaiiensis* Perkins said (1913:clxvii):

Thirty-three species of the genus *Heterocrossa* have been described, and doubtless many others remain to be discovered. The species appear to be often variable and very difficult to separate, a difficulty which will be much increased by the discovery of new forms. The moths are often very numerous, being attracted by light or disturbed from amongst foliage, especially that of the Ohia tree. They are also commonly found at rest on tree-trunks, and once, when sheltering from a heavy rain storm, I remember noticing half-a-dozen examples all close together on a single stem of a tree-fern, none of these individuals much resembling one another, and perhaps each formed a distinct species . . . The caterpillars attack many kinds of fruit of forest trees and shrubs, e.g. of *Clermontia* and other Lobeliaceae, of *Vaccinium*, *Eugenia*, *Pittosporum*, *Mahoe* [*Alectryon*], *Sideroxylon* [*Planchonella*] and, doubtless, many others. Others live in buds, e.g. those of *Metrosideros*. These caterpillars are sought after by the wasps of the genus *Odynerus*, and as many as three dozen have been found in a single cell. They are also obtained by the native birds, while the moths themselves are often caught and devoured by the 'Elepaio' (*Chasiempis*) and by some of the Drepanididae, especially by those belonging to the genus *Oreomyza*.

## DISTRIBUTION OF THE HAWAIIAN CARPOSINA

If the species are listed by type locality only, the following is the result:

Kauai . . . . .	11	Maui . . . . .	4
Oahu . . . . .	7	Lanai . . . . .	3
Molokai . . . . .	5	Hawaii . . . . .	9

No species has yet been found on the Leeward Islands, and no specimens have been collected from great areas of the main islands. I have seen no record of the capture of any species on the vast, high bulk of West Maui where there must be many species. As recorded here, the known distribution of the described species among the main islands is as in the lists given below.

In the following lists, where no type locality indication follows the name, the type locality is the island under which the species is listed. Where the type locality is an island other than the island heading a list, the type locality island is indicated by the word "type" in parentheses after the appropriate island name. These lists demonstrate the supposed distribution as it has been recorded, but they also reveal our ignorance. There are probably several errors represented in the lists, and various uncertain distributions are noted by question marks.

Kauai (13 species)

*cervinella* (Walsingham)  
*corticella* (Walsingham)  
*distincta* (Walsingham)  
*divaricata* (Walsingham)  
*gracillima* (Walsingham), Oahu, Molokai, Maui (type), Hawaii  
*graminicolor* (Walsingham), Oahu, Hawaii  
*graminis* (Walsingham)  
*olivaceonitens* (Walsingham), Oahu, Maui, Hawaii  
*piperatella* (Walsingham)  
*plumbeonitida* (Walsingham), Hawaii?  
*semitogata* (Walsingham)  
*tincta* (Walsingham)?, Lanai?, Hawaii (type)  
*viridis* (Walsingham), Oahu

Oahu (16 species)

*benigna* Meyrick  
*crinifera* (Walsingham)?, Molokai (type)  
*gemmata* (Walsingham)?, Hawaii (type)  
*glauca* Meyrick  
*gracillima* (Walsingham), Kauai, Molokai, Maui (type), Hawaii  
*graminicolor* (Walsingham), Kauai (type), Hawaii  
*herbarum* (Walsingham)?, Lanai (type), Hawaii?  
*lacerata* Meyrick  
*nigromaculata* (Walsingham)  
*nigronotata* (Walsingham)?, Hawaii (type)  
*olivaceonitens* (Walsingham), Kauai (type), Maui, Hawaii  
*pusilla* (Walsingham)  
*saurates* Meyrick  
*solutella* (Walsingham)?, Hawaii (type)  
*subumbrata* (Walsingham)  
*viridis* (Walsingham)?, Kauai (type)

## Molokai (6 species)

- bicincta* (Walsingham)
- crinifera* (Walsingham), Oahu?
- ferruginea* (Walsingham)
- gracillima* (Walsingham), Kauai, Oahu, Maui (type), Hawaii
- punctulata* (Walsingham)
- trigononotata* (Walsingham), Maui

## Maui (6 species)

- atronotata* (Walsingham), Oahu, Hawaii
- gracillima* (Walsingham), Kauai, Oahu, Molokai, Hawaii
- mauii* (Walsingham)
- olivaceonitens* (Walsingham), Kauai (type), Oahu, Hawaii
- togata* (Walsingham)
- trigononotata* (Walsingham), Molokai (type)

## Lanai (4 species)

- herbarum* (Walsingham), Oahu?, Hawaii?
- irrorata* (Walsingham)
- subolivacea* (Walsingham)
- tincta* (Walsingham)?, Kauai?, Hawaii (type)

## Hawaii (14 species)

- achroana* (Meyrick)
- dispar* (Walsingham)
- gemmata* (Walsingham), Oahu?
- gracillima* (Walsingham), Kauai, Oahu, Molokai, Maui (type)
- graminicolor* (Walsingham), Kauai (type), Oahu
- herbarum* (Walsingham)?, Oahu?, Lanai (type)
- inscripta* (Walsingham)
- latifasciata* (Walsingham)
- nigronotata* (Walsingham), Oahu?
- olivaceonitens* (Walsingham), Kauai (type), Oahu, Maui
- plumbeonitida* (Walsingham), Kauai (type)
- pygmaeella* (Walsingham)
- solutella* (Walsingham), Oahu?
- tincta* (Walsingham), Kauai?, Lanai?

**HOSTPLANTS AND HABITS OF THE LARVAE OF CARPOSINA**

The hostplants of less than half of the described species of *Carposina* are known. Most of the known larvae feed upon berries and fruits, but some feed upon leaves, some are leaf miners, some are stem borers or stem gall formers, and some feed upon terminal buds.

The following is a summary of the families and genera of the known hostplants in Hawaii together with the parts of the plants attacked by the larvae (when known):



Saxifragaceae: *Broussaisia* (fruit clusters)  
 Pittosporaceae: *Pittosporum*  
 Sapindaceae: *Alectryon*  
 Rhamnaceae: *Alphitonia* (seeds)  
 Tiliaceae: *Elaeocarpus* (fruits)  
 Myrtaceae: *Metrosideros*, *Eugenia*, *Syzygium* (terminal buds)  
 Ericaceae: *Vaccinium* (leaves and berries)  
 Epacridaceae: *Styphelia* (berries)  
 Myrsinaceae: *Myrsine* (berries)  
 Sapotaceae: *Pouteria* (flowers, buds, fruits)  
 Oleaceae: *Osmanthus* (fruits)  
 Gesneriaceae: *Cyrtandra* (stem borer)  
 Rubiaceae: *Bohea* (terminal buds), *Hedyotis* (fruit capsules), *Plectronia* (fruits)  
 Campanulaceae: *Clermontia* (buds, flowers, fruits), *Cyanea* (stem borer, leaf miner, buds, fruits)  
 Goodeniaceae: *Scaevola* (stem galls)

[As this proof was being read, Dr. Sattler wrote to say that a large species has been reared from *Pritchardia* palm fruits on Hawaii. This is the first record of a species from a monocot.]

No key to the species of *Carposina* has been made, and it has been an almost impossible task to identify specimens of the genus. Many incorrect determinations have been made. I regret most deeply that I have not had an opportunity to construct a key. The illustrations presented here, especially those of the genitalia, will give major assistance to those who wish to identify species in this group. A detailed key is most urgently required, however.

In addition to the characters displayed by various parts of the male and female genitalia other characters which may be useful in constructing a key to the species include: the color patterns of the moths; their sizes, which range from 6 to 26 mm.; the size, shape, and proportions of the labial palpal segments; the nature of the vestiture on the undersides of the forewings (see *gemma* for example); the scale tuft development; unusual scales on the forewing of such species as *herbarum*; the presence or absence and extent of curled scales on the forewings (these are revealed best when viewed with the light coming from the end of the wing). There appear to be good characters in the venation, and I regret that I have been unable to descale and to draw the wings of every species.

The larva of *Carposina* has the frons extending dorsad only about half the distance to the vertical triangle or to the level of the P1 setae. Each mandible has three acute and one obtuse tooth. The prothorax has the L1 and L2 setae in a subvertical line (the L3 setae are obsolete). The pronotal shield has no secondary setae. On abdominal segments one to seven the D1 setae are shorter than the D2 setae and only slightly closer together than the D2 and are very small on segment eight. SD1 is directly above the spiracle on abdominal segments 1 to 7 and is above and in front of the spiracle on segment 8. L1 and L2 are on the same pinaculum, directly below the spiracle, and L2 is much shorter than L1; L3 is farther from L1 than L1 is from the spiracle. Spiracles are small and are not protuberant. The prolegs have uniordinal crochets.

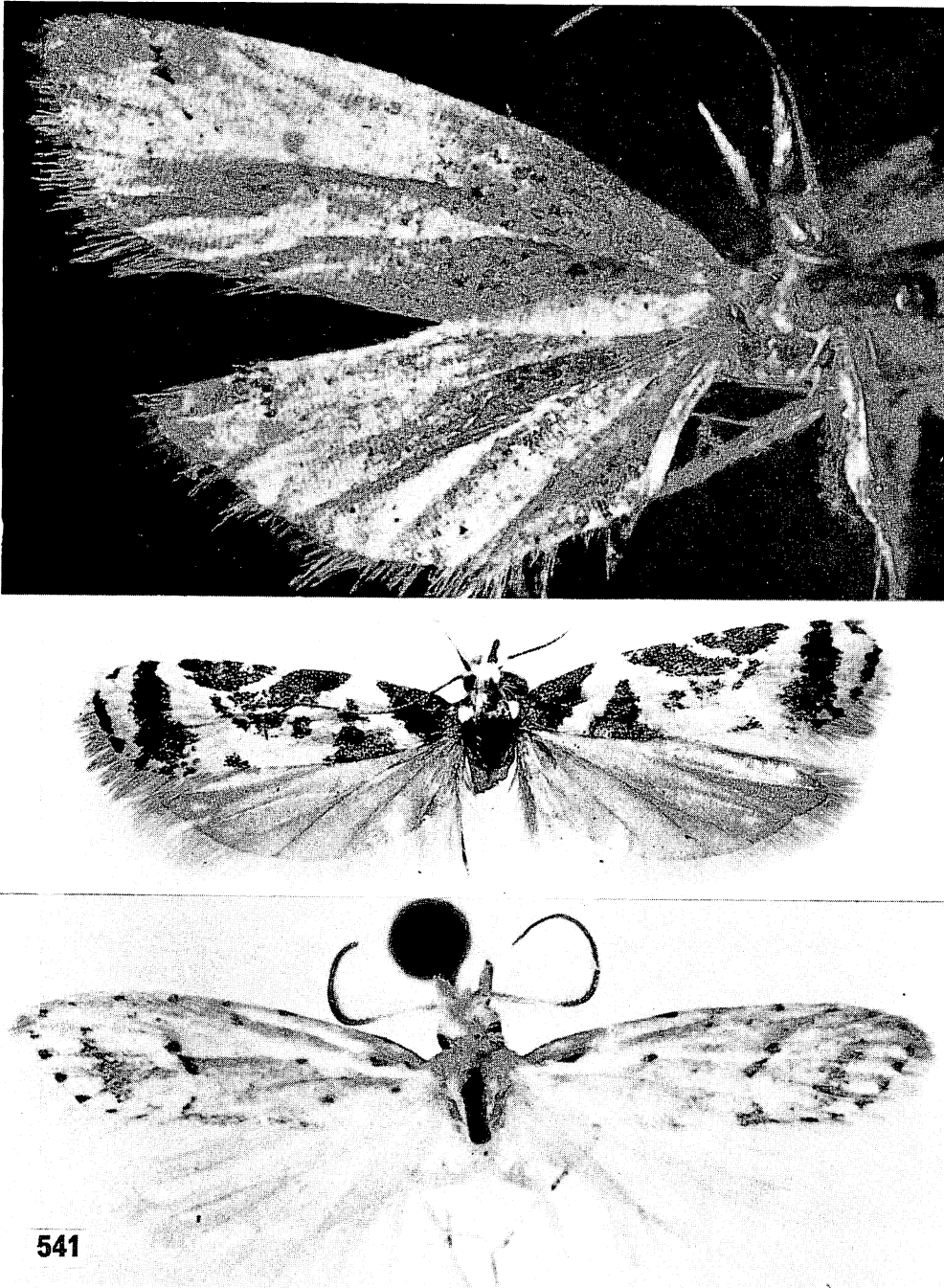


Figure 541—*Carposina*. Top, *achroana* (Meyrick), holotype female (BM slide 1840); Hawaii, Blackburn, 1899; forewing 8 mm., pale straw-colored and white with a few yellow and fuscous flecks. Middle, *atronotata* (Walsingham), holotype female (BM slide 1863); Haleakala, 10,000 feet, Maui; expanse 18 mm.; forewings white and fuscous. This specimen is figured in *Fauna Hawaiiensis*. Bottom, *benigna* (Meyrick), lectotype male (BM slide 9535 Clarke); Koolau Mts., Oahu; expanse 13 mm.; forewings white and yellow with fuscous maculae.

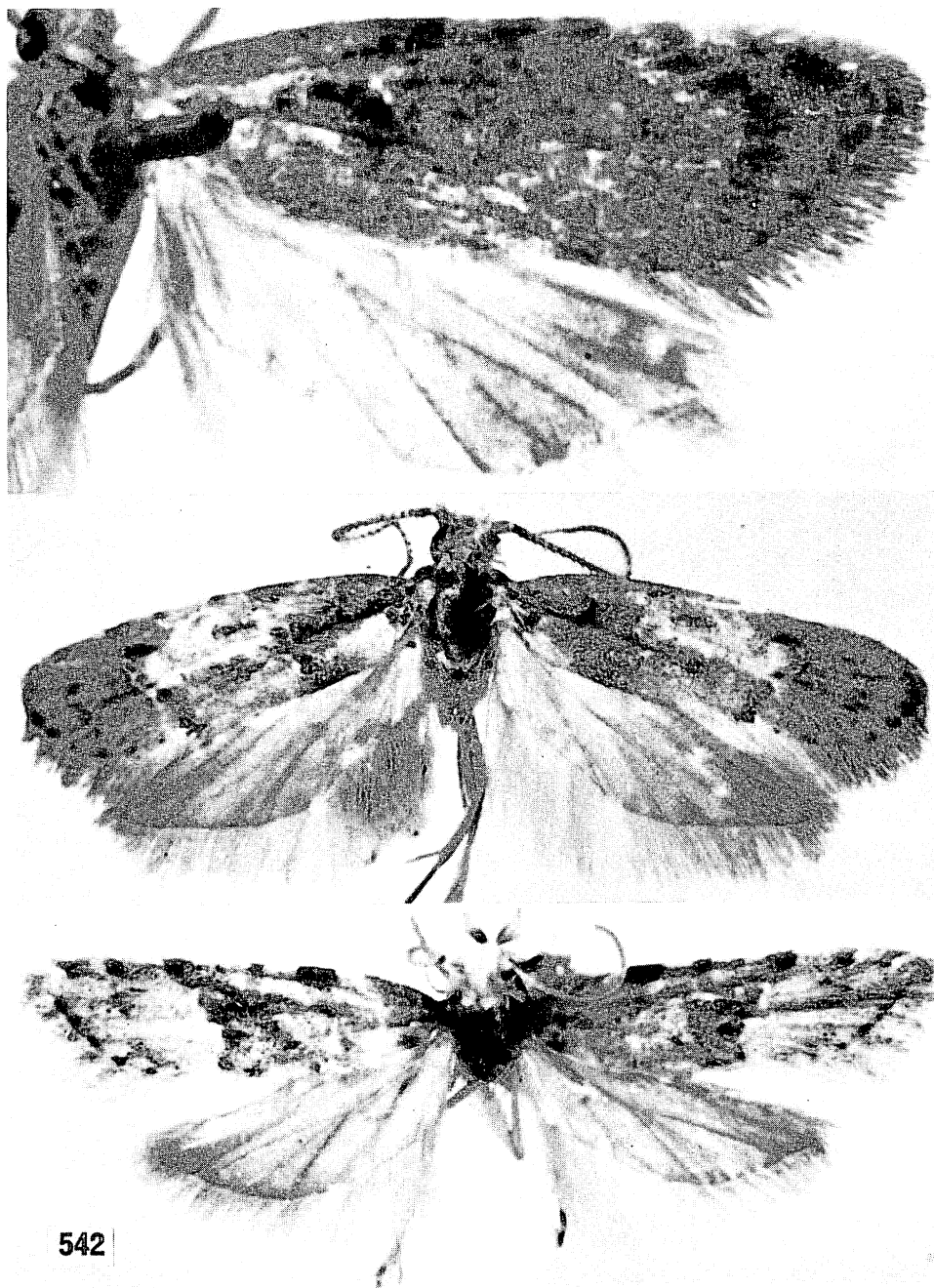


Figure 542—*Carposina*. Top, *bicincta* (Walsingham), holotype female (BM slide 7544); Molokai, about 4,000 feet; forewing 7 mm., brownish fuscous interspersed with white. Middle, *cervinella* (Walsingham), holotype male (BM slide 3876); Kaholuamano, Kauai; expanse 11.5 mm.; forewings flavous with a white or cream discal area and fuscous maculae. Bottom, *crinifera* (Walsingham), holotype male (BM slide 3880); Molokai, above 3,000 feet; expanse 14 mm.; forewings with white and greenish background with some yellow and with fuscous maculae. Each of these specimens was used for the illustrations in *Fauna Hawaiiensis*.

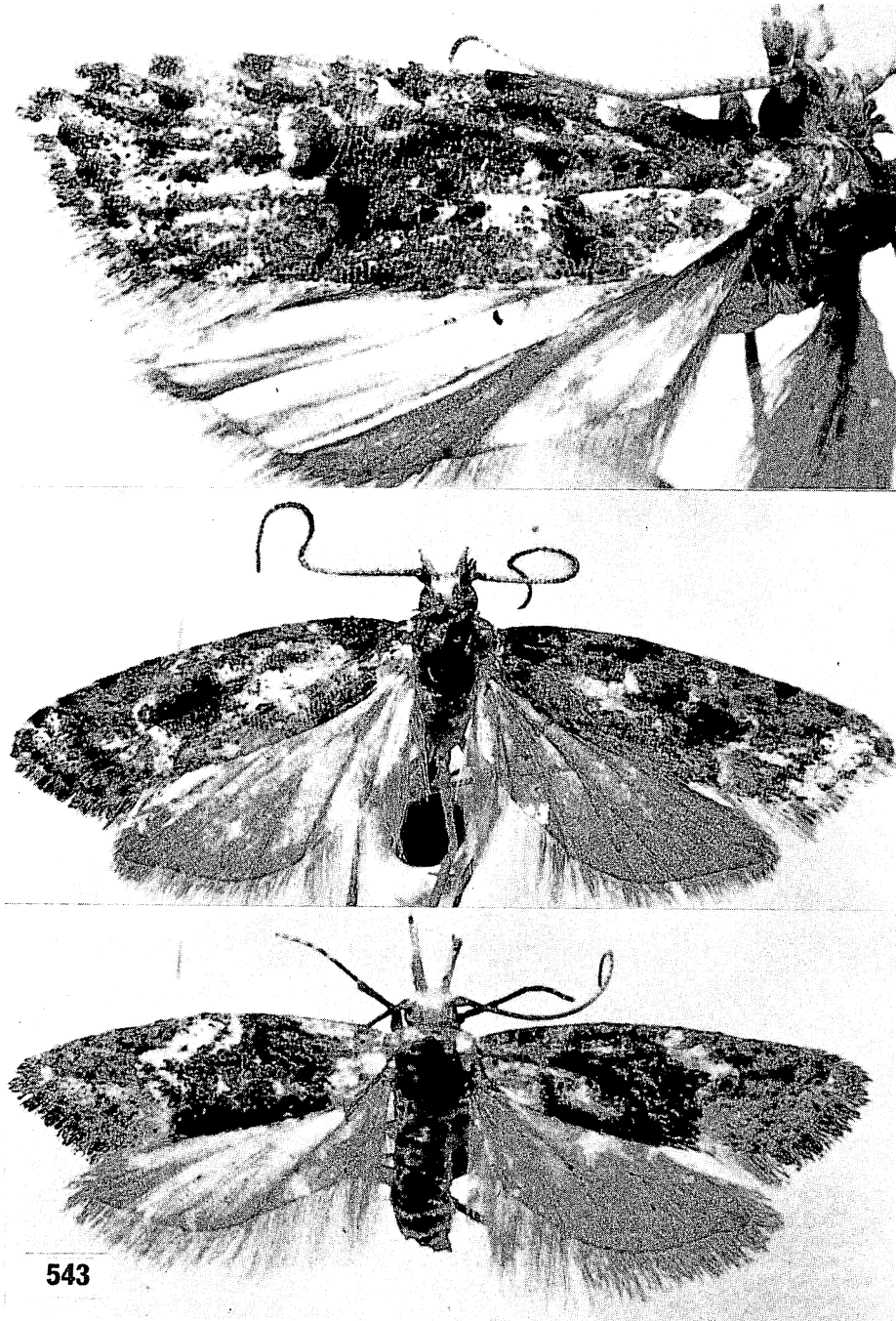


Figure 543—*Carposina*. Top, *corticella* (Walsingham), holotype male (BM slide 3877); forewing 9 mm., mostly yellowish fuscous with yellow and white areas and fuscous maculae. Middle, *piperatella* (Walsingham), allotype male (BM slide 3878); Kaholuamano, 4,000 feet, Kauai; expanse 14 mm.; forewings white and brownish with fuscous maculae. Bottom, *semitogata* (Walsingham), holotype female (BM slide 7543); expanse 13 mm.; forewings white with mostly fuscous maculae but with some yellow as well. The top and bottom specimens were used for the *Fauna Hawaiiensis* illustrations.

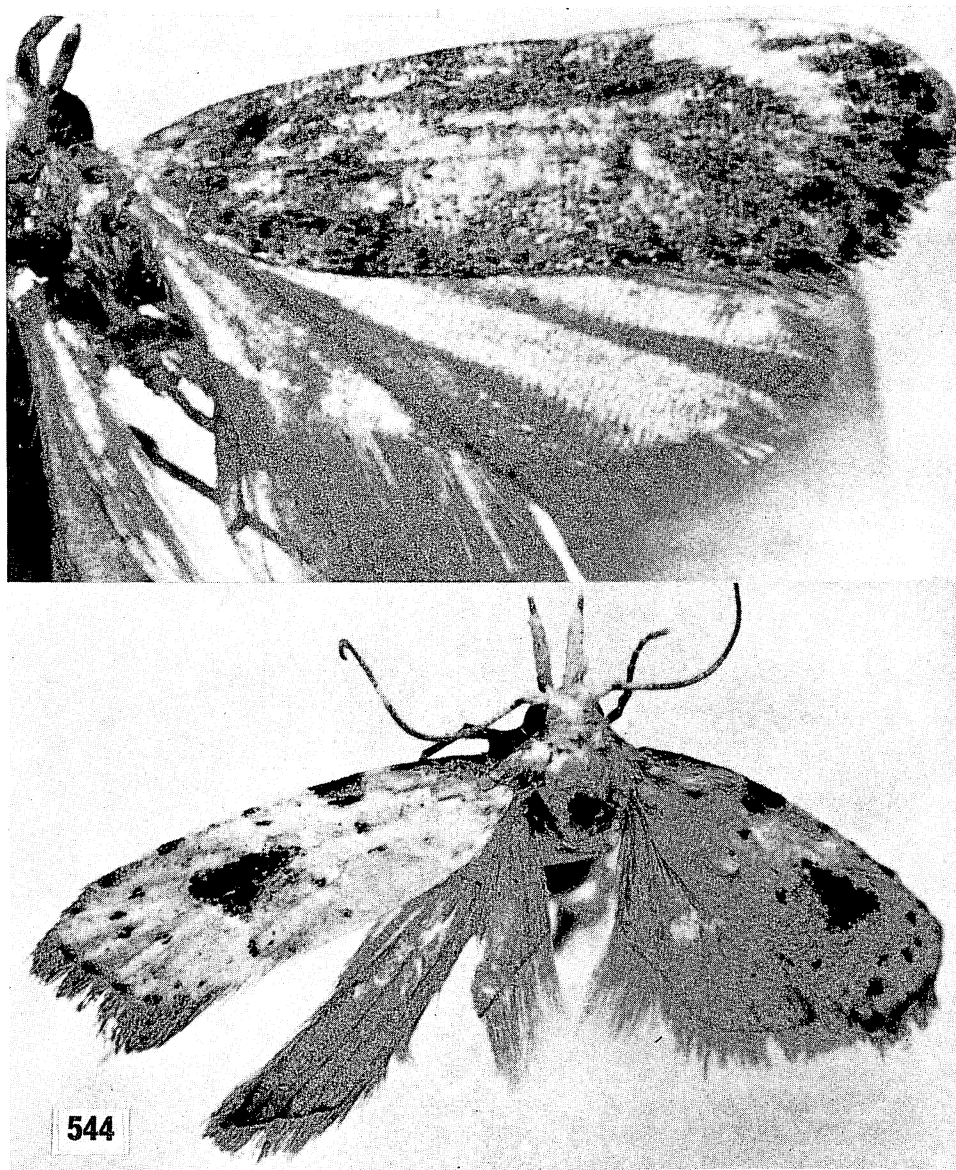


Figure 544—*Carposina*. Top, *dispar* (Walsingham), allotype male (BM slide 3881); forewing 4.75 mm., partly abraded, brownish fuscous with mostly scattered yellow squamae and a prominent oblique white macula from the costa. Bottom, *distincta* (Walsingham), holotype female (BM slide 3884); forewing 7.5 mm., cream- or straw-colored with some butter-yellow and with fuscous maculae. This specimen is figured in *Fauna Hawaïensis*.

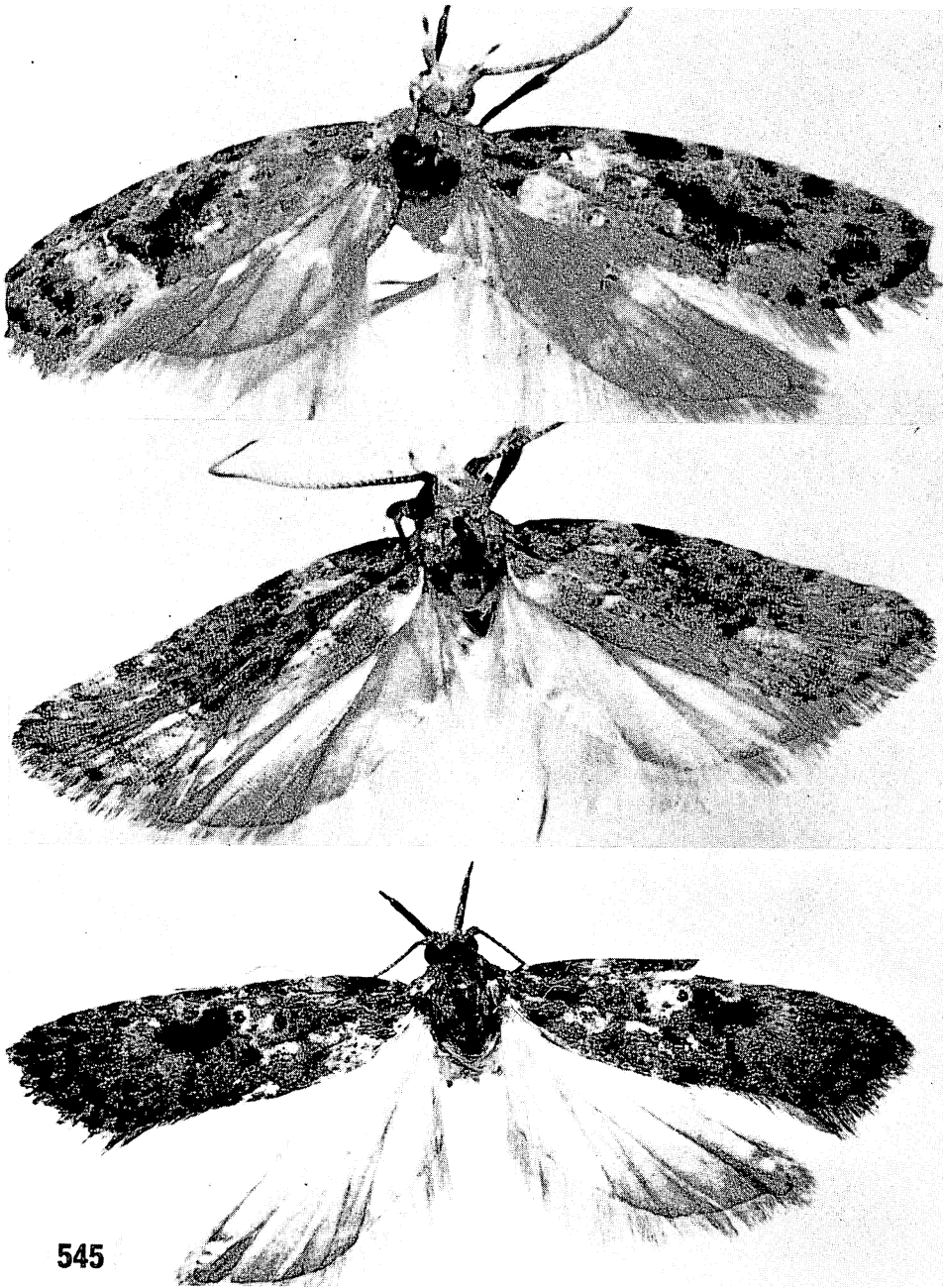


Figure 545—*Carposina*. Top, *divaricata* (Walsingham), holotype male (BM slide 3882); expanse 12 mm.; forewings yellow and brownish fulvous with some olive and with fuscous maculae. Middle, *ferruginea* (Walsingham), holotype male (BM slide 3883); Molokai, about 5,000 feet; expanse 17 mm.; forewings yellow with brownish fuscous and white maculae. Bottom, *gemma* (Walsingham), female paratype; abdomen lost; Oloa, Hawaii; expanse 22 mm.; forewing has fulvous, yellowish, and greenish background scaling with fuscous maculae and with mostly yellowish scale tufts with some white squamae. The top and middle specimens are illustrated in *Fauna Hawaiiensis*.



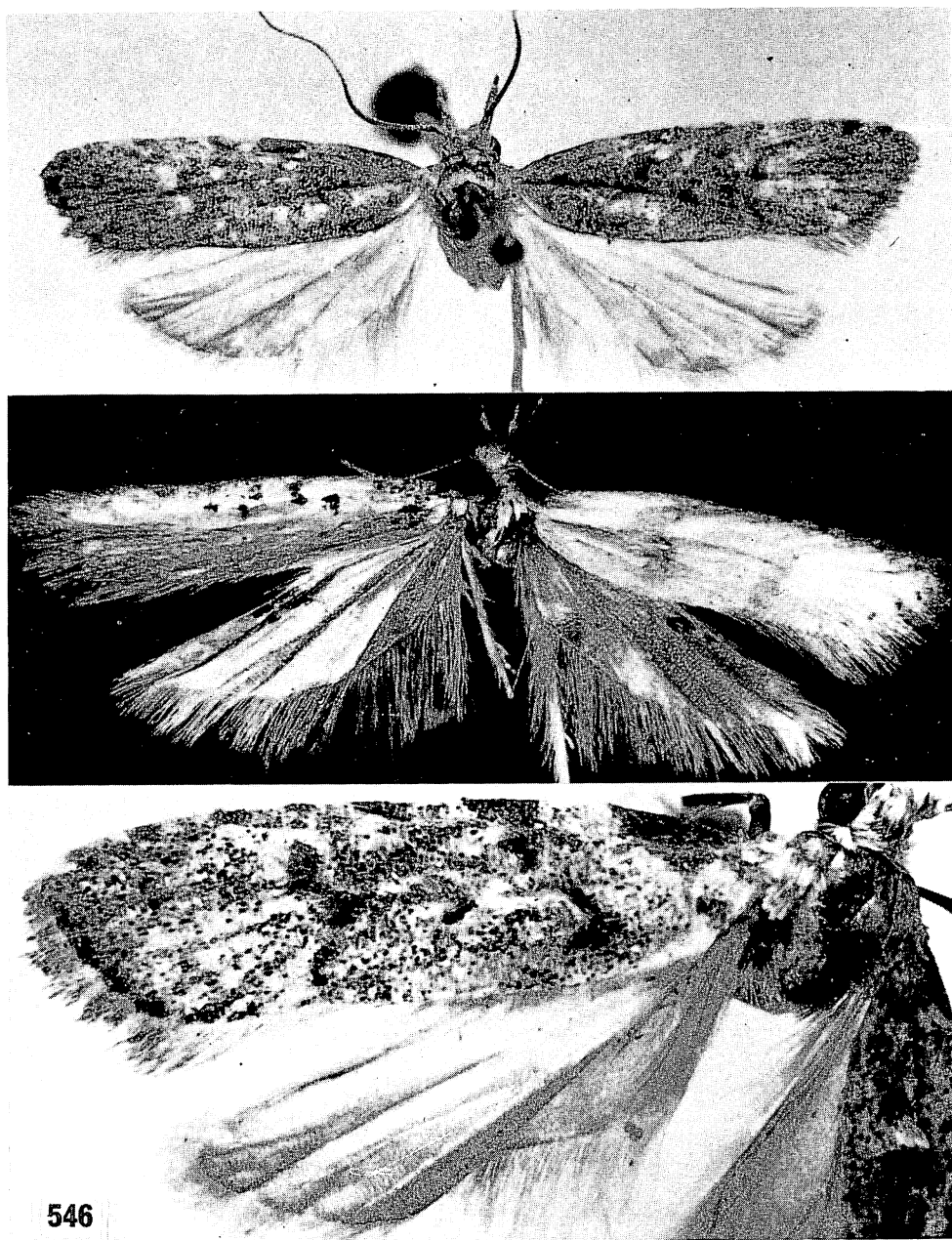


Figure 546—*Carposina*. Top, *glauca* Meyrick, paralectotype; abdomen lost; Koolau Mts., Oahu; expanse 14 mm.; forewings white and pale fuscous, possibly with greenish tinges when alive. Middle, *gracillima* (Walsingham), holotype female (BM slide 1848); Haleakala, 5,000 feet, Maui; expanse 13 mm.; forewings mostly cream to white with a few fuscous spots (the darker maculae on the forewings are mostly abraded areas). This specimen is figured in *Fauna Hawaiiensis*. Bottom, *graminicolor* (Walsingham), holotype female (BM slide 3888); Kaholuamano, 4,000 feet, Kauai; forewing 9 mm., white and, probably, greenish background sprinkled with fuscous and with fuscous maculae, some of which are edged with yellow.

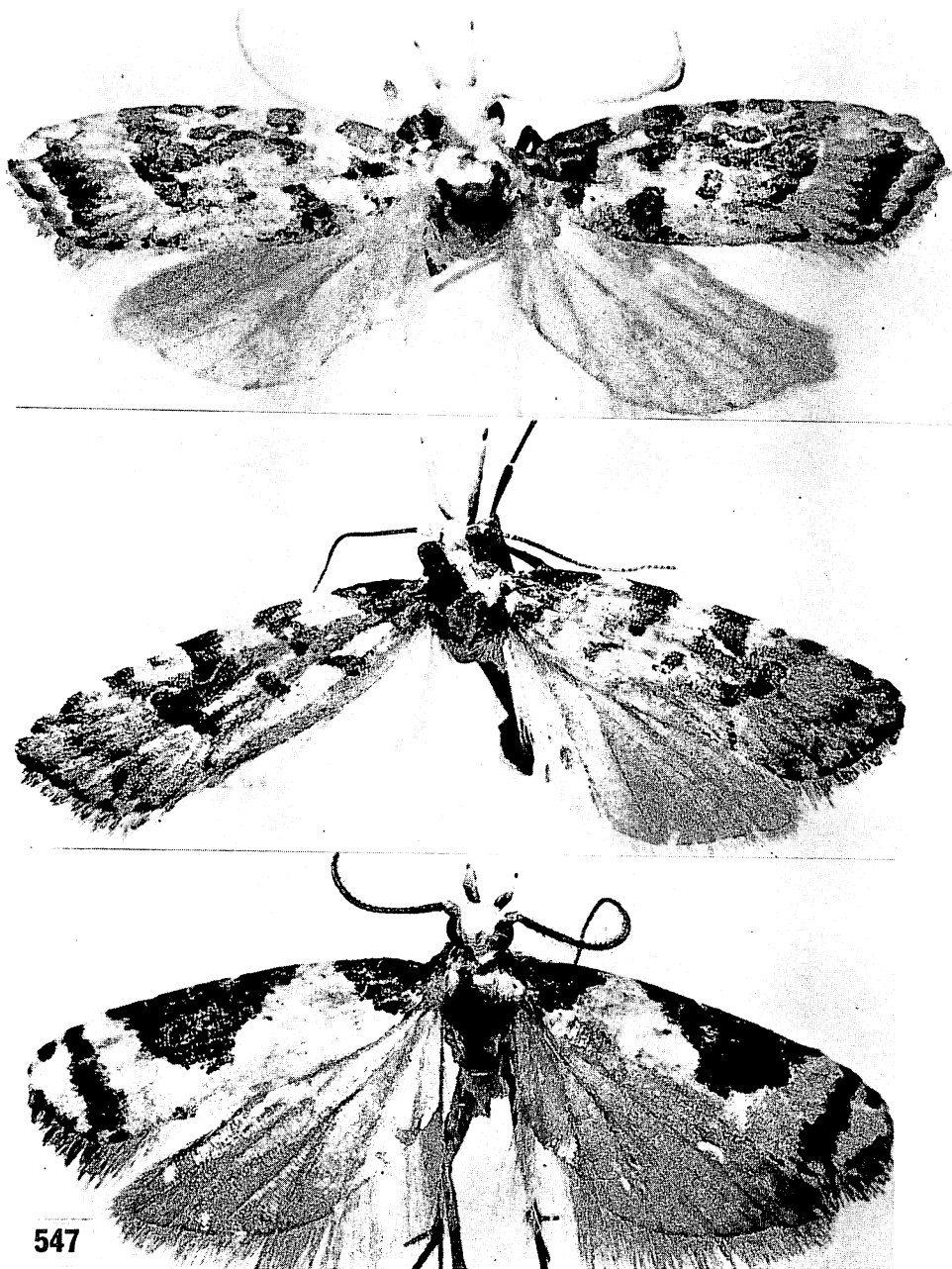


Figure 547—*Carposina*. Top, *graminis* (Walsingham), allotype male (BM slide 3908); Kauai, 3,000 to 4,000 feet; forewing 8 mm., white and yellowish or greenish background scaling with brownish maculae. Middle, *herbarum* (Walsingham), holotype female (BM slide 3889), Lanai, 2,000 feet; expanse 17.5 mm.; forewings with pale yellow or greenish background scaling over white and with brownish fuscous maculae. Bottom, *inscripta* (Walsingham), holotype male (BM slide 1849); Kilauea Hawaii; expanse 13 mm.; forewings white and dark fuscous. These three specimens are figured in *Fauna Hawaiiensis*.



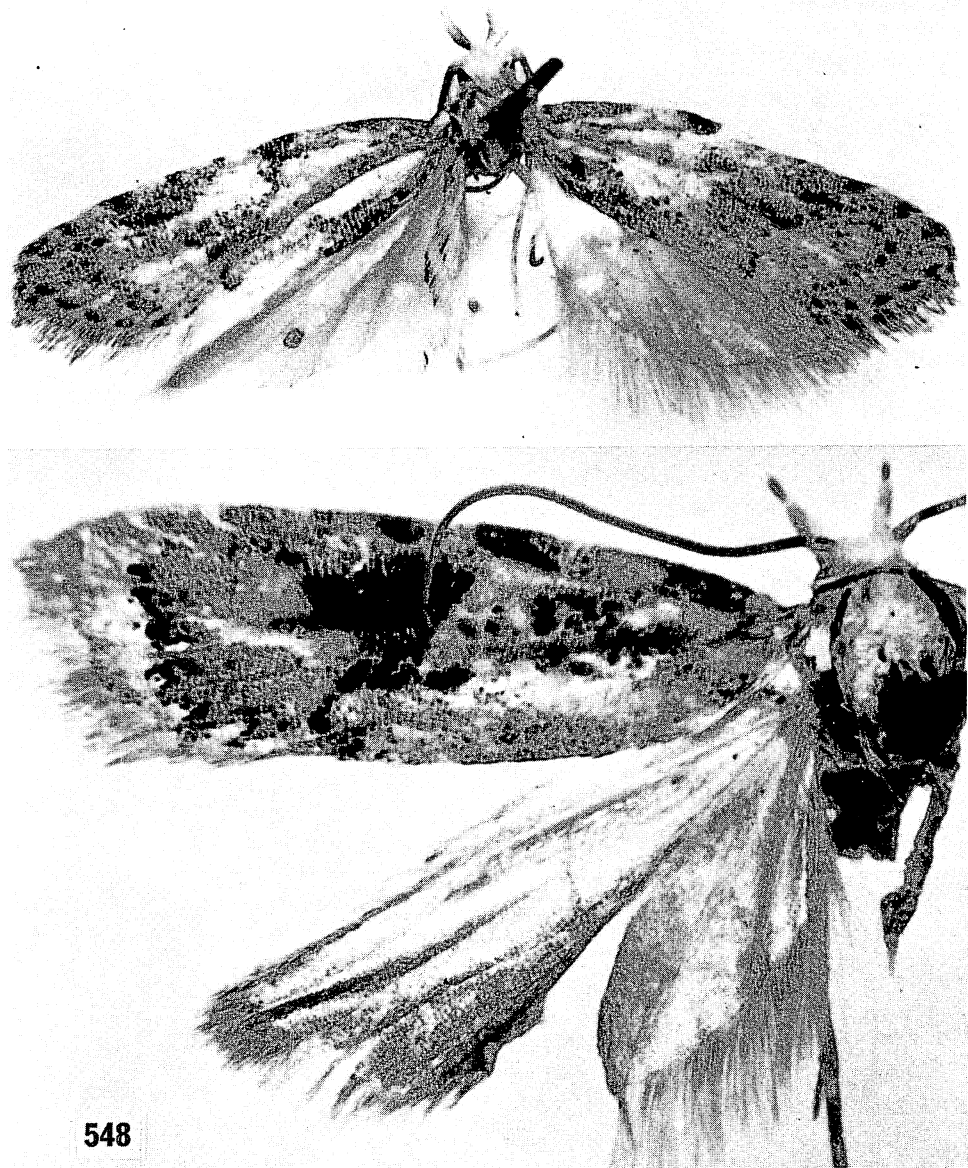


Figure 548—*Carposina*. Top, *irrorata* (Walsingham), holotype male (BM slide 1864); Lanai, 3,000 feet; expanse 12 mm.; forewings white and flavous with fuscous maculae. This specimen is illustrated in *Fauna Hawaiiensis*. Bottom, *lacerata* Meyrick, holotype female, abdomen lost; Koolau Mts., Oahu; forewing 9.25 mm., white and yellow, evidently tinged with green when alive, with fuscous maculae.

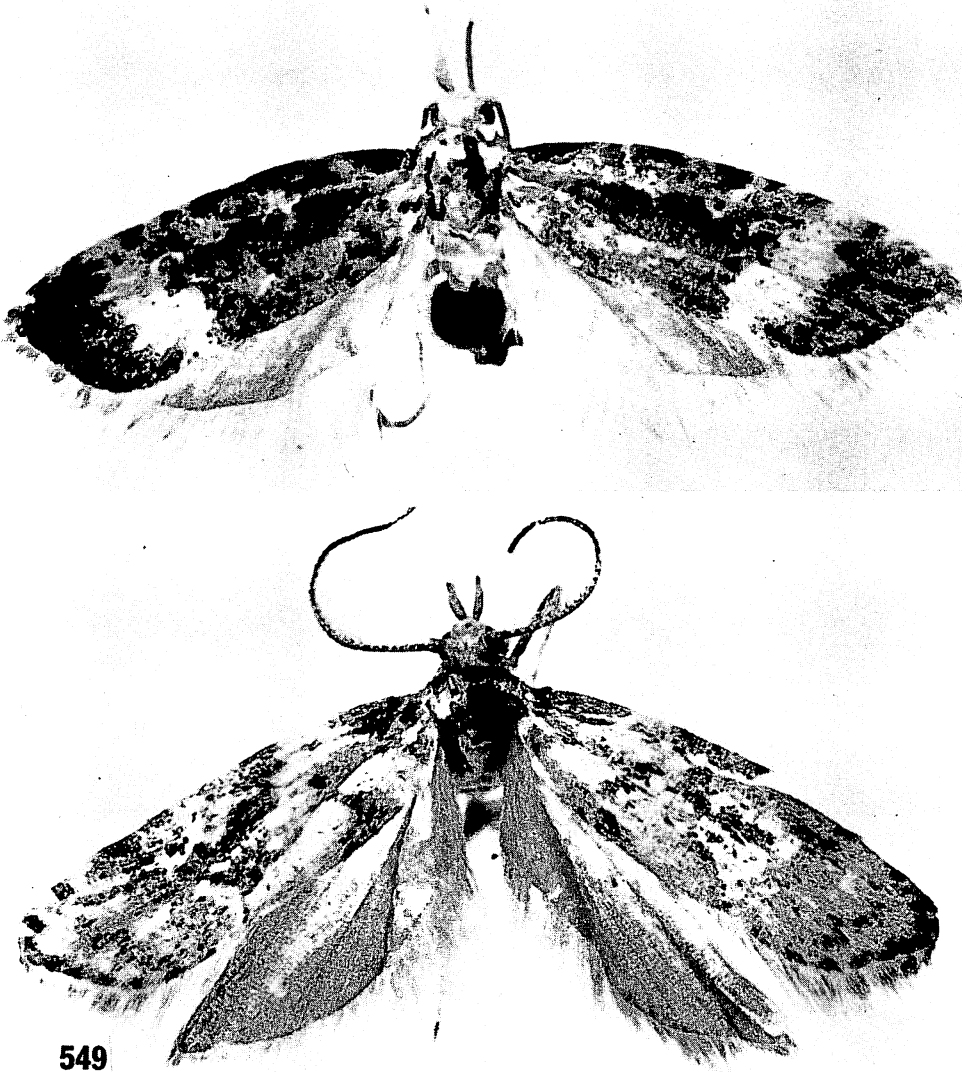


Figure 549—*Carposina*. Top, *latifasciata* (Walsingham), holotype female (BM slide 3890); Kona, 3,500 feet, Hawaii; expanse as mounted 16 mm.; forewings white with the dark areas being pale and dark fuscous. Bottom, *mauii* (Walsingham), allotype male (BM slide 1869); Haleakala, 5,000 feet, Maui; expanse as mounted 12 mm.; forewings white, flavous, and fuscous. These specimens are illustrated in *Fauna Hawaiiensis*.

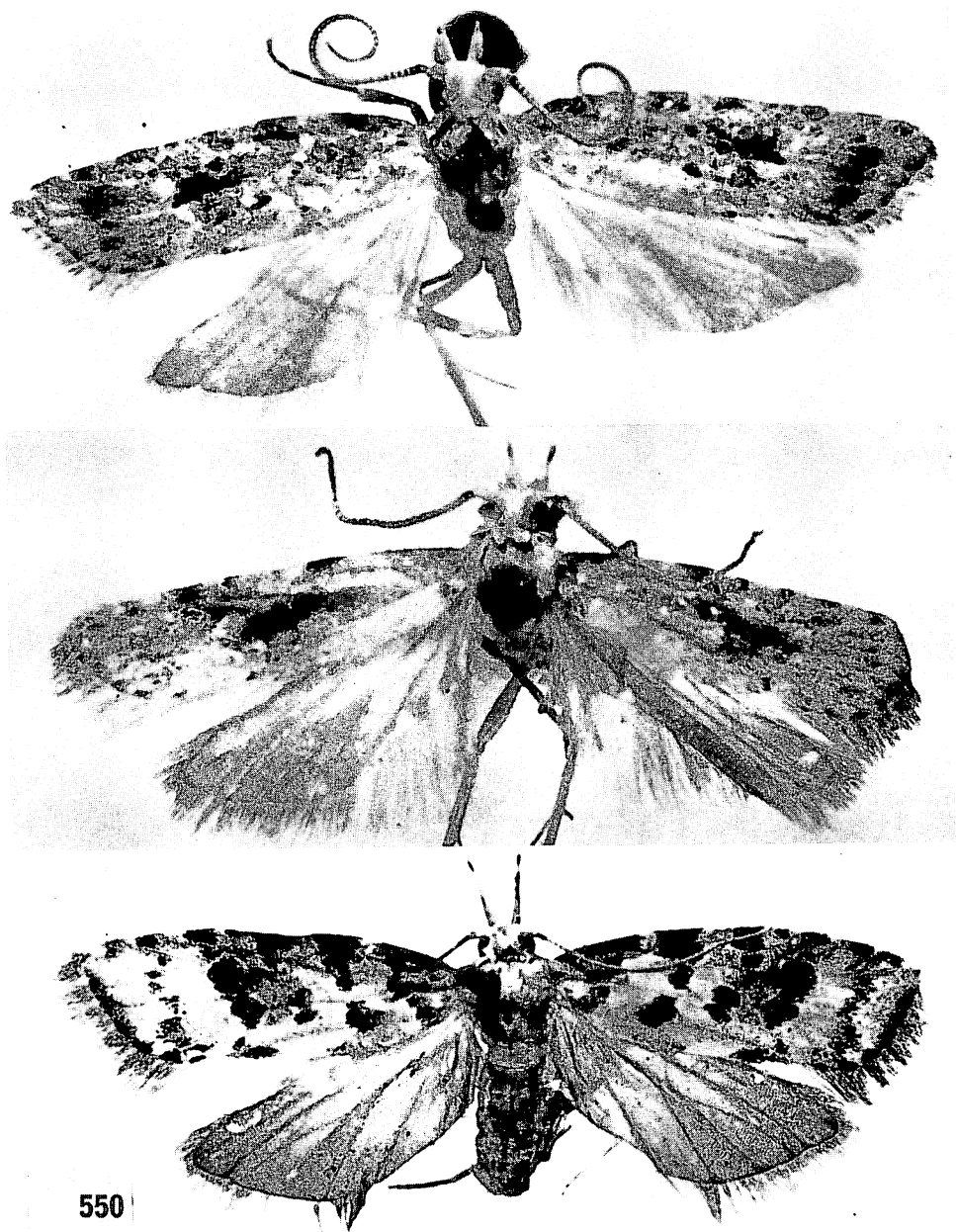


Figure 550—*Carposina*. Top, *saurates* Meyrick, from the synonymous *nereitis* Meyrick, lectotype male (BM slide 9534, Clarke); Koolau Mts., Oahu; expanse 14 mm.; forewings white, brownish, and pale fuscous with darker fuscous markings and evidently tinged with green when alive. Middle, *nigromaculata* (Walsingham), allotype male (BM slide 3910); Waianae Mts., 2,000 feet, Oahu; expanse as mounted 10 mm.; forewings yellow and flavous with fuscous maculae. Bottom, *nigronotata* (Walsingham), holotype female (BM slide 7546); Olaa, 2,000 feet, Hawaii; expanse 17 mm.; forewings with dirty white background with some yellow (possibly greenish in life) and with fuscous maculae. This specimen is figured in *Fauna Hawaiensis*.



Figure 551—*Carposina*. Top, *olivaceonitens* (Walsingham), holotype female (BM slide 5028); Kauai, 3,000 to 4,000 feet; forewing 11 mm., background mostly olive with some white patches and with prominent, dark fuscous maculae. Bottom, *plumbeonitida* (Walsingham), allotype male (BM slide 3915); Kaholuamano, 4,000 feet, Kauai; expanse 16 mm.; forewings with white and yellowish (probably greenish in life) background with some greyish and with fuscous maculae. This specimen was figured in *Fauna Hawaiiensis*.

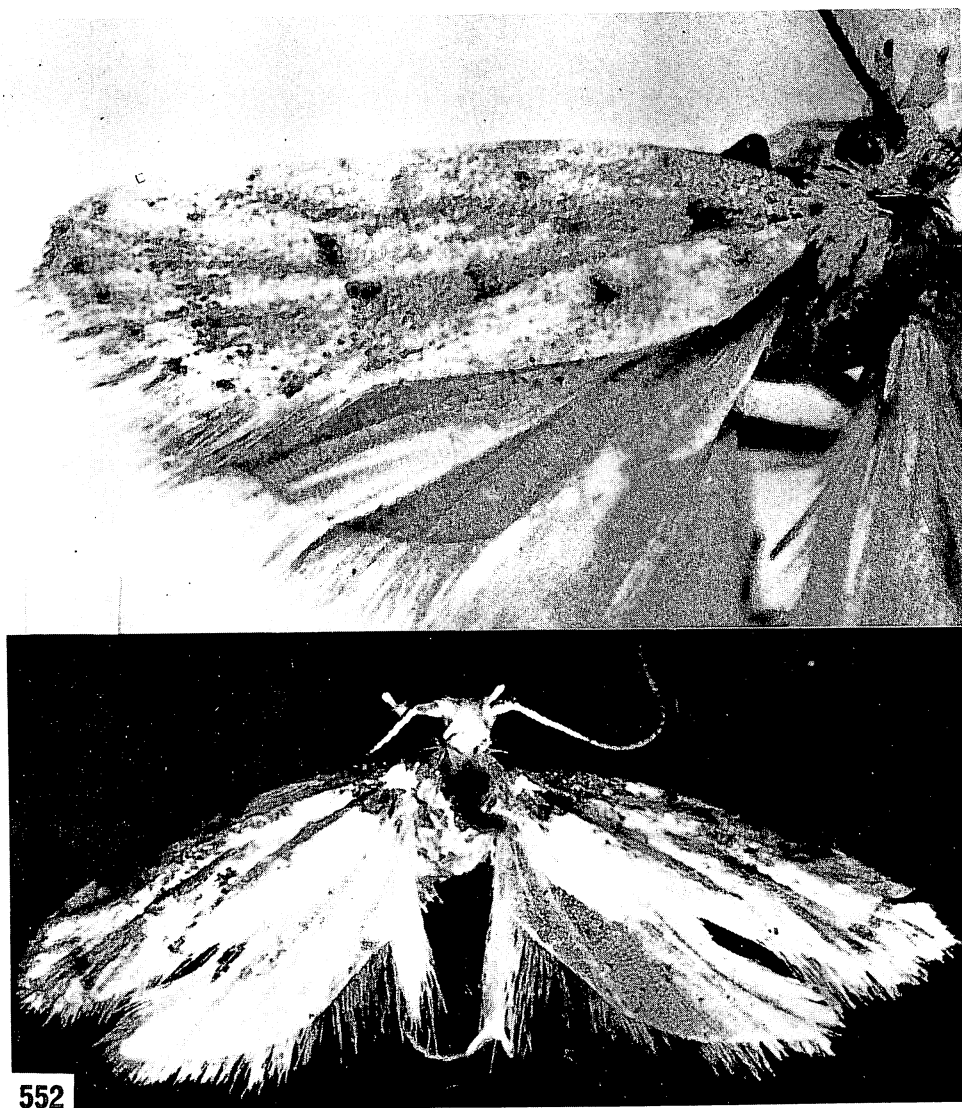


Figure 552—*Carposina*. Top, *punctulata* (Walsingham), allotype male (BM slide 1843); Molokai, 4,000 feet; forewing 7.5 mm., white and flavous with fuscous maculae. Bottom, *pusilla* (Walsingham), holotype male (BM slide 1851); Waianae Mts., 2,000 feet, Oahu; expanse 7.5 mm., white and flavous with fuscous maculae. These specimens are figured in *Fauna Hawaiiensis*.

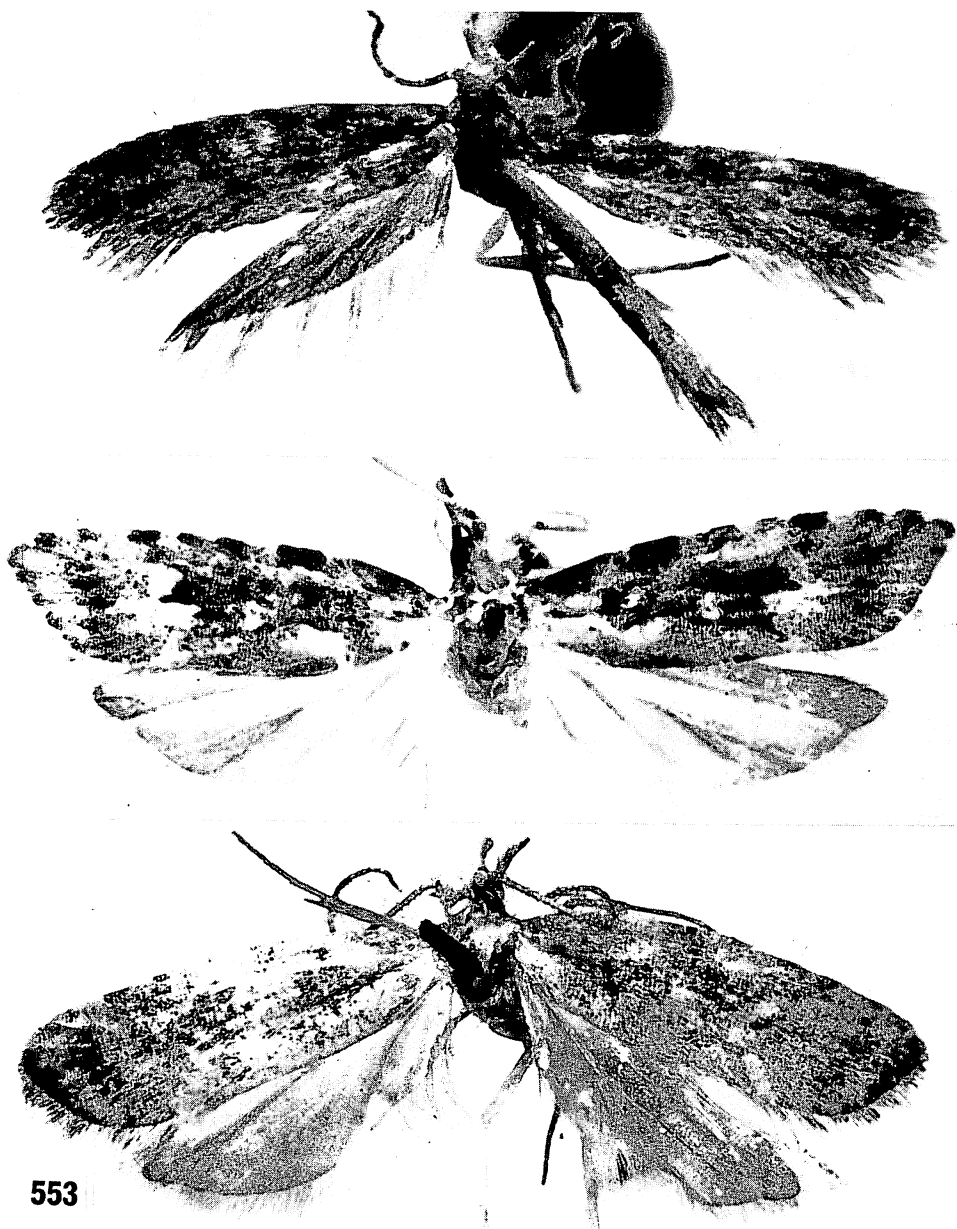


Figure 553—*Carposina*. Top, *pygmaeella* (Walsingham), holotype male (BM slide 3909); Kona, 3,000 feet, Hawaii; expanse 6 mm.; forewings brownish fuscous with dirty white flecks. Middle, *saurates* Meyrick, lectotype male (BM slide 9533 Clarke); Koolau Mts., Oahu; expanse 15.5 mm., white and fuscous tinged with green. Bottom, *solutella* (Walsingham), allotype male (BM slide 1841); Kilauea, Hawaii; expanse 12 mm.; forewings white with yellow and fuscous scaling.

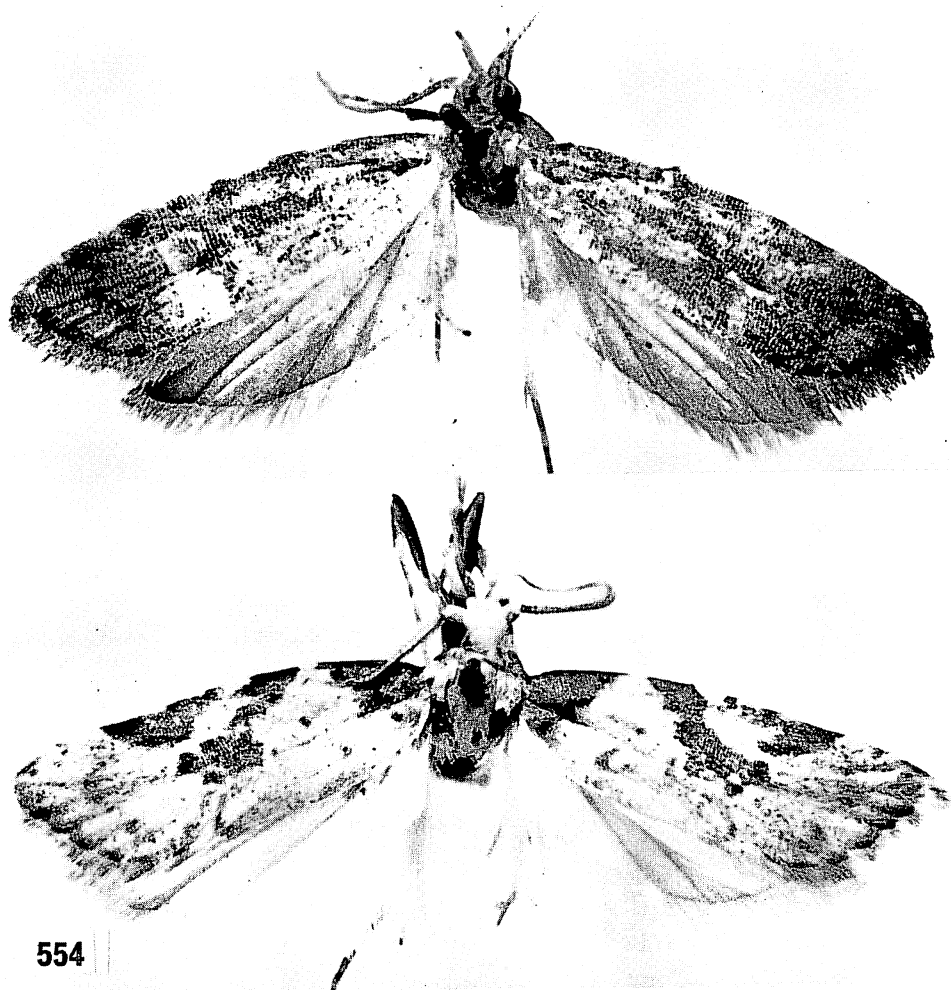


Figure 554—*Carposina*. Top, *subumbrata* (Walsingham), holotype male (BM slide 3919); Waianae Mts., Oahu; expanse 13.5 mm.; forewings brownish fuscous with some white and yellow scaling. Bottom, *trigonotata* (Walsingham), holotype male (BM slide 1846); Molokai, 4,000 feet; expanse 17 mm.; forewings white, flavous, and brownish with fuscous maculae. These specimens are figured in *Fauna Hawaiiensis*.



Figure 555—*Carposina*. Top, *tineta* (Walsingham), holotype female (BM slide 3892); Oloa, Hawaii; expanse 20.5 mm.; forewings pale yellow or greenish with some white and with flavous and fuscous maculae. Middle, *subolivacea* (Walsingham), holotype female (BM slide 7545); Lanai, 2,000 feet; expanse 17 mm.; forewings with white and pale yellowish (possibly green in life) background with dark fuscous maculae. Bottom, *viridis* (Walsingham), holotype female (BM slide 3893); Kauai, 3,000 to 4,000 feet; expanse 20 mm.; forewings white with dark fuscous maculae edged in part with yellow. These specimens are figured in *Fauna Hawaiiensis*.



***Carposina achroana*** (Meyrick) (figs. 541, moth; 558, male genitalia; 592, female genitalia).

*Heterocrossa achroana* Meyrick, 1883*a*:31. Walsingham, 1907*b*:671, pl. 13, fig. 14.

*Carposina achroana* (Meyrick) Meyrick, 1922*b*:5.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).

Hostplant: unknown.

The type series in the British Museum consists of two examples (collected by Blackburn) which Meyrick listed as male and female, but they are both females. Meyrick originally placed this species in the family Cochylidae (now Phaloniidae).



Figure 556—*Carposina togata* (Walsingham), allotype male (BM slide 3956); Haleakala, 5,000 feet, Maui; forewing 7.5 mm., white, yellow, and brownish with fuscous maculae.

**Carposina atronotata** (Walsingham) (figs. 541, moth; 592, 593, female genitalia).

*Heterocrossa atronotata* Walsingham, 1907b:669, pl. 13, fig. 9.

*Carposina atronotata* (Walsingham) Meyrick, 1922b:6.

Endemic. Maui (type locality: Haleakala, 10,000 feet).

Hostplant: unknown.

This species was described from a unique female. It was recorded from *Vaccinium* on Oahu by Swezey (*Proc. Hawaiian Ent. Soc.* 8:12, 1932) who also considered specimens from Hawaii to be members of this species. There are differences in the genitalia of specimens from Oahu, Maui, and Hawaii, and I have concluded that they constitute more than one species. I have, therefore, deleted the Oahu and Hawaii records and have listed the Swezey material under new species 1 below.

**Carposina benigna** Meyrick (figs. 541, moth; 560, male genitalia).

*Carposina benigna* Meyrick, 1913c:76; 1922b:6, fig. 7.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

**Carposina bicincta** (Walsingham) (figs. 542, moth; 557, 593, female genitalia).

*Heterocrossa bicincta* Walsingham, 1907b:661, pl. 12, fig. 23.

*Carposina bicincta* (Walsingham) Meyrick, 1922b:6.

Endemic. Molokai (type locality: above 4,500 feet).

Hostplant: unknown.

This species was described from three females, and no other information has been assembled.

**Carposina cervinella** (Walsingham) (figs. 11–A, *b–c*, antenna; 542, moth; 561, 562, male genitalia; 589, 594, female genitalia).

*Heterocrossa cervinella* Walsingham, 1907b:667, pl. 13, fig. 6.

*Carposina cervinella* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

**Carposina corticella** (Walsingham) (figs. 543, moth; 561, 562, male genitalia).

*Heterocrossa corticella corticella* Walsingham, 1907b:664, pl. 12, fig. 28.

*Carposina corticella* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Although the species was originally described from Kauai, Oahu, and Molokai, I believe it best to restrict the name to the Kauai material until further study demonstrates beyond doubt that the species does occur outside of Kauai. Walsingham included only one specimen from Oahu and one from Molokai under this name. He considered *piperatella* and *semitogata* as varieties, but the genitalia reveal that *corticella* is a different species. All of Walsingham's 13 specimens from Kauai are males as are the other two examples. Meyrick, 1922b:6, incorrectly listed *latifasciata* as a synonym.

**Carposina crinifera** (Walsingham) (figs. 542, moth; 563, 564, male genitalia; 589, 593, female genitalia).

*Heterocrossa crinifera* Walsingham, 1907b:657, pl. 12, fig. 17.

*Carposina crinifera* (Walsingham) Meyrick, 1922b:6.

Endemic. Oahu?, Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

This species was described from a pair from Molokai, but Walsingham included two specimens from Oahu as paratypes which he said "are not in good condition but they appear to belong to the same species". I have, therefore, questioned the Oahu record; it may be in error.

Dr. Swezey (1954:42, 113) recorded what he supposed was *crinifera* from *Broussaisia* and *Hedyotis* (= *Kadua*) *grandis* on Oahu, but he made incorrect identifications. I have figured male genitalia from his material (figure 565) and have listed the species at the end of this chapter as new species 2.

In 1913d:222, Dr. Swezey misidentified another species which he had reared from *Cyanea* (= *Rollandia*) as *crinifera*, but he withdrew his determination in 1954:121. I have listed this species below as new species 3.

**Carposina dispar** (Walsingham) (figs. 544, moth; 566, male genitalia; 593, female genitalia).

*Heterocrossa dispar* Walsingham, 1907b:661, pl. 12, fig. 24.

*Carposina dispar* (Walsingham) Meyrick, 1922b:6.

Endemic. Hawaii (type locality: Kona, 2,000 feet).

Hostplant: unknown.

This species is allied to *piperatella* and *semitogata*; its gnathus is obsolete but it is developed on the other two forms.

**Carposina distincta** (Walsingham) (figs. 544, moth; 595, female genitalia).

*Heterocrossa distincta* Walsingham, 1907b:666, pl. 13, fig. 5.

*Carposina distincta* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (3,000 to 4,000 feet).

Hostplant: unknown.

Dr. Swezey reported (1925:199, 203) that he had reared this species from the terminal buds of *Metrosideros* and *Syzygium* (*Eugenia*) *sandwicensis* on Oahu and had captured an adult on Mt. Olympus, Oahu, from which a *Gordius* worm emerged (note in *Proc. Hawaiian Ent. Soc.* 2:195, 1913). In 1949, however, he told me that these records are in error and that the species in question is undescribed (see also Swezey, 1954:214). I have listed the Swezey material under new species 4 below.

**Carposina divaricata** (Walsingham) (figs. 538, wing venation; 545, moth; 566, male genitalia; 590, 596, female genitalia).

*Heterocrossa divaricata* Walsingham, 1907b:665, pl. 13, fig. 3

*Carposina divaricata* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

The extensive type series of *divaricata* contains more than one species, and I regret that I have not had time to study all of the material and to correct the confusion.

The male genital saccus is the longest and narrowest of any of the species I have examined. Other species which have an elongate saccus are *pusilla* and *solutella*.

Dr. Swezey reported this species from *Elaeocarpus bifidus* and *Syzygium sandwicensis* from Oahu. He said that *Pristomerus hawaiiensis* Perkins was a parasite, but his data were based upon misidentifications and do not apply to *Carposina divaricata*. I have figured male genitalia from specimens of Swezey's wrongly named Oahu series. By comparing them with the figure of the holotype of *divaricata*, it will be seen that Swezey's specimens are different from *divaricata*. I have listed the Swezey material as new species 5 at the end of this chapter.

**Carposina ferruginea** (Walsingham) (figs. 545, moth; 564, 568, male genitalia).

*Heterocrossa ferruginea* Walsingham, 1907b:664, pl. 13, fig. 1.

*Carposina ferruginea* (Walsingham) Meyrick, 1922b:6.

Endemic. Molokai (type locality: about 5,000 feet).

Hostplant: unknown.

**Carposina gemmata** (Walsingham) (figs. 545, moth; 569, male genitalia; 594, 597, female genitalia).

*Heterocrossa gemmata* Walsingham, 1907b:660, pl. 12, fig. 21.

*Carposina gemmata* (Walsingham) Meyrick, 1922b:6.

Endemic. Oahu?, Hawaii (type locality: Olaa).

Hostplants: *Clermontia*?, *Cyanea* (= *Rollandia*)?

The species was described from six females. The bursa copulatrix is unusual because there are no signa in either the holotype or a paratype that were dissected. Both dissected specimens contained a wirelike spermatophore. Another species which has obsolete signa is *atronotata*.

The hostplant and Oahu data are from Swezey. They may be incorrect and are subject to verification. Swezey (*Proc. Hawaiian Ent. Soc.* 4:10, 1919) reported that he had reared this species from the buds and fruits of the hostplants on Oahu.

**Carposina glauca** Meyrick (fig. 546, moth).

*Carposina glauca* Meyrick, 1913c:74.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

There are three examples in the Meyrick collection in the British Museum. None of these has an abdomen, and I am unable to illustrate the genitalia.

(Text continued on page 869.)

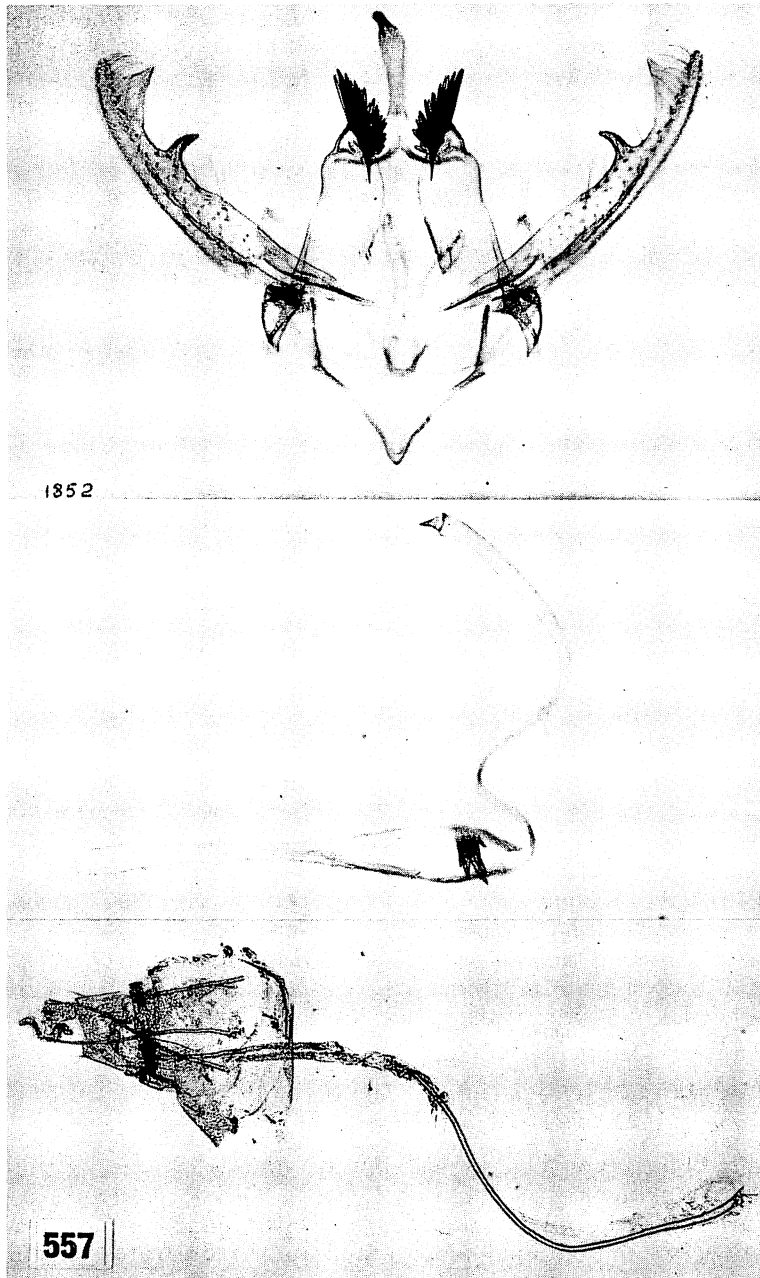
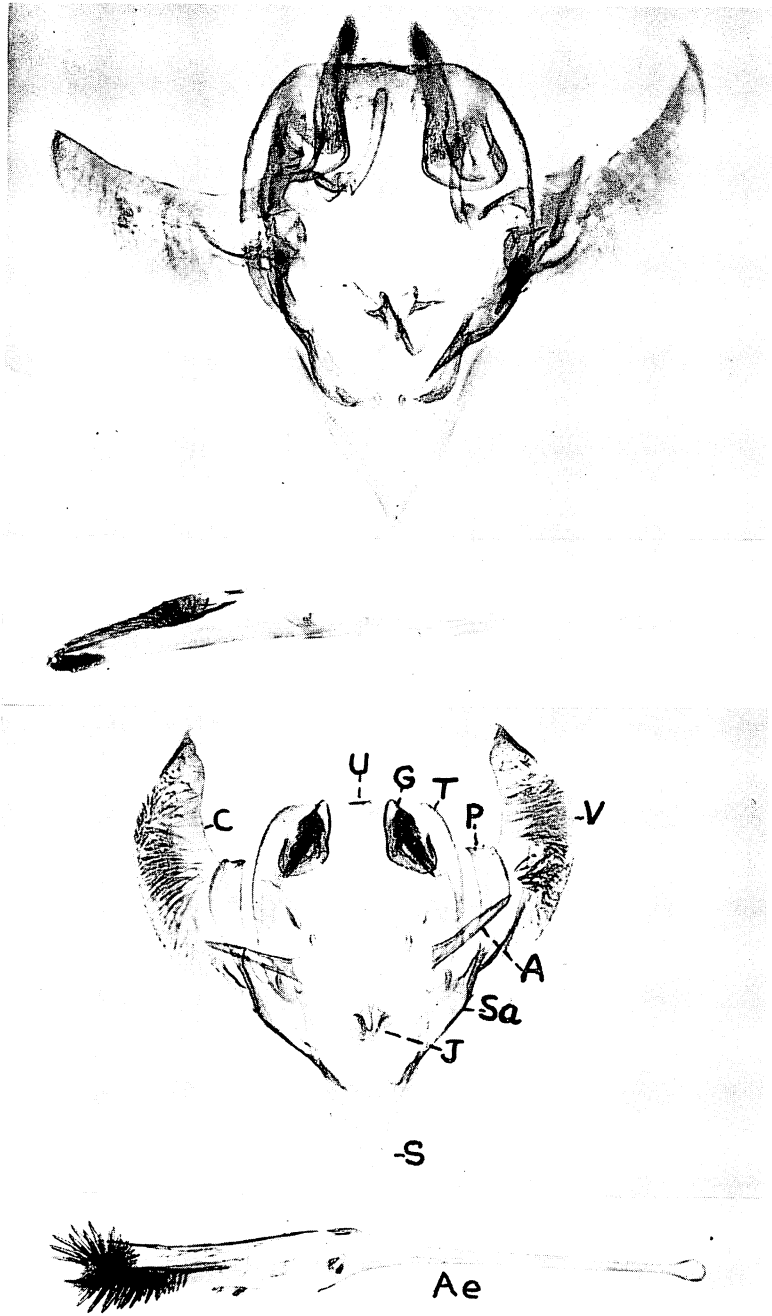


Figure 557—Top and middle (aedeagus), male genitalia of *Heterocrossa adaptella* (Walker), the type-species of *Heterocrossa*, for comparison with the figures of *Carposina*; holotype (BM slide 1852); New Zealand. Bottom, female genitalia of *Carposina bicincta* (Walsingham), holotype (BM slide 7544); Molokai, about 4,000 feet; to show the long, wirelike spermatophore; the genitalia are partly decomposed, and part of the bursa copulatrix is missing.



558

Figure 558—Male genitalia of *Carposina*. Top, the type-species, *berberidella* Herrich-Schäffer from Europe (BM slide 1853); see also figure 539. Bottom, *achroana* (Meyrick), determined by Walsingham (BM slide 1845); Kilauea, Hawaii; A, anellar lobe; Ae, aedeagus; C, costa of valva; G, right gnathus; J, juxta; P, processus of sacculus; S, saccus; Sa, sacculus; T, tegumen; U, rudiment of uncus; V, valva.



Figure 559—Male genitalia of *Carposina* new species 1. Top, a specimen from Puu Kalena, Oahu; ex *Vaccinium* leaves (slide Z-V-6-61-1). Bottom, supposedly the same species; Kilauea section of Hawaii National Park, (slide Z-V-6-61-2). The gnathus is obsolete in this species. These specimens were wrongly determined as *atrionotata* by Dr. Swezey.

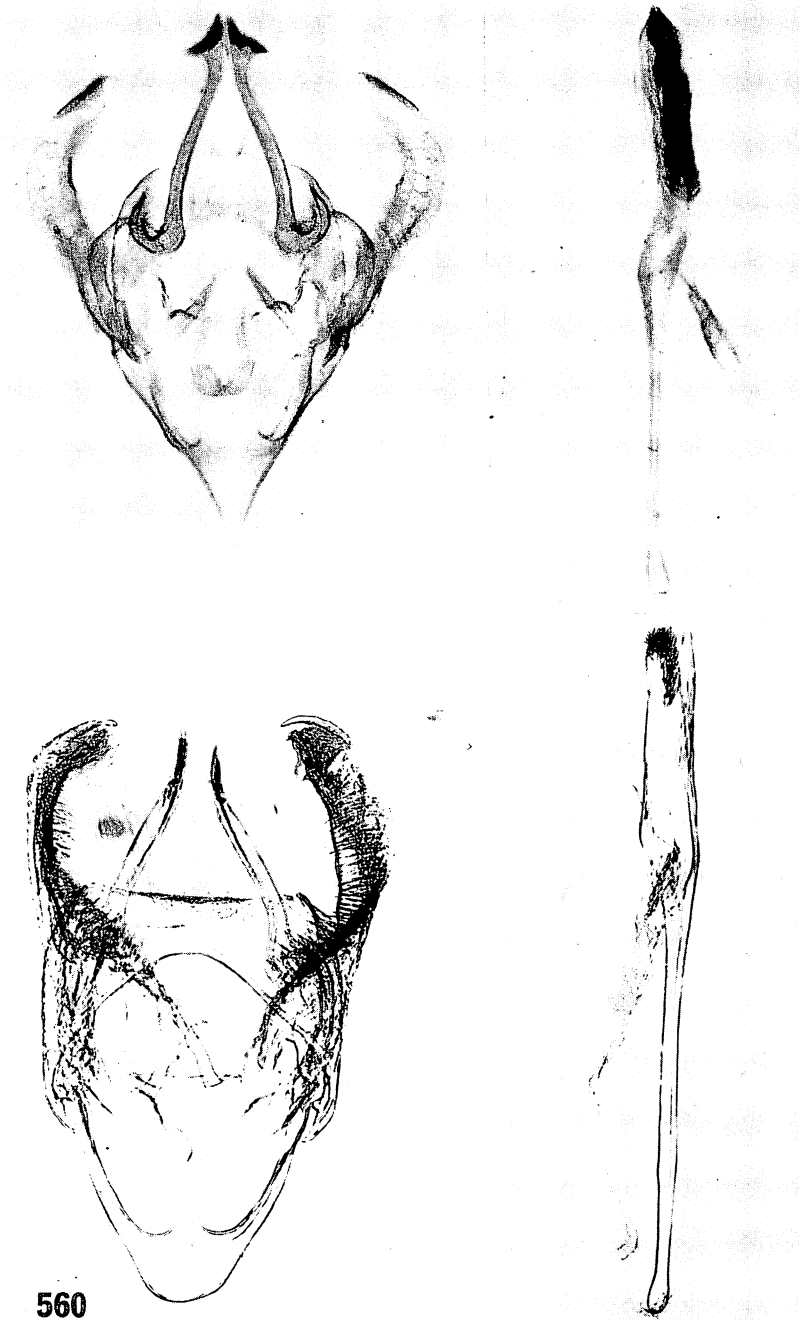


Figure 560—Male genitalia of *Carposina*. Top, *benigna* Meyrick, lectotype (BM slide 9535 Clarke); Koolau Mts., Oahu. Bottom, *herbarum* (Walsingham)?, determined by Swezey (slide JDB-7). This may not be *herbarum*, which was described from an unique female; see the discussion in the text.



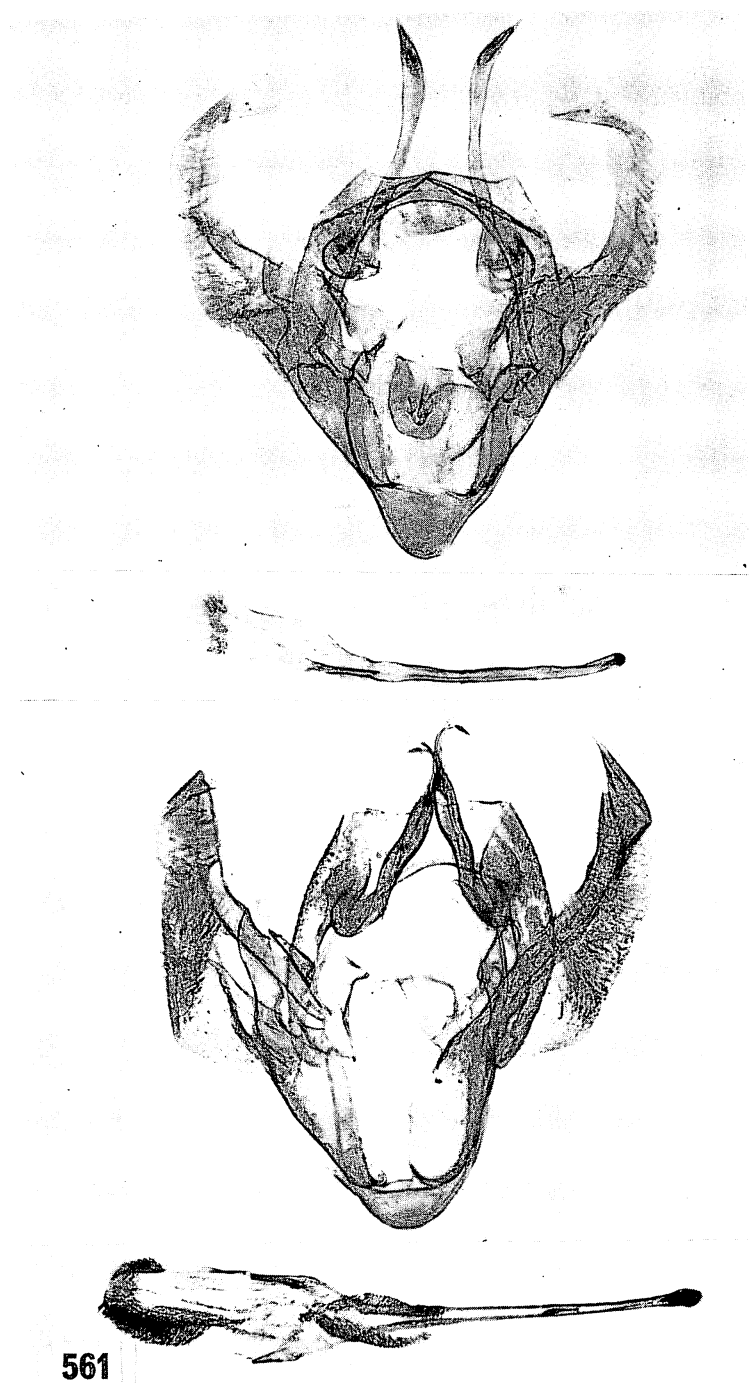
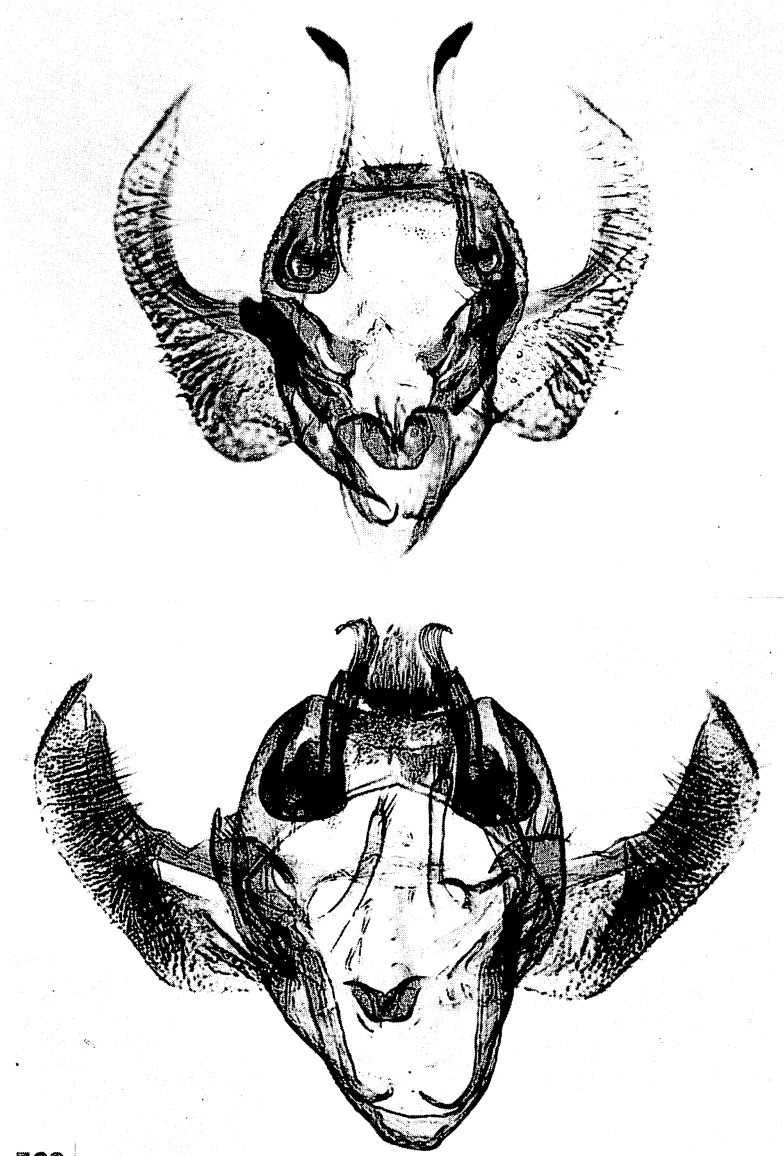


Figure 561—Male genitalia of *Carposina*. Top, *cervinella* (Walsingham), holotype (BM slide 3876); Kaholuamano, 4,000 feet, Kauai. Bottom, *corticella* (Walsingham), holotype (BM slide 3877); Kauai, 3,000 to 4,000 feet. Compare figure 562.



562

Figure 562—Male genitalia of *Carposina*. Top, *cervinella* (Walsingham), paratype (BM slide 15850); Kauai, 3,000 to 4,000 feet. Bottom, *corticella* (Walsingham), paratype (BM slide 15824); Kauai, 3,000 to 4,000 feet; compare figure 561.

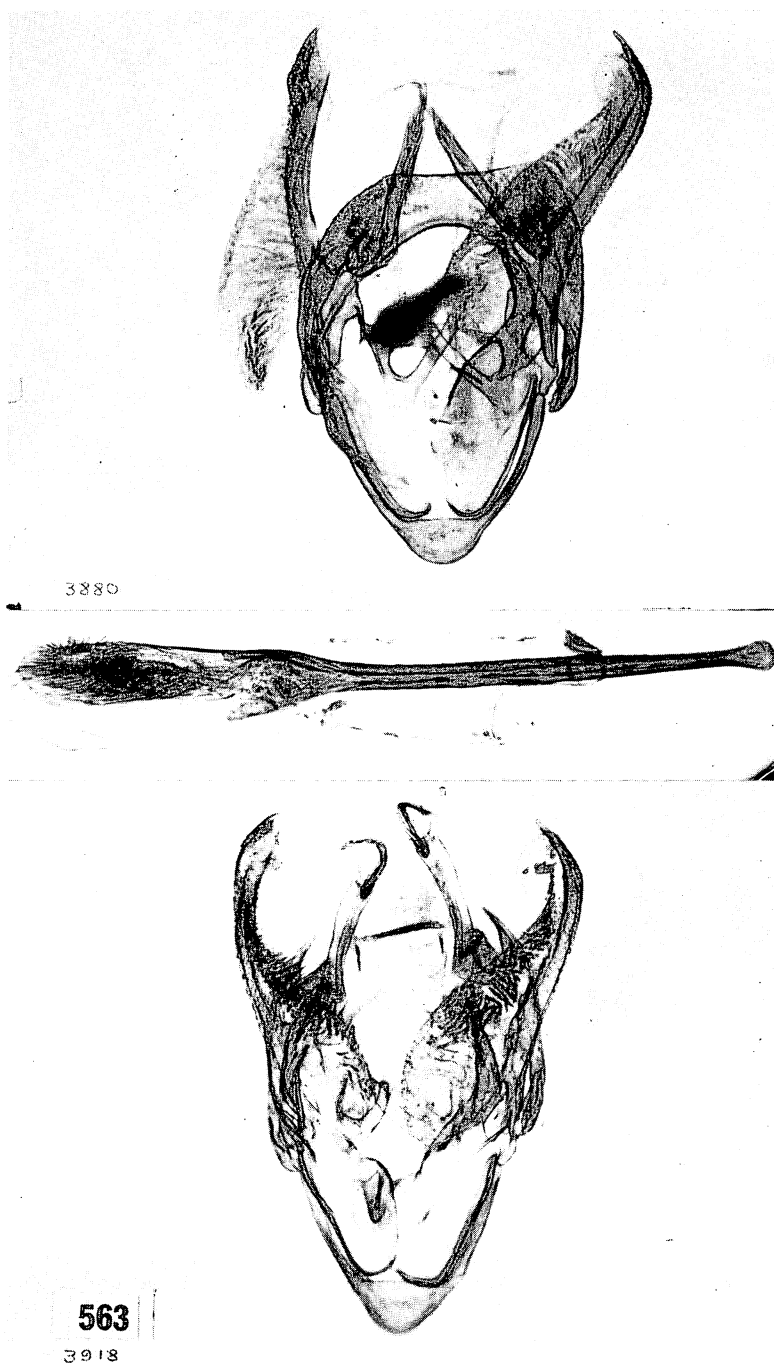


Figure 563—Male genitalia of *Carposina crinifera* (Walsingham). Top and middle, holotype (BM slide 3880); Molokai, over 3,000 feet (the out-of-focus dark mass near the middle of the genitalia was caused by dust on the slide). Bottom, a paratype (BM slide 3918); Waianae Mts., Oahu. Compare figure 564.

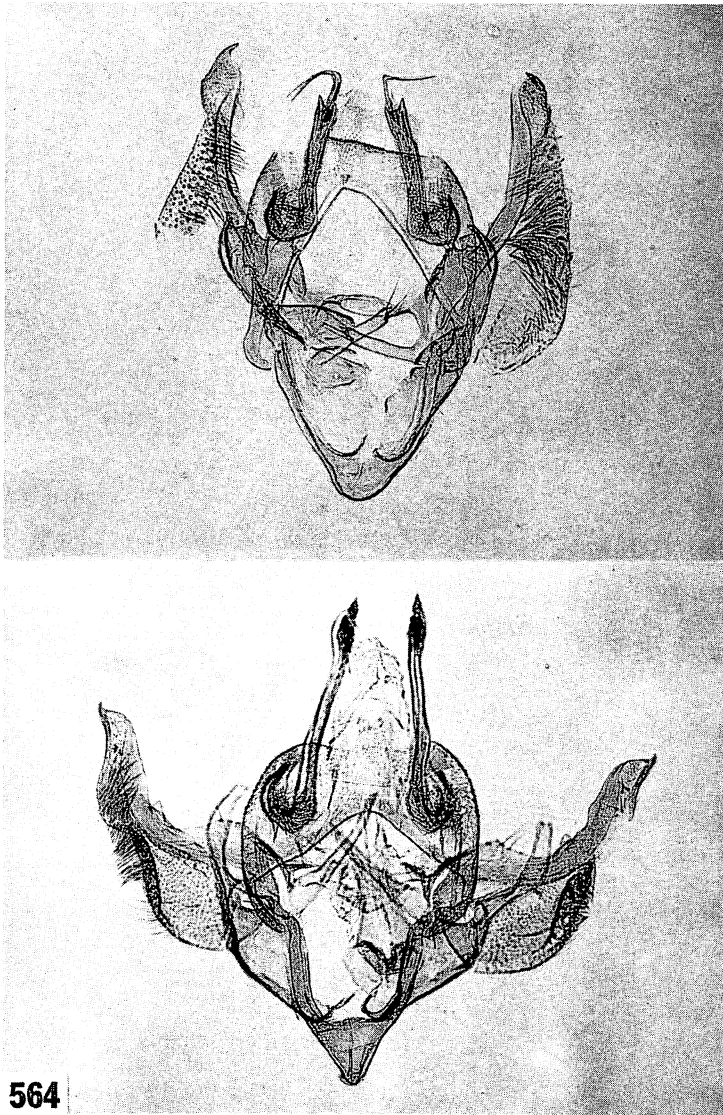
**564**

Figure 564—Male genitalia of *Carposina*. Top, *crinifera* (Walsingham), holotype (BM slide 3880, remounted; compare figure 563); Molokai, above 3,000 feet. Bottom, *ferruginea* (Walsingham), paratype (BM slide 3917, remounted; compare figure 568); Molokai, about 5,000 feet.

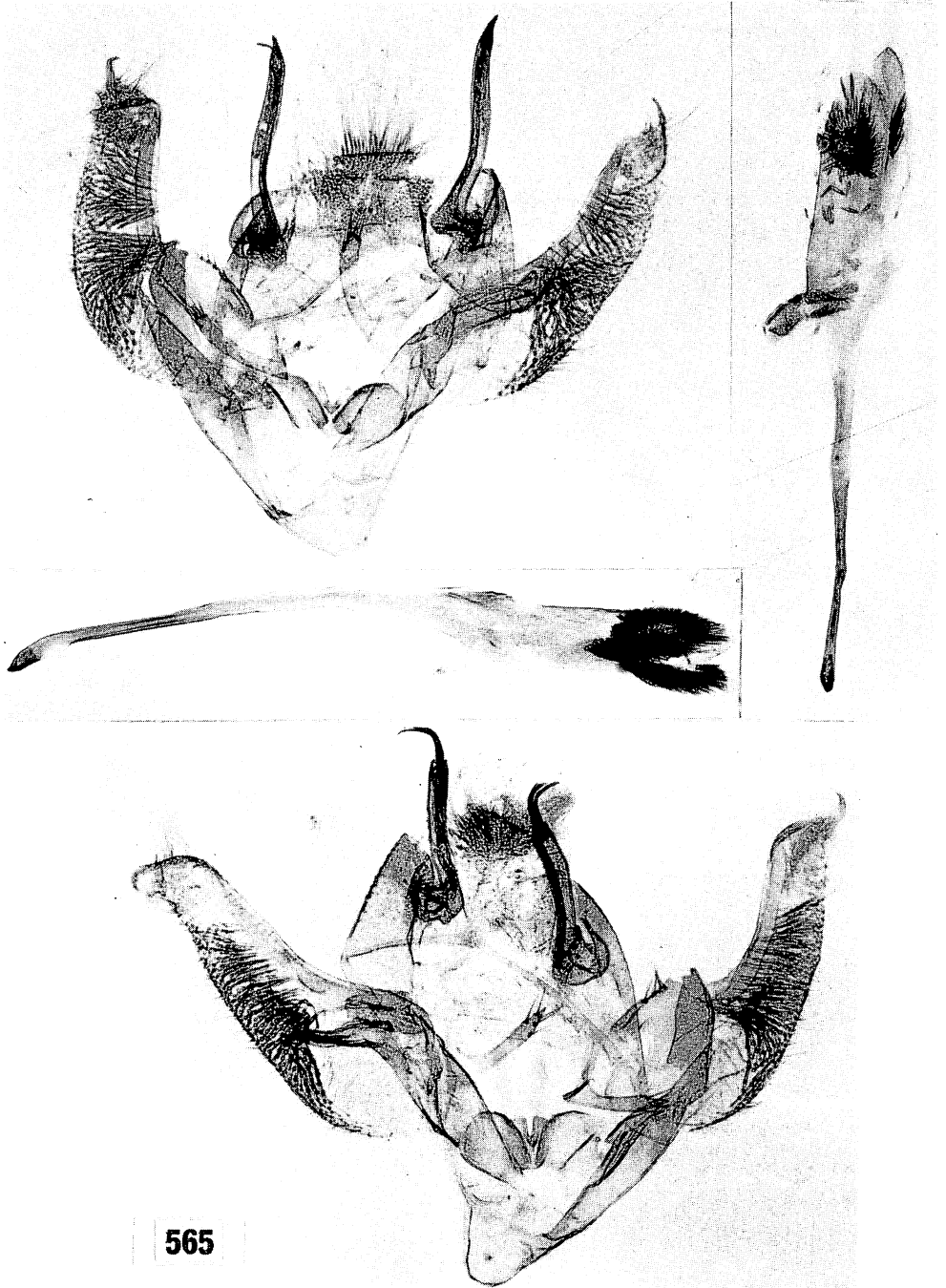


Figure 565—Male genitalia of *Carposina*. Top, new species 2 (slide Z-V-8-61-4) wrongly determined as *crinifera* by Dr. Swezey; Mt. Tantalus, Oahu; ex *Kadua* fruits; the saccus is more pointed than on the type of *crinifera* (compare figure 563). Middle and bottom, possibly the same species although perhaps distinct; Mt. Kaala, Oahu; ex *Broussaia* berries (slide Z-V-8-61-3).

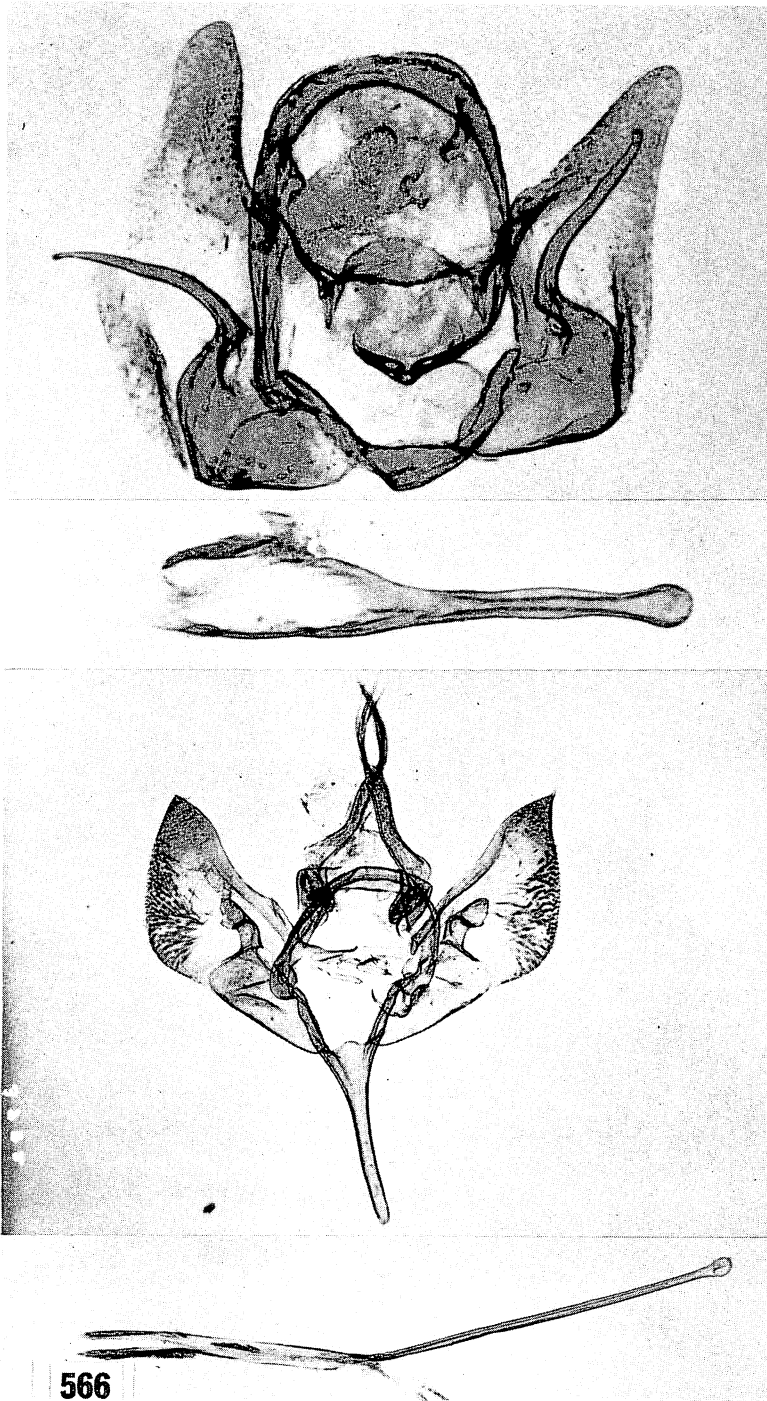


Figure 566—Male genitalia of *Carposina*. Top, *dispar* (Walsingham), allotype (BM slide 3881); Kona, over 2,000 feet, Hawaii; note that the gnathus and anellar lobes are obsolete, and note the long, slender processus of sacculus; compare *piperatella* and *semitogata* which are rather similar but which have a developed gnathus. Bottom, *divaricata* (Walsingham), holotype (BM slide 3882); Kauai, 3,000 to 4,000 feet.

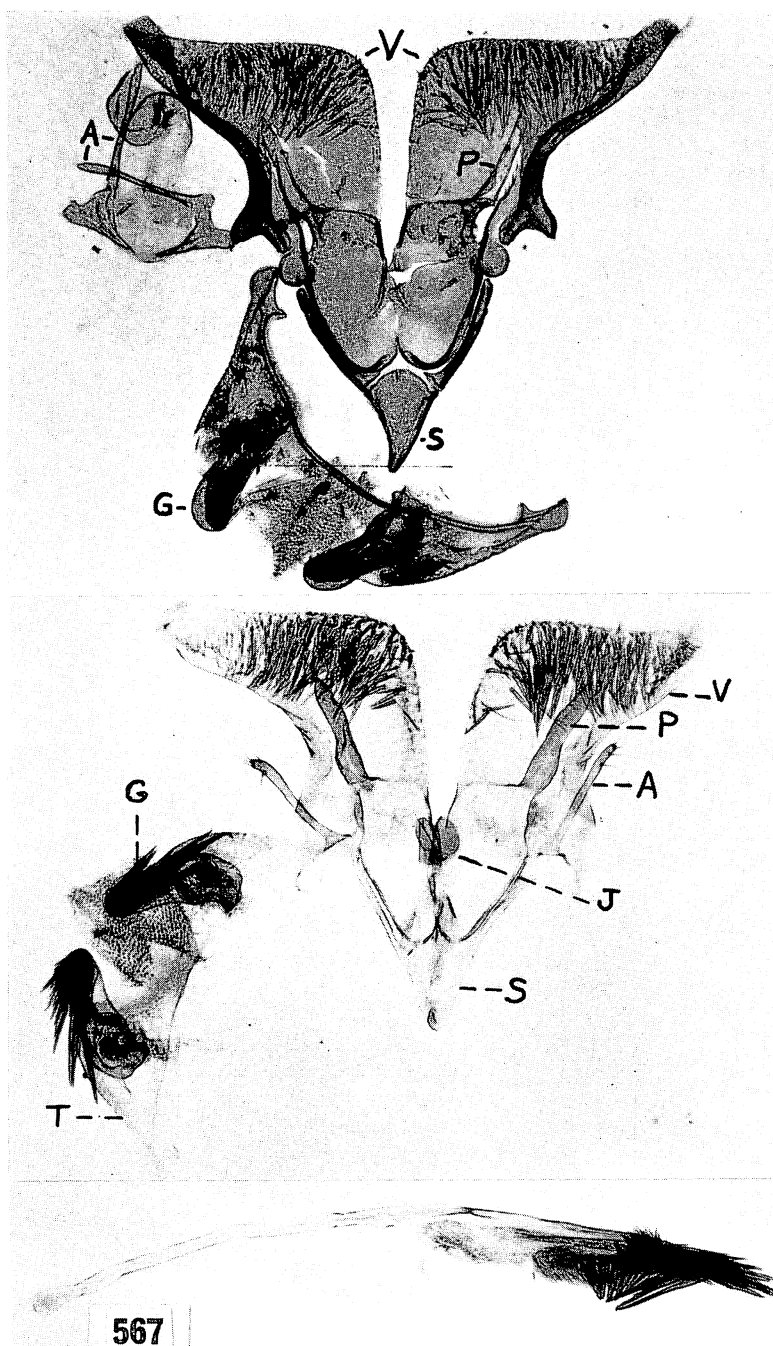


Figure 567—*Carposina* new species 5, formerly confused with *divaricata* by Dr. Swezey. Top, from Waialae Iki, Oahu; ex *Elaeocarpus* (slide Z-V-8-61-1). Middle, and the aedeagus illustrated at bottom, Palolo, Oahu; ex "ohia ha" fruits (slide Z-V-8-61-2). Some small individual differences and differences in staining and preparation are displayed. This is an unusually divergent species; see text for discussion. Note how distinct it is from *divaricata* in figure 566. A, anellar lobe; G, gnathus; J, juxta; P, processus of saccus; S, saccus; T, tegumen; V, valva.

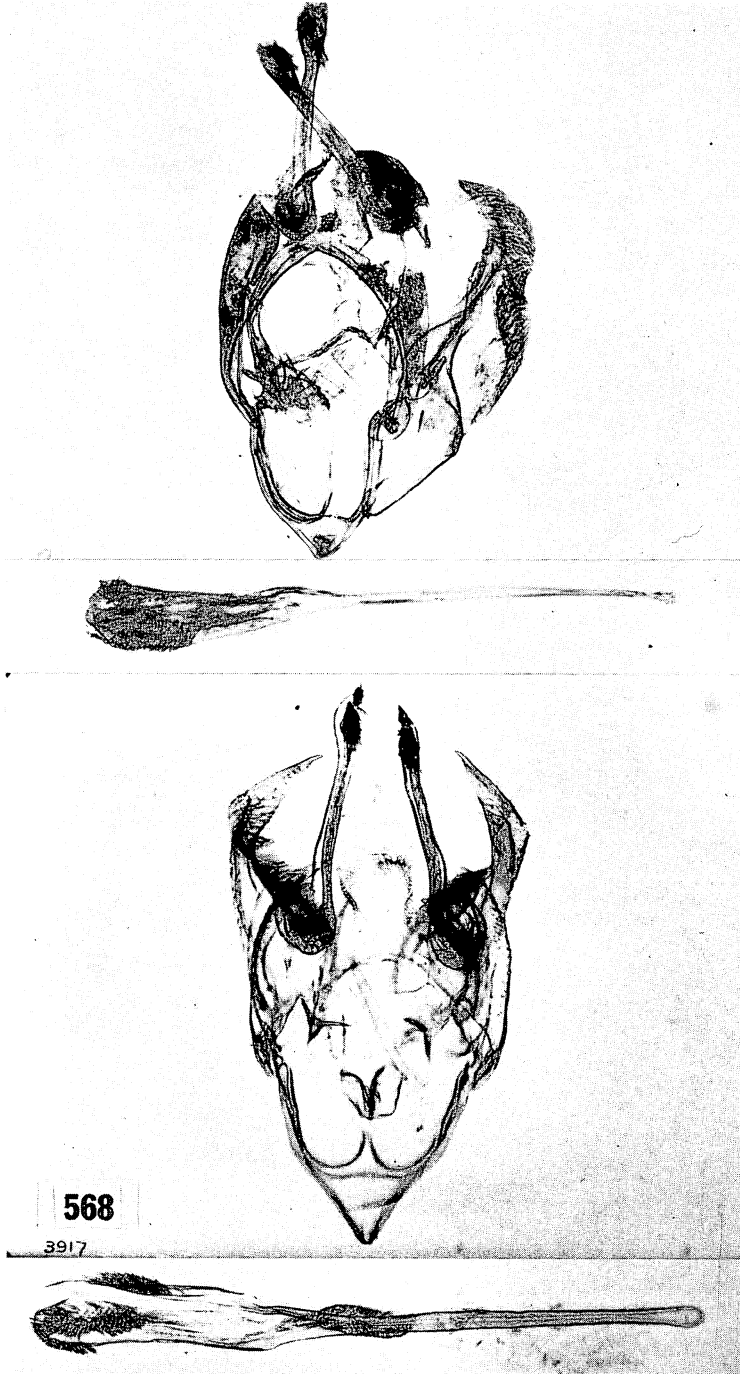


Figure 568—Male genitalia of *Carposina ferruginea* (Walsingham). Top, holotype (BM slide 3883); Molokai, about 5,000 feet; this is a poor preparation, and the left valva is removed. Bottom, a paratype from the same locality (BM slide 3917). Compare figure 564.





Figure 569—Male genitalia of *Carposina*. Top, *gemmata* (Walsingham)?, as determined by Dr. Swezey; Palolo, Oahu; ex *Clermontia* fruit; part of internal sac of aedeagus is at middle (slide Z-V-7-61-1); see text for comment. Bottom, *saurates* Meyrick, from the lectotype of the synonymous *neretis* Meyrick (BM slide 9534 Clarke); Koolau Mts., Oahu. Compare figure 573.

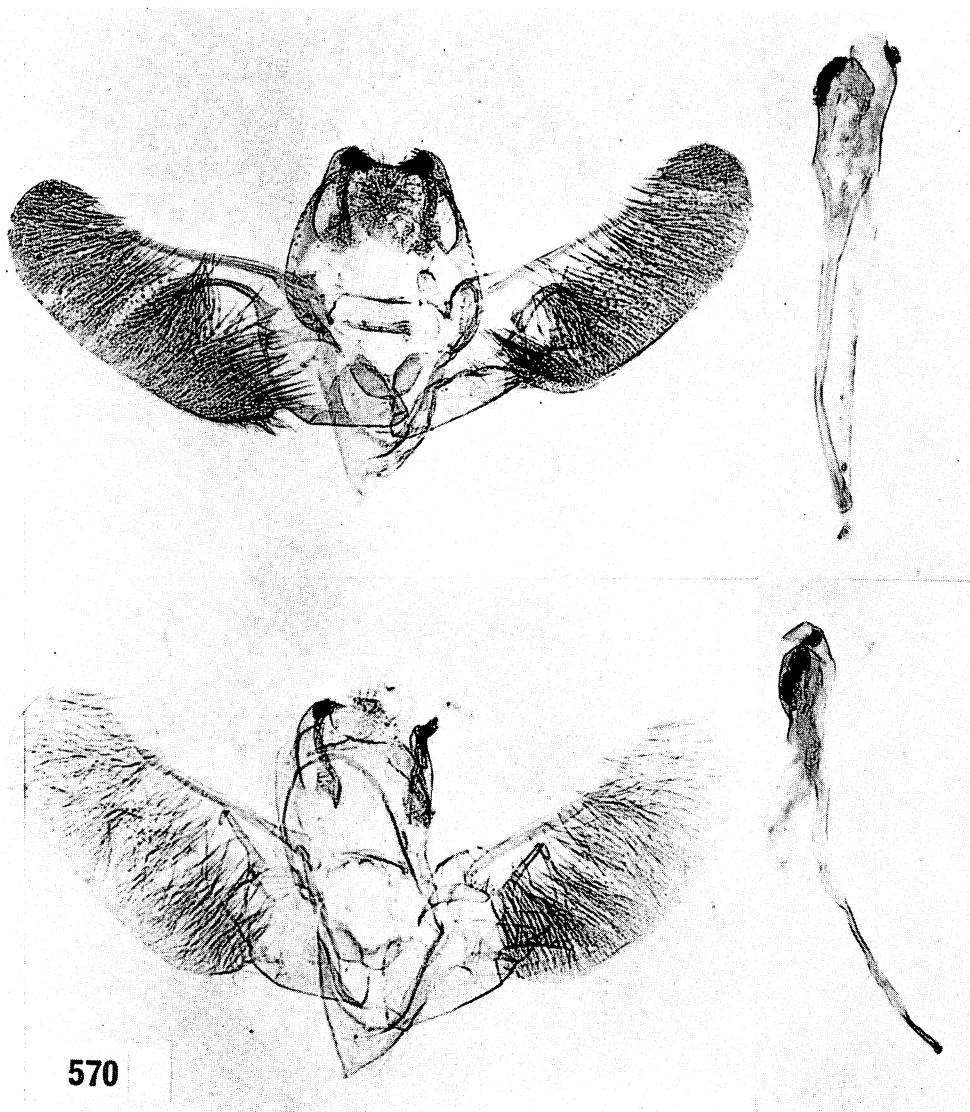


Figure 570—Male genitalia of *Carposina gracillima* (Walsingham) from specimens determined by Dr. Swezey. Top, a specimen from Kokee, Kauai (slide Z-V-8-61-5). Bottom, a specimen from Lanihuli, Oahu (slide Z-V-8-61-6).

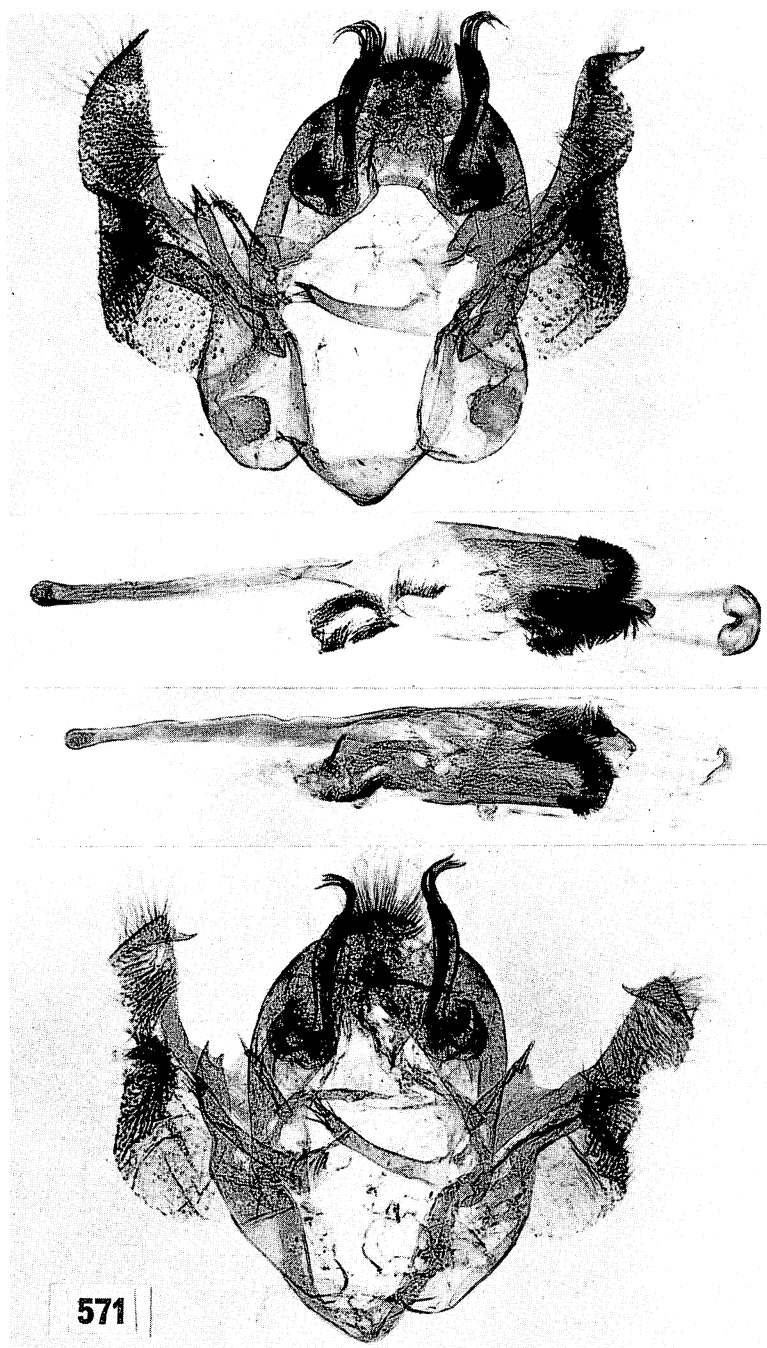


Figure 571—Male genitalia of *Carposina graminicolor* (Walsingham) from specimens determined by Dr. Swezey. Top, Kilauea, Hawaii (slide Z-V-10-61-1); ex *Osmanthus* fruits. Bottom, Wailupe, Oahu (slide Z-V-1-61-2); ex *Plectronia*.

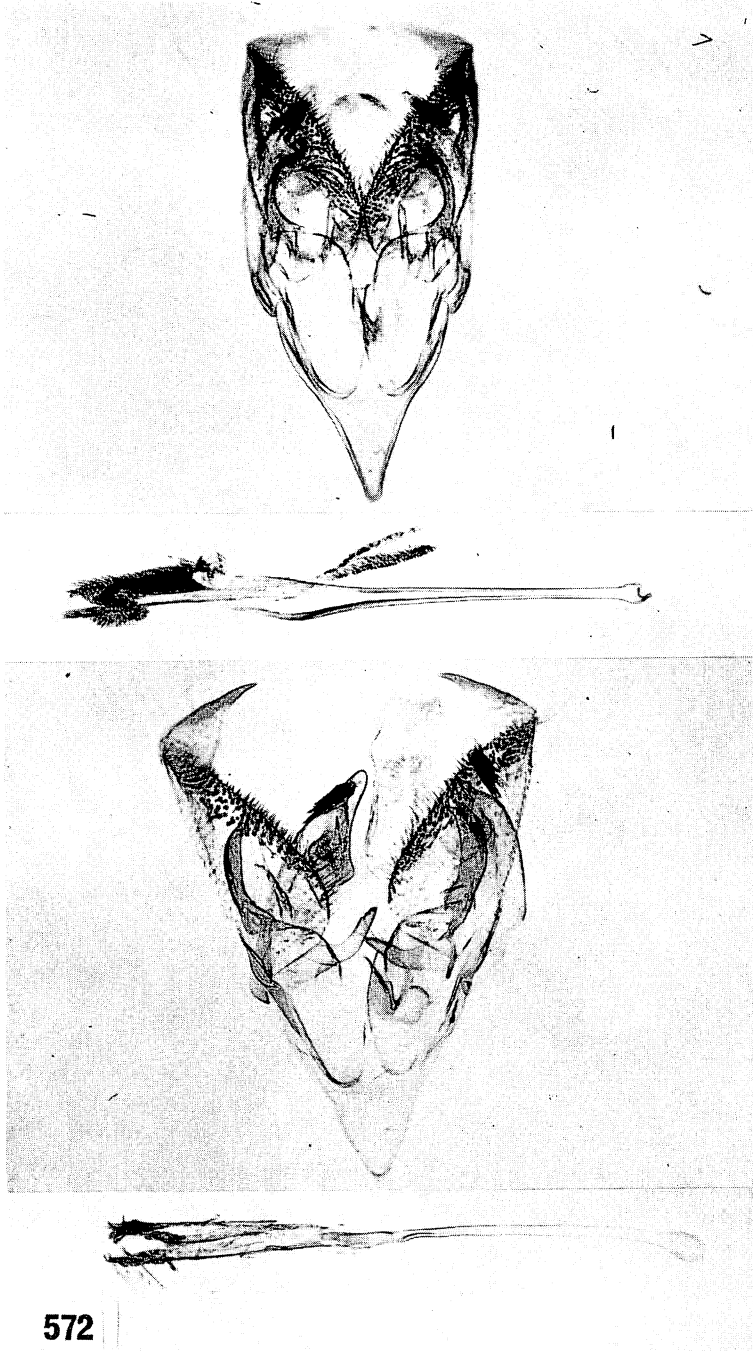


Figure 572—Male genitalia of *Carposina*. Top, *graminis* (Walsingham), allotype (BM slide 3908); Kauai, 3,000 to 4,000 feet; compare figure 573. Bottom, supposedly one of the paratypes (Busck slide 77; Walsingham specimen 27330), of *graminis*, but this is evidently another species and demonstrates that the type series is mixed. Note the differences in the anellar lobes.

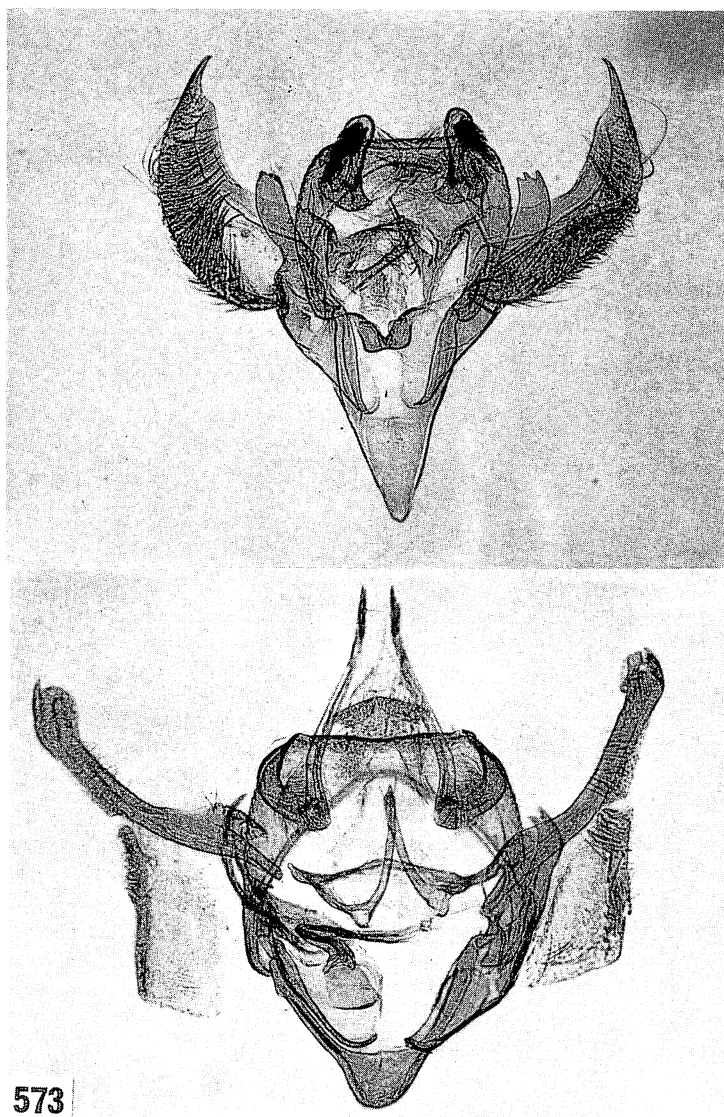


Figure 573—Male genitalia of *Carposina*. Top, *graminis* (Walsingham), paratype (BM slide 15826); Kauai, 3,000 to 4,000 feet; compare figure 572. Bottom, *saurates* Meyrick from the lectotype of the synonymous *nereitis* Meyrick (BM slide Clarke 9534, remounted; compare figure 569); Koolau Mts., Oahu.

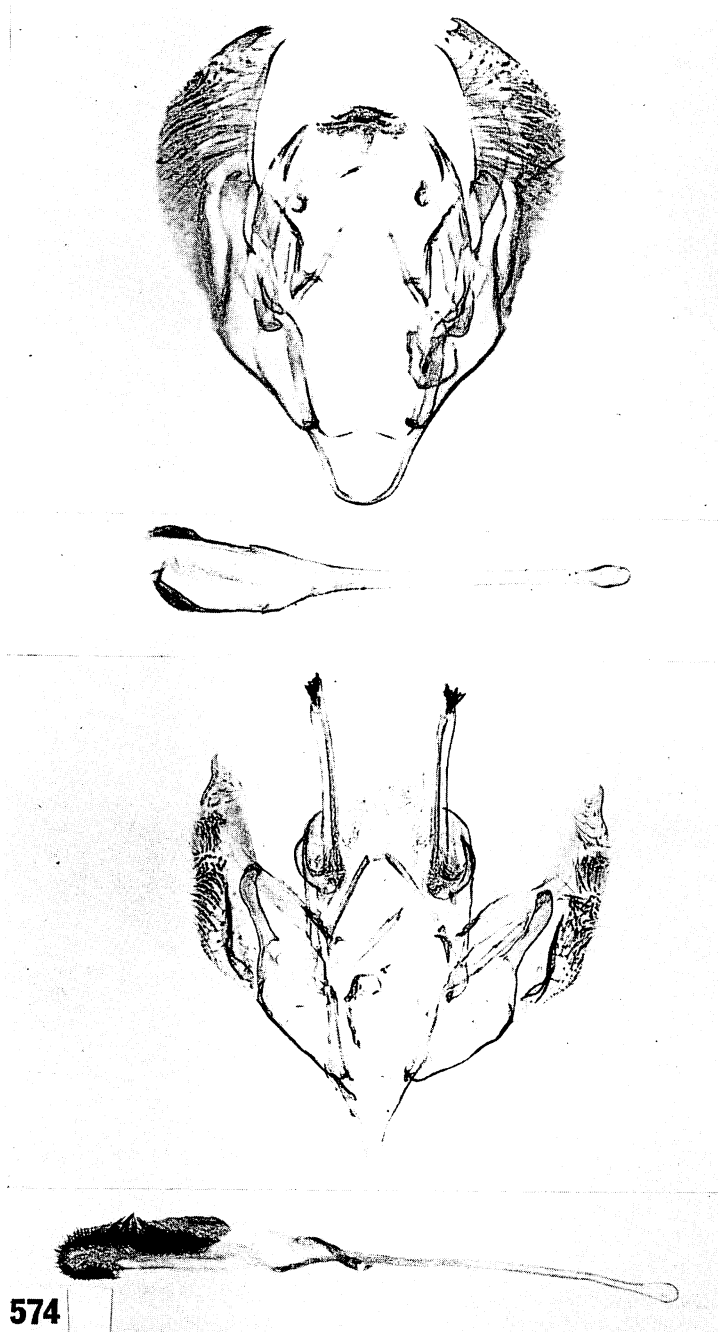


Figure 574—Male genitalia of *Carposina*. Top, *inscripta* (Walsingham), holotype (BM slide 1849); Kilauea, Hawaii. Bottom, *irrorata* (Walsingham), holotype (BM slide 1864); Lanai, 3,000 feet.

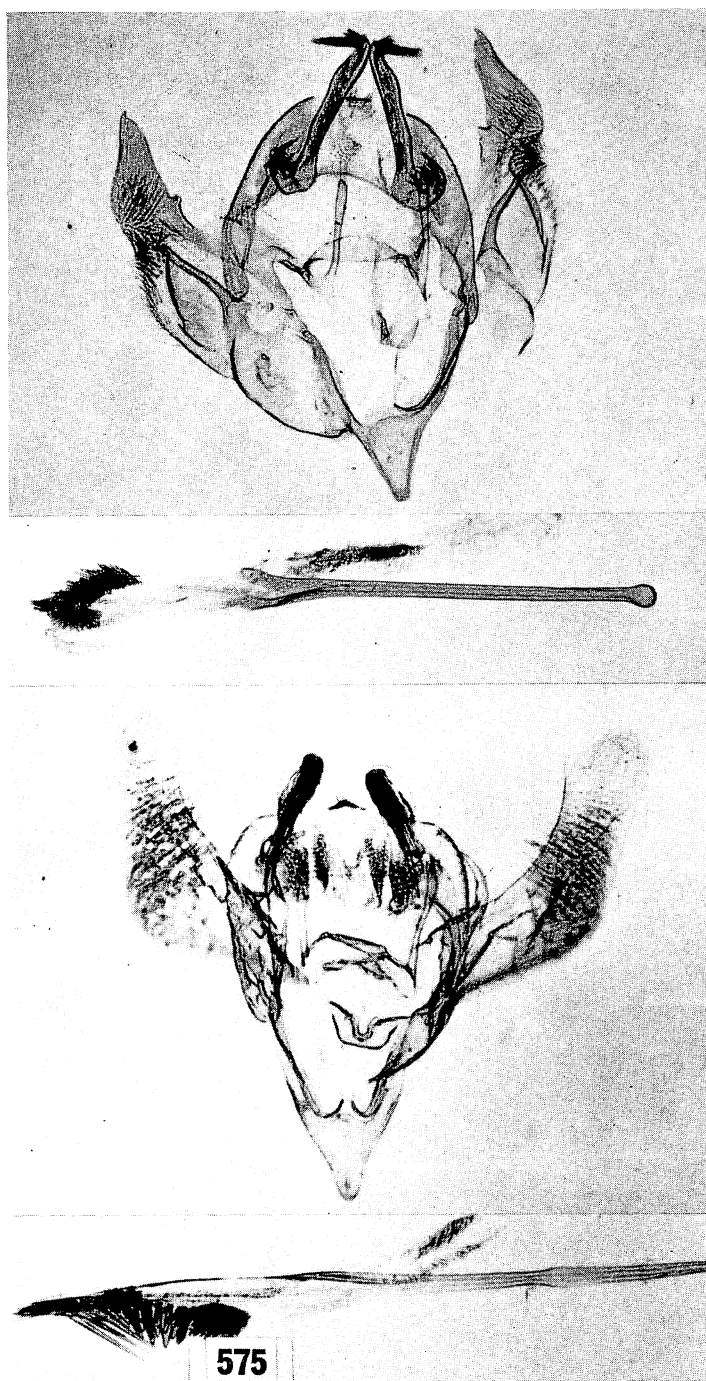
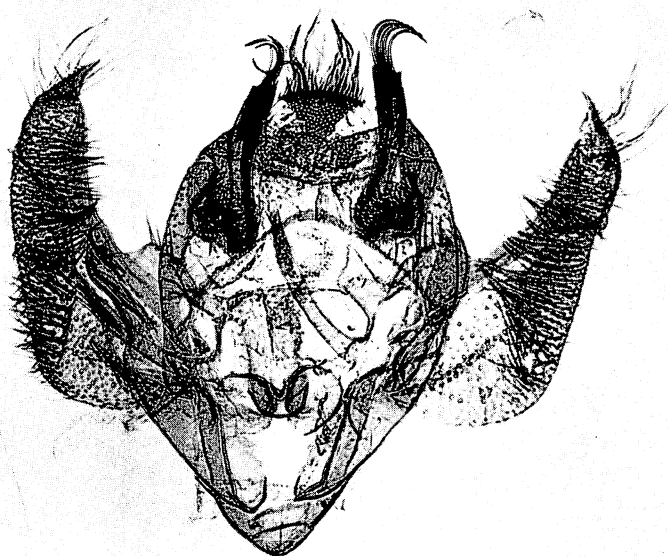
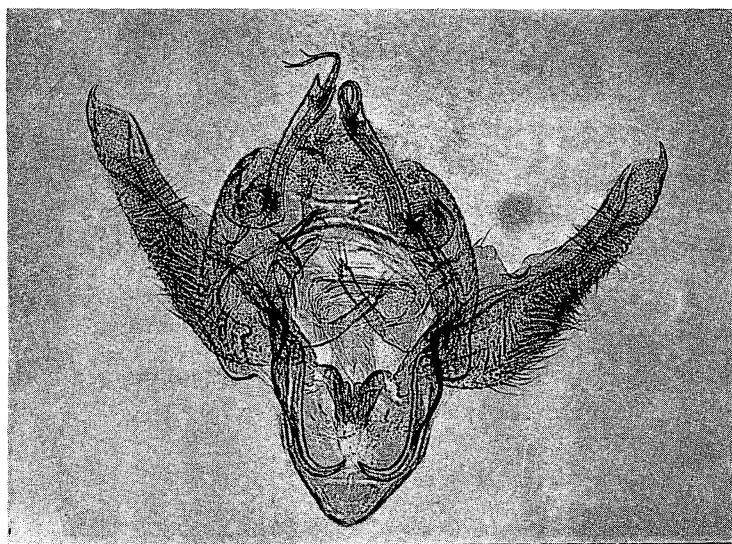


Figure 575—Male genitalia of *Carposina*. Top, *mauii* (Walsingham), allotype (BM slide 1869); Haleakala, 5,000 feet, Maui. Note the dentiform processes on the costae of the valvae. Bottom, *nigromaculata* (Walsingham), allotype (BM slide 3910); Waianae Mts., above 2,000 feet, Oahu. Note the unusually broad apices of the valvae.



576

Figure 576—Male genitalia of *Carposina*. Top, *nigronotata* (Walsingham), allotype (BM slide 3911); Kilauea, Hawaii; see also figure 577. Bottom two figures are from a specimen incorrectly determined by Dr. Swezey as *nigronotata*, but it is evidently *subumbrata*; Halawa, Oahu; ex *Myrsine* (slide Z-V-7-61-2).



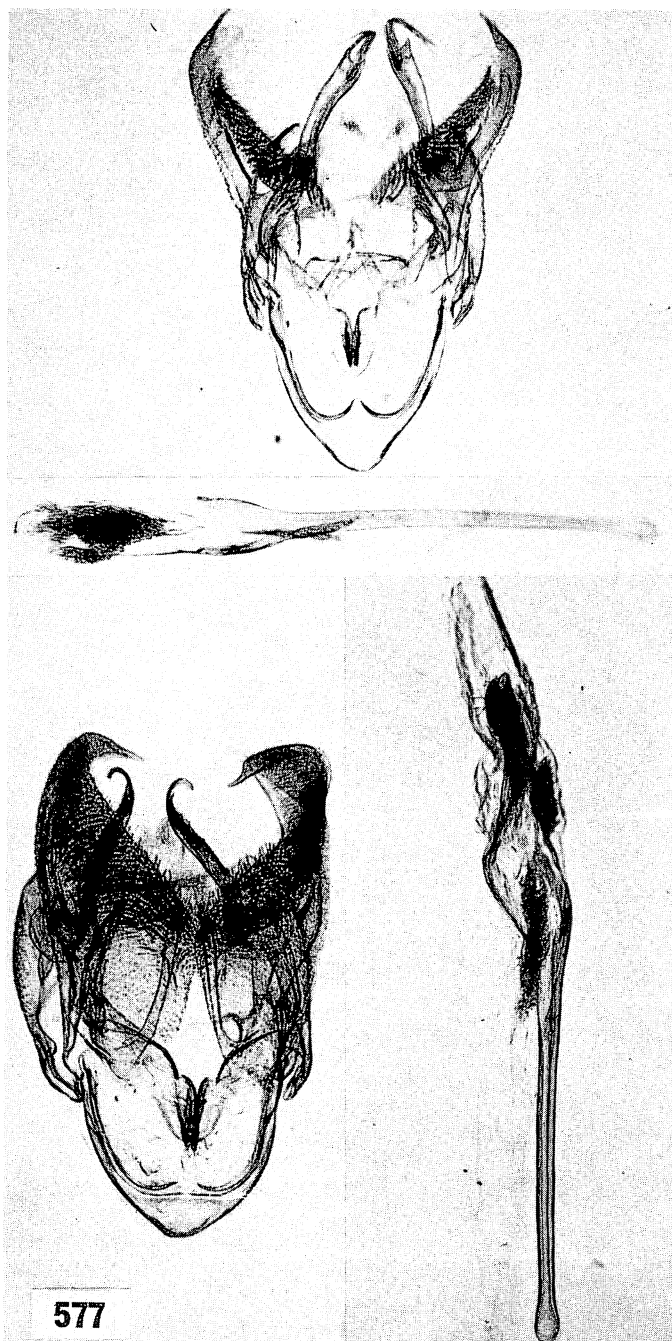


Figure 577—Male genitalia of *Carposina*. Top, *nigronotata* (Walsingham), allotype (BM slide 3911); Kilauea, Hawaii. Compare figure 576. Bottom, *olivaceonitens* (Walsingham), allotype (BM slide 3914); Kauai, 3,000 to 4,000 feet. See figure 578 of this specimen after remounting.

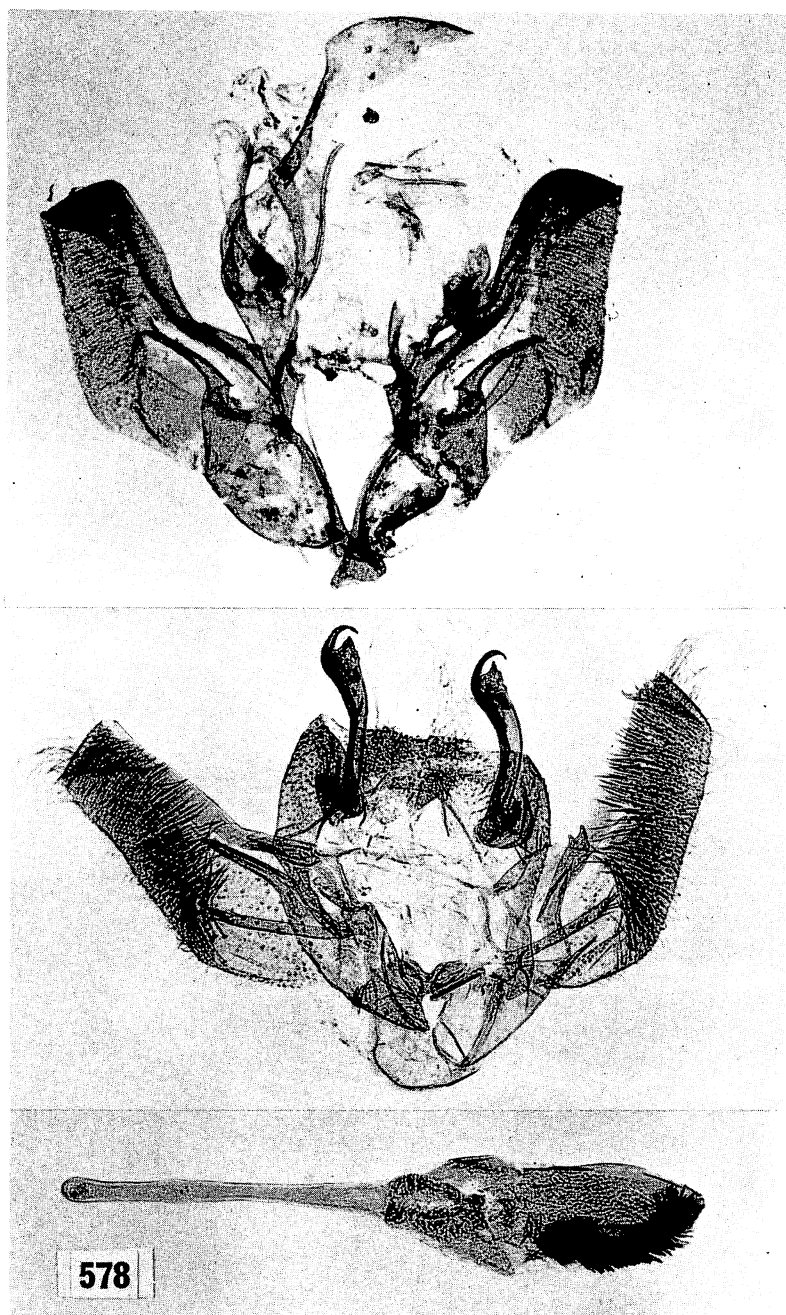


Figure 578—Male genitalia of *Carposina olivaceonitens* (Walsingham). Top, allotype (BM slide 3914), damaged during remounting (see figure 577 of this before remounting); Kauai, 3,000 to 4,000 feet. Bottom, a specimen from Makaleha, Oahu; ex *Pouteria* (= *Sideroxylon*) (slide V-7-61-3). Note that on the processus of the right sacculus the apical teeth are visible, but on the left sacculus and on the upper figure they cannot be seen because of their positions.

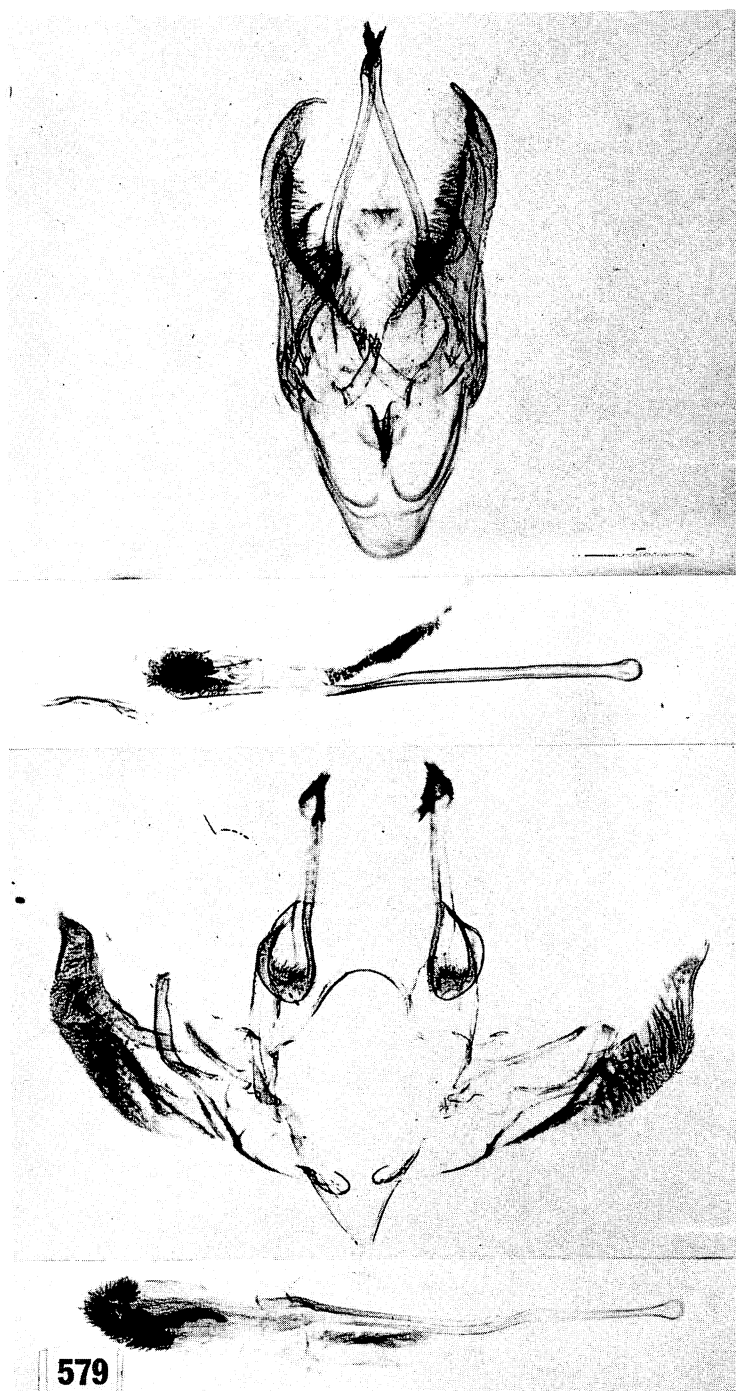


Figure 579—Male genitalia of *Carposina*. Top, *plumbeonitida* (Walsingham), allotype (BM slide 3915); Kaholuamano, 4,000 feet, Kauai; note the dentate apices of the crossed arms of the anellus; compare figure 580. Bottom, *punctulata* (Walsingham), allotype (BM slide 1843); Molokai, 4,000 feet.

**580**

Figure 580—Male genitalia of *Carposina*. Top, *plumbeonitida* (Walsingham), allotype (BM slide 3915, remounted; compare figure 579); Kahuluamano, 4,000 feet, Kauai. Bottom, *subolivacea* (Walsingham), allotype (BM slide 3916, remounted; compare figure 584); Lanai, 2,000 feet.

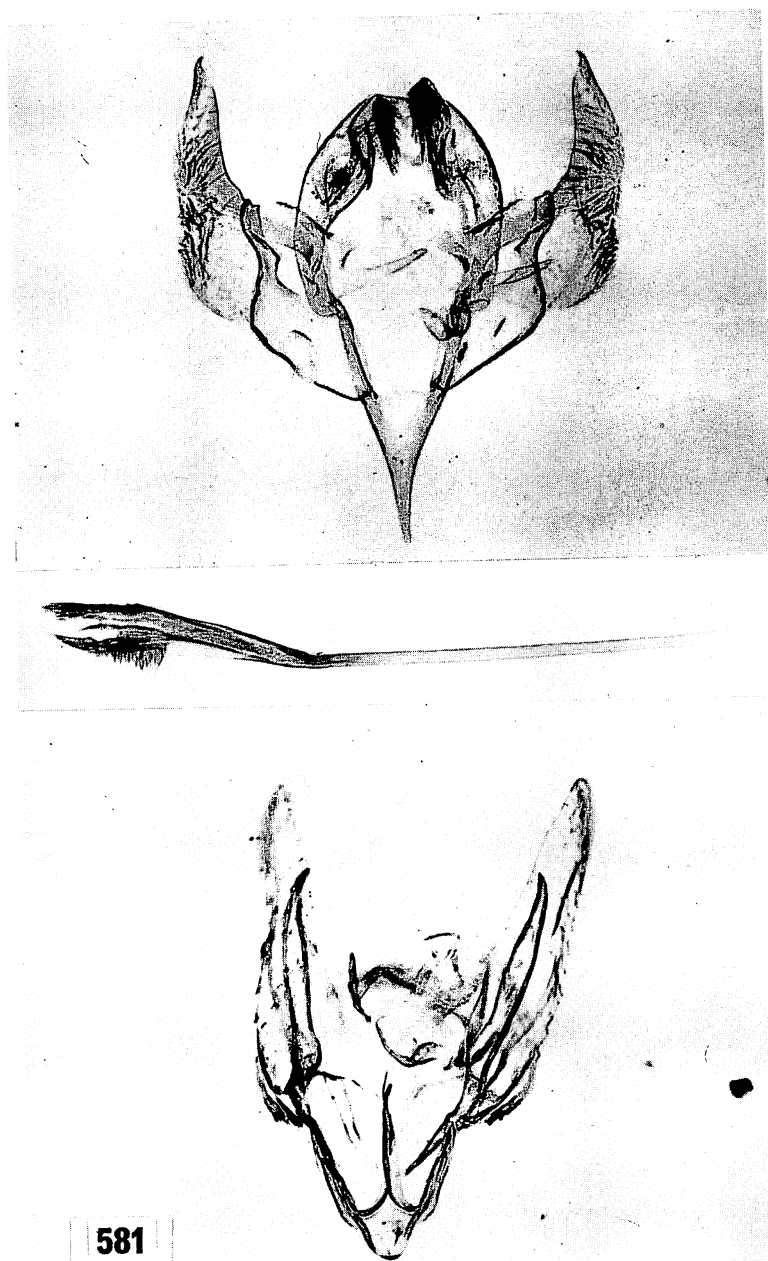


Figure 581—Male genitalia of *Carposina*. Top and middle, *pusilla* (Walsingham), holotype (BM slide 1851); Waianae Mts., Oahu. Bottom, *pygmaeella* (Walsingham), holotype (BM slide 3909); Kona, 3,000 feet, Hawaii. The rounded apices of the valvae are not spined; anellar lobes reduced or obsolete; gnathus obsolete; processus of sacculus long and daggerlike, its apex not dentate and reaching as far as distal fourth of the valva. (This is a poor and misleading preparation; compare figure 582.)

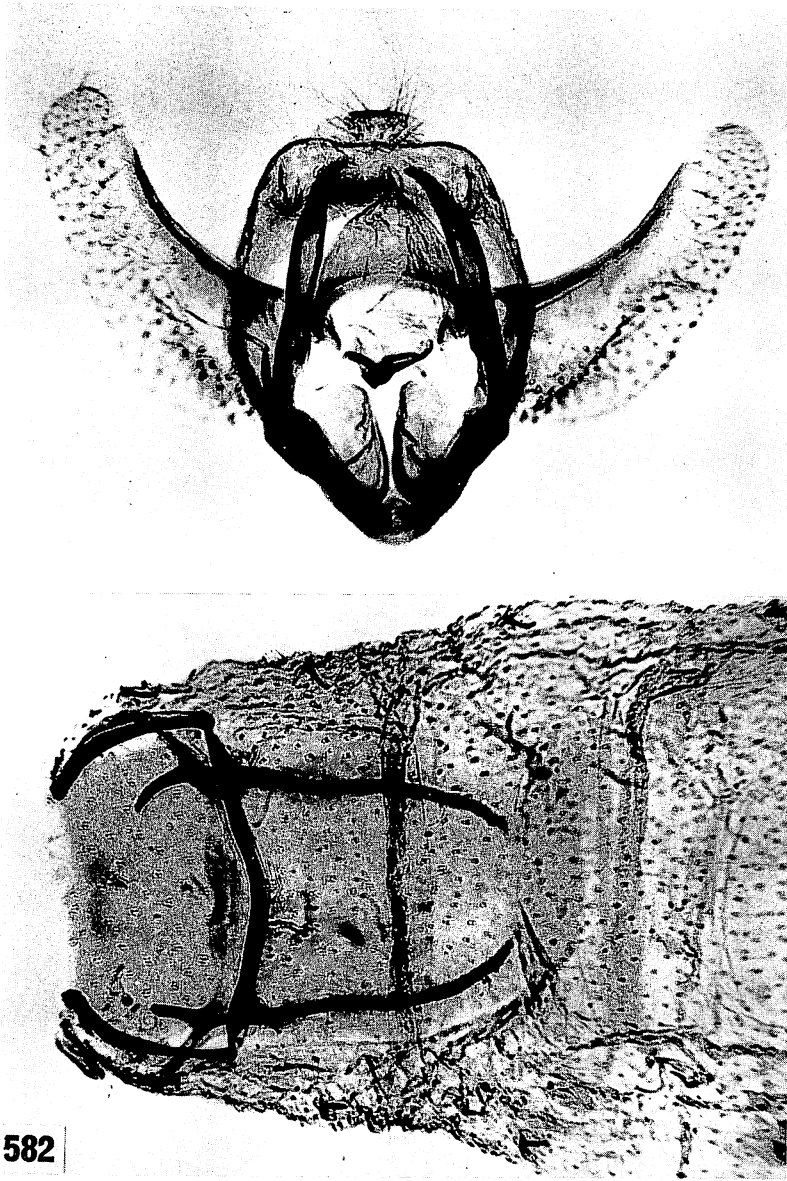
**582**

Figure 582—*Carposina pygmaeella* (Walsingham), male genitalia and base of abdomen of a paratype (BM slide 15851); Kona, 2,000 feet, Hawaii. The anellar lobes are obsolete; compare figure 581.

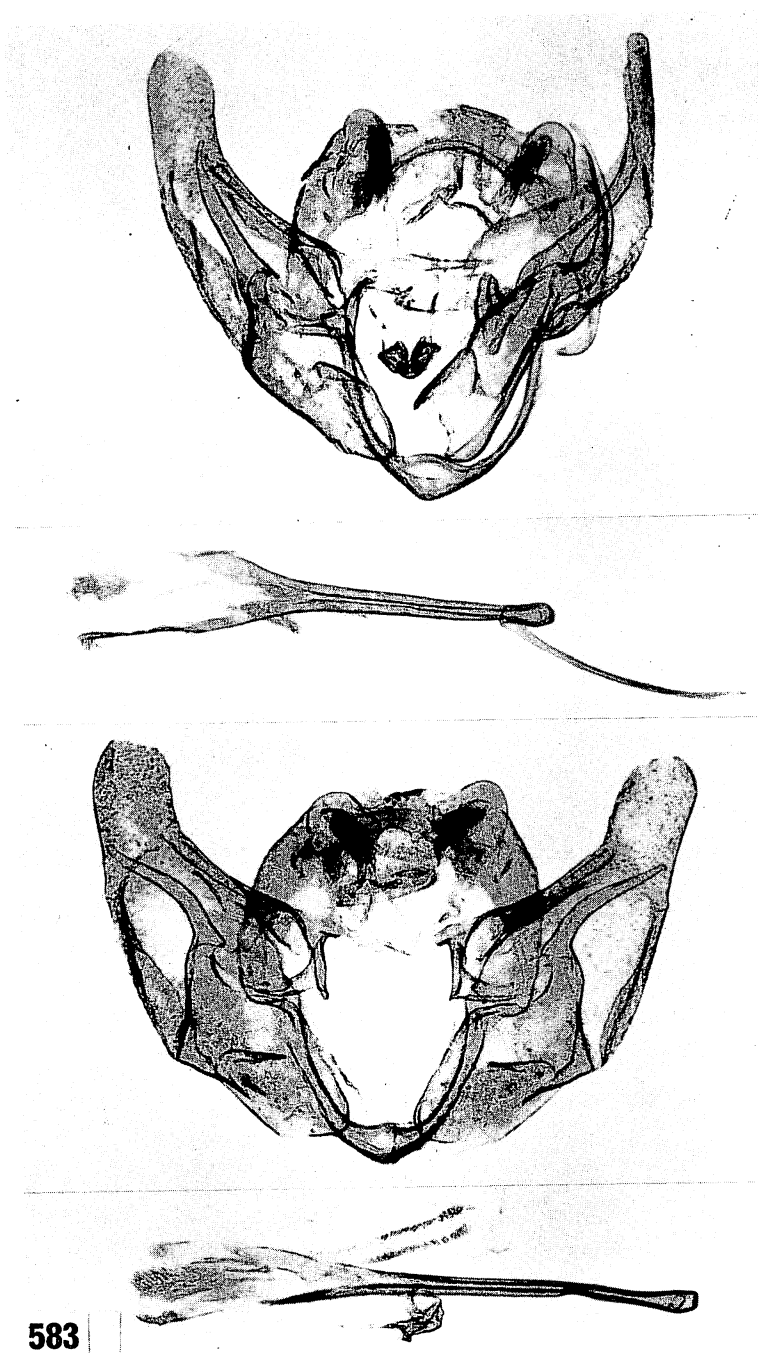


Figure 583—Male genitalia of *Carposina*. Top, *semitogata* (Walsingham), allotype (BM slide 3879); Kauai, 3,000 to 4,000 feet. Bottom, *piperatella* (Walsingham), allotype (BM slide 3878); Kaholuamano, 4,000 feet, Kauai. These may prove to be the same species, but there appear to be differences in the processus of the sacculus. They were described as "varieties" of *corticella*, but that is a distinct species.

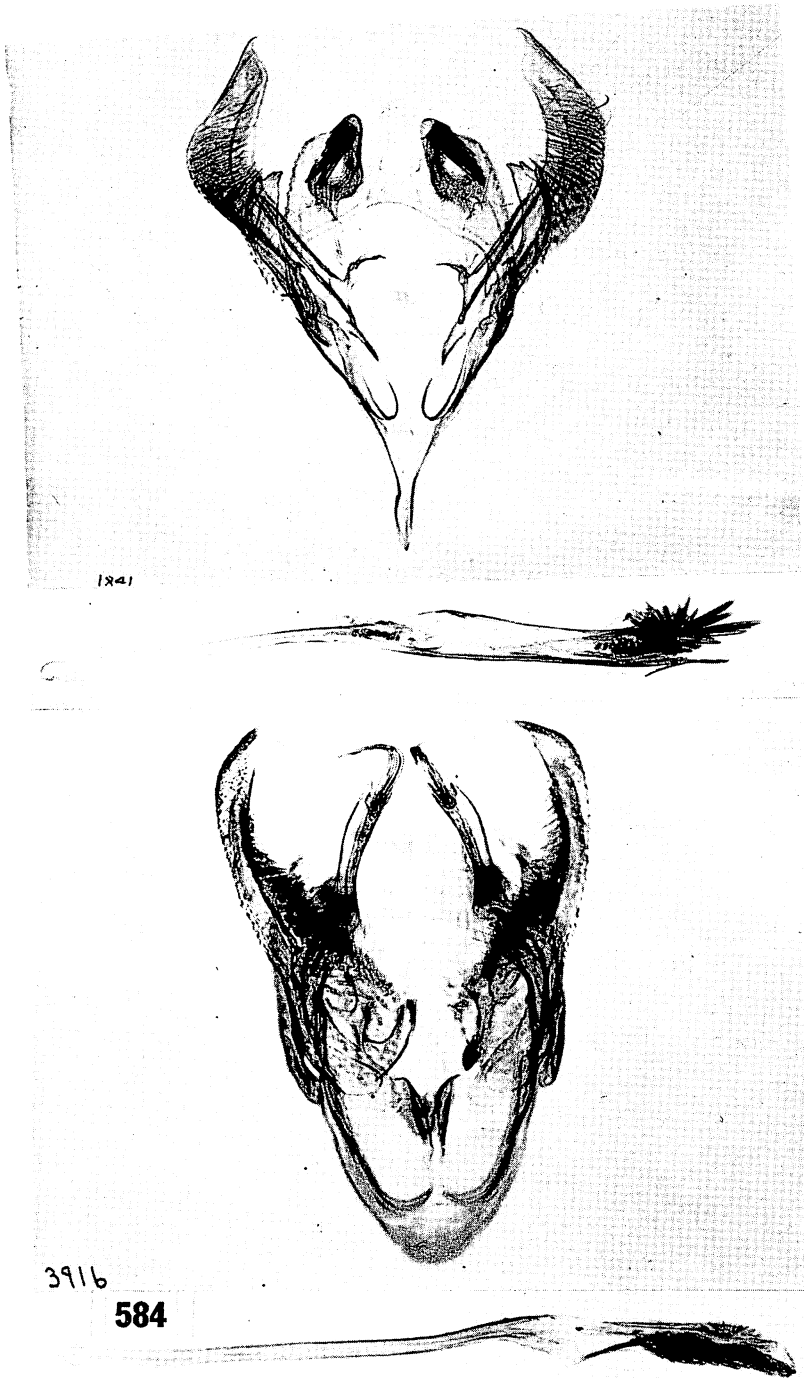


Figure 584—Male genitalia of *Carposina*. Top, *solutella* (Walsingham), allotype (BM slide 1841); Kilauea, Hawaii. Bottom, *subolivacea* (Walsingham), allotype (BM slide 3916); Lanai, 2,000 feet; compare figure 580.



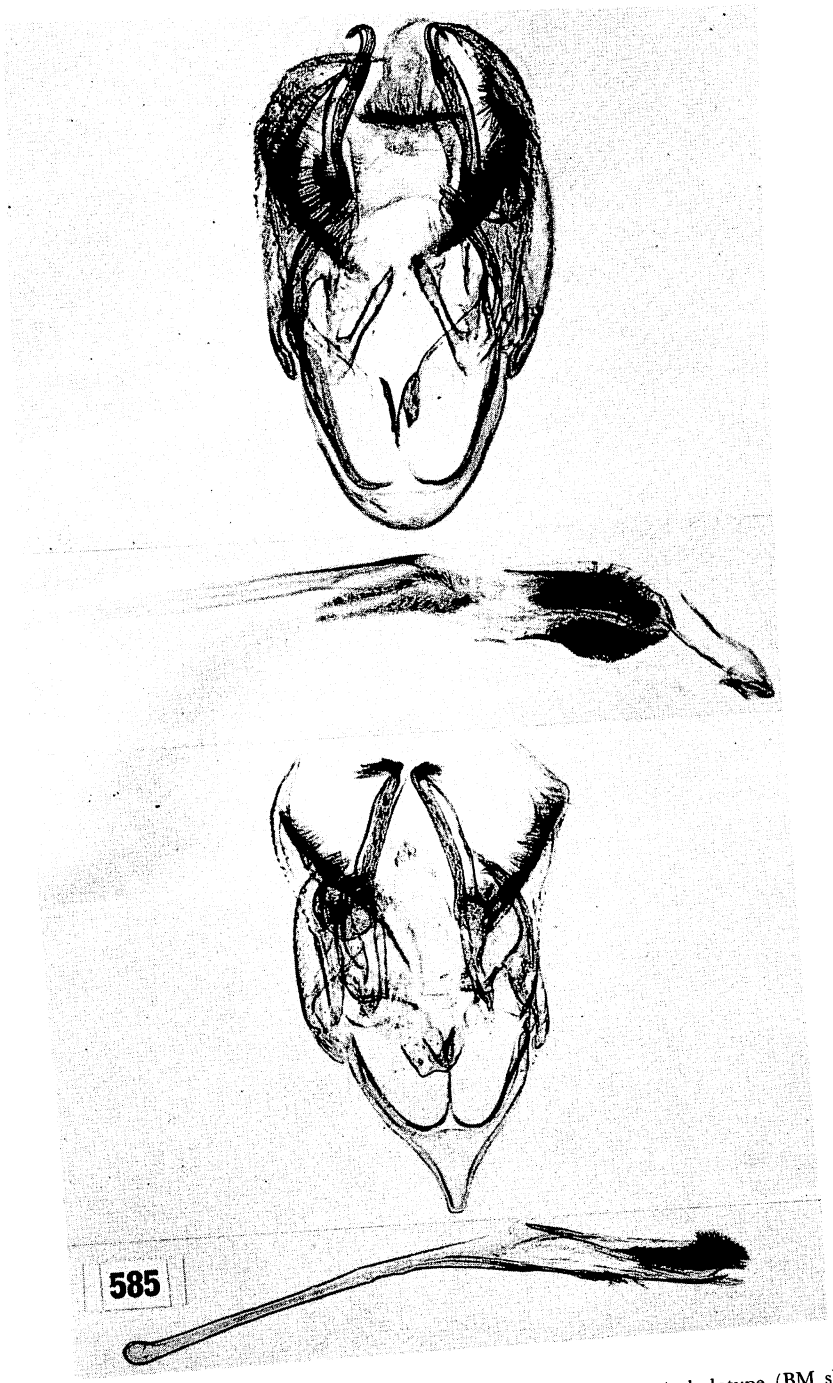


Figure 585—Male genitalia of *Carposina*. Top, *subumbrata* (Walsingham), holotype (BM slide 39); Waianae Mts., Oahu; compare figure 586. Bottom, *togata* (Walsingham), allotype (BM slide 39); Haleakala, 5,000 feet, Maui; compare figure 586.

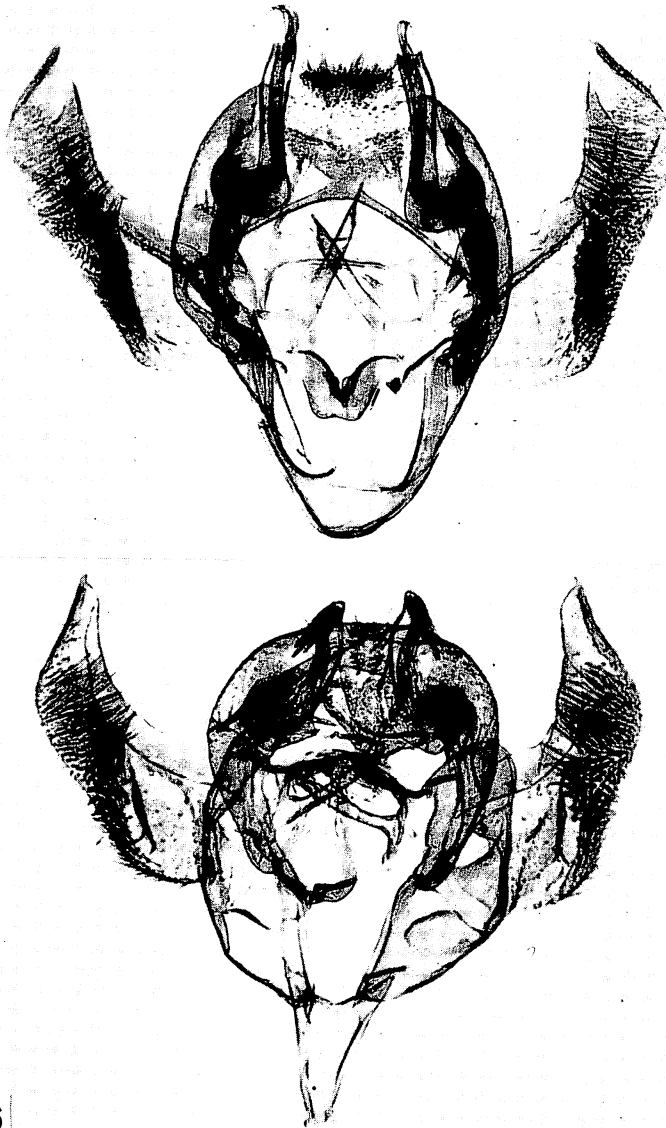
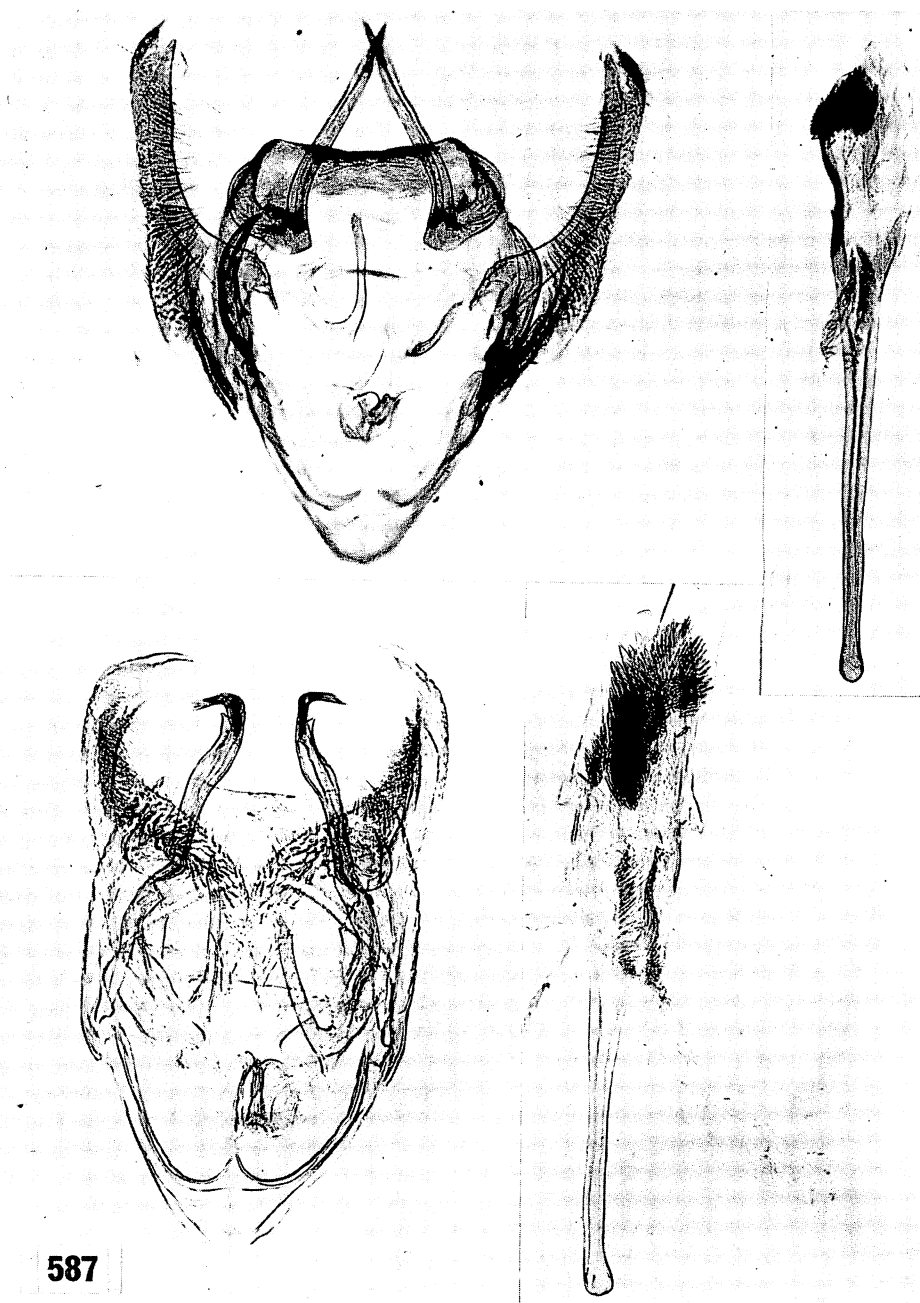
**586**

Figure 586—Male genitalia of *Carposina*. Top, *subumbrata* (BM slide 15820, compare figure 585); northwest Koolau Mts., Oahu. Bottom, a specimen of a species erroneously designated as a paratype of *togata* (Walsingham); Maui, 5,000 feet (BM slide 15848); compare figure 585.



587

Figure 587—Male genitalia of *Carposina*. Top, *saurates* Meyrick, lectotype (BM slide 9533 Clarke); Koolau Mts., Oahu. Compare figure 569, 573. Bottom, *viridis* (Walsingham)?, determined by Dr. Swezey (slide JDB-8).

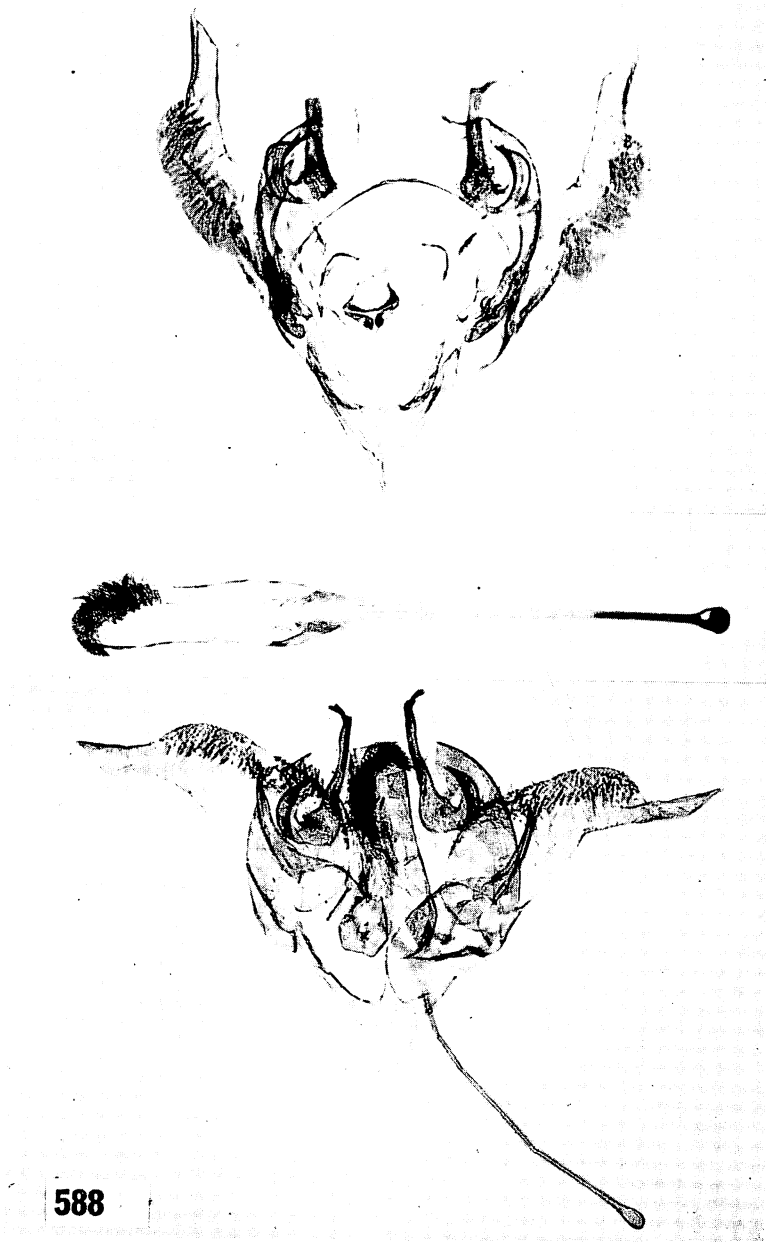


Figure 588—Male genitalia of *Carposina trigonotata* (Walsingham): Top, holotype (BM slide 1846); Molokai, 4,000 feet. Bottom, a paratype (Busck slide 197; Walsingham specimen 26365); Molokai; aedeagus in situ. These genitalia differ from those of a paratype from Maui (Busck slide 189; Walsingham specimen 28135); study of the variation is required.

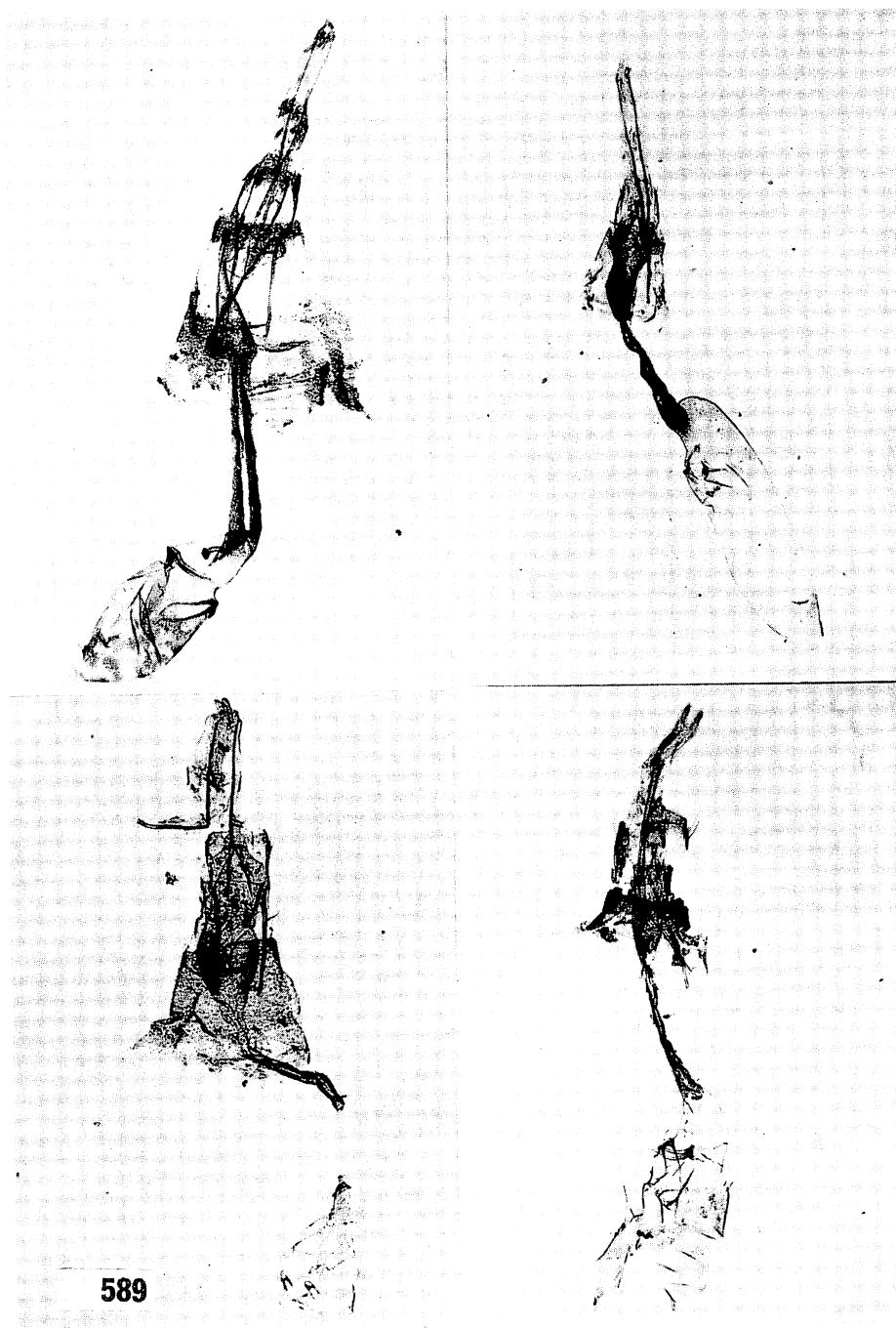


Figure 589—Female genitalia of *Carposina*. Top left, *cervinella* (Walsingham), allotype (BM slide 7533); Kaholuamano, 4,000 feet, Kauai; see enlarged ostium in figure 594. Top right, *crinifera* (Walsingham), allotype (BM slide 7540); Molokai, above 3,000 feet; see enlarged ostium in figure 593. Bottom left, *gracillima* (Walsingham), paratype (BM slide 8481); Kaholuamano, 4,000 feet, Kauai; enlargement of ostium in figure 596. Bottom right, *graminis* (Walsingham), holotype (BM slide 7539); Kauai, 3,000 to 4,000 feet; see figure 596 for enlargement of ostium. Note the different positions of the signa. The two specimens at bottom are partly decomposed.

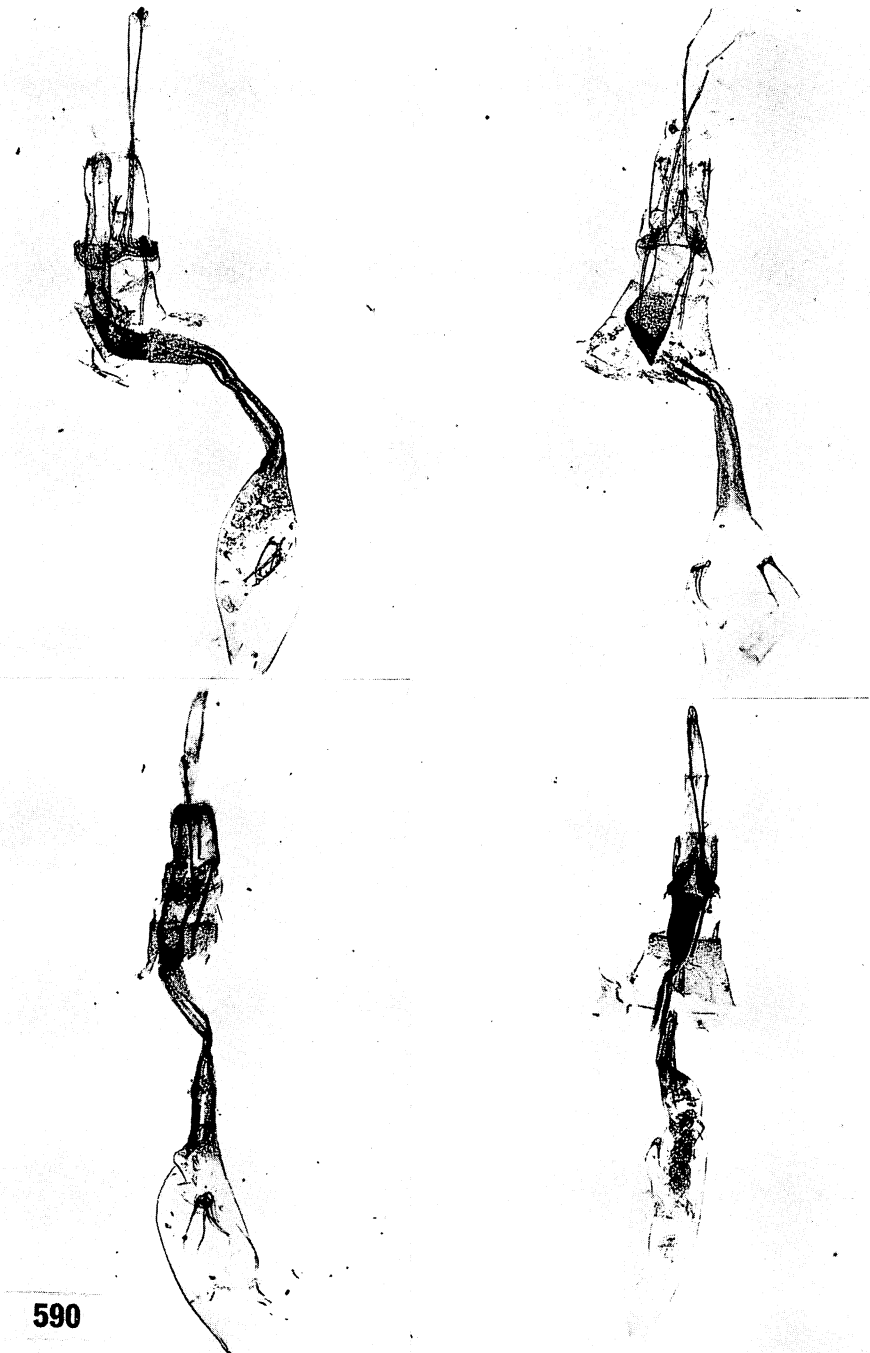


Figure 590—Female genitalia of *Carposina*. Top left, *divaricata* (Walsingham), allotype (BM slide 7536); Kauai, 3,000 to 4,000 feet; see figure 596 for enlargement of ostium. Top right, *mauii* (Walsingham), holotype (BM slide 7535); Haleakala, 5,000 feet, Maui; ostium enlargement in figure 596. Bottom left, *nigromaculata* (Walsingham), allotype (BM slide 7534); Waianae Mts., 2,000 feet, Oahu; see figure 599 of enlarged ostium. Bottom right, *nigronotata* (Walsingham), holotype (BM slide 7546); Olaa, 2,000 feet, Hawaii; ostium enlargement on figure 599.

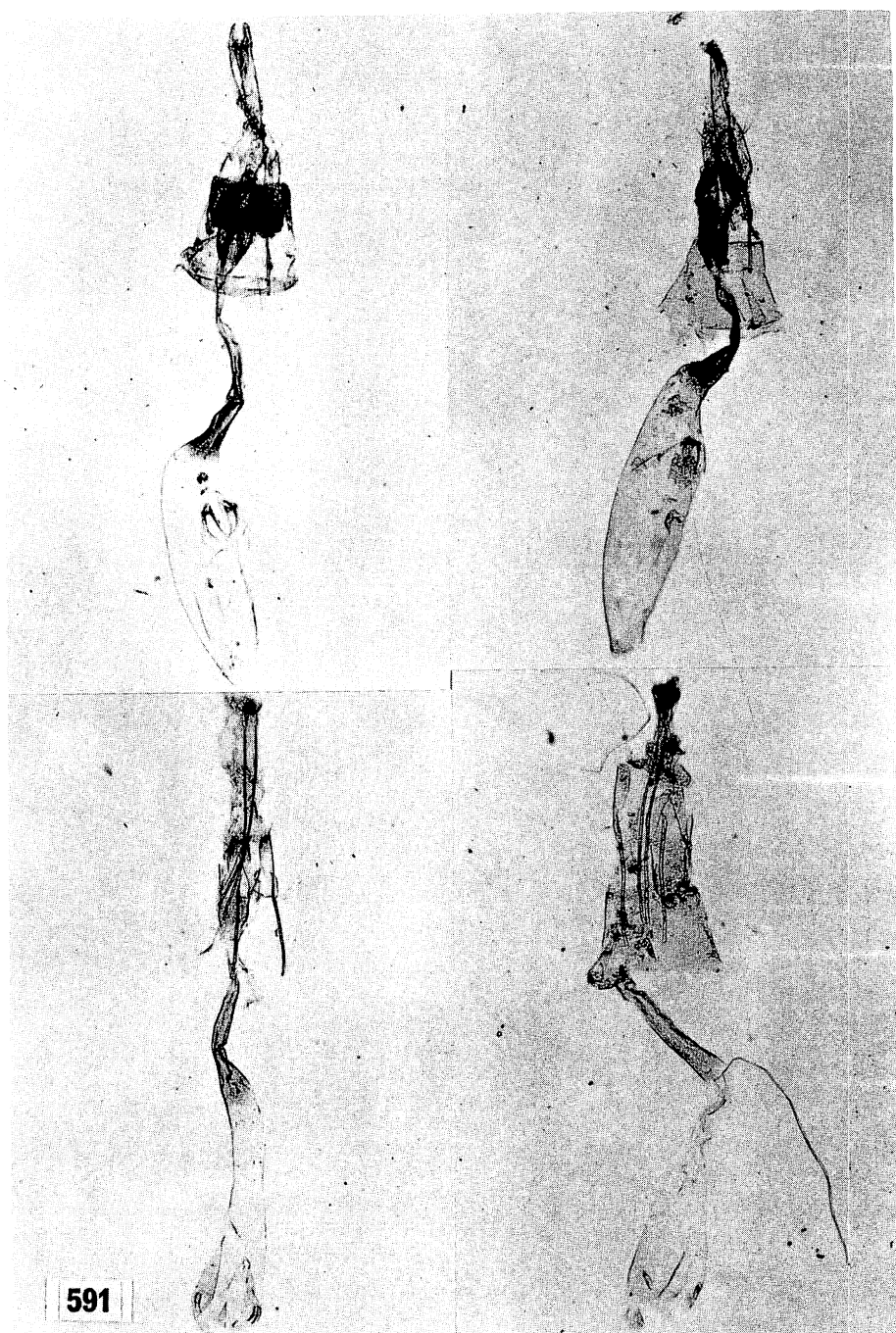


Figure 591—Female genitalia of *Carposina*. Top left, *plumbeonitida* (Walsingham), holotype (BM slide 7541); Kauai, 3,000 to 4,000 feet; ostium enlargement in figure 602. Top right, *subolivacea* (Walsingham), holotype (BM slide 7545); Lanai, 2,000 feet; ostium enlarged in figure 602. Bottom left, *piperatella* (Walsingham), holotype (BM slide 7542); Kauai, 3,000 to 4,000 feet; ostium enlarged in figure 599. Bottom right *semitogata* (Walsingham), holotype (BM slide 7543) (the thread at the right of the bursa is debris); Kauai, 3,000 to 4,000 feet; ostium enlarged on figure 599. The two figures at the bottom may represent the same species; see text for discussion. Note the differences in the positions of the signa in the top and bottom figures.

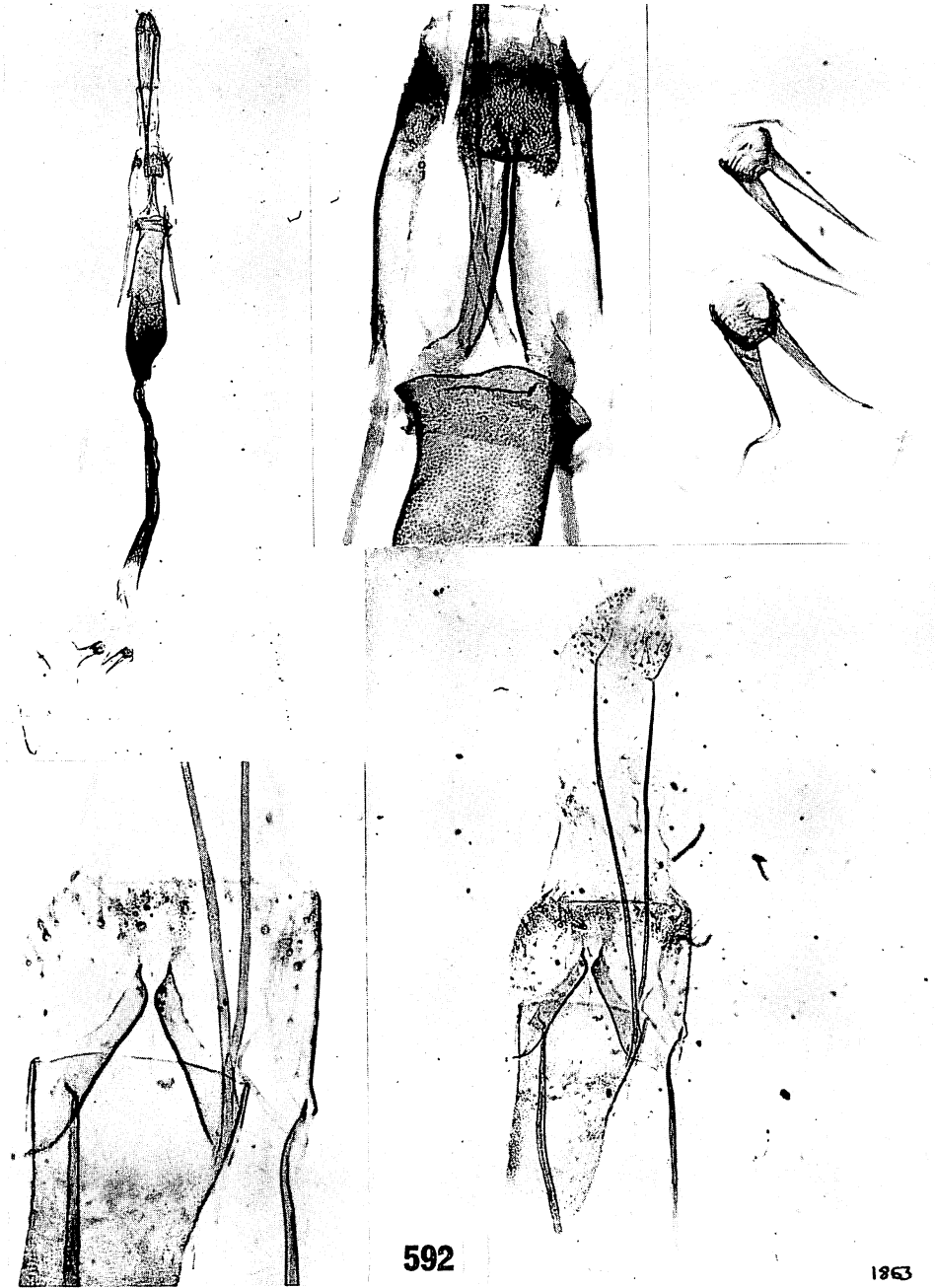


Figure 592—Female genitalia of *Carposina*. Top left, *achroana* (Meyrick), holotype (BM slide 1840); Mauna Loa, Hawaii. Bottom, *atronotata* (Walsingham), holotype (BM slide 1863); Haleakala, 10,000 feet, Maui. The signa are obsolete in this species; a small sclerotized macula in the wall of the bursa of the holotype may or may not represent the remnant of a signum. See also figure 593.





Figure 593—Female genitalia of *Carposina*. Top left, a specimen determined as *atronotata* (Walsingham) by Dr. Swezey; Kilauea section of Hawaii National Park (slide Z-V-4-61); signa obsolete. This is very close to the genitalia of the type, but there are minor differences; compare figure 592. Top right, *bicincta* (Walsingham), holotype (BM slide 7544); Molokai, about 4,000 feet; abdomen partly decomposed. Bottom left, *crinitifera* (Walsingham), allotype (BM slide 7540); Molokai, above 3,000 feet. Bottom right, *dispar* (Walsingham), holotype (BM slide 7538); Kaawaloa, 1,500 feet, Hawaii.

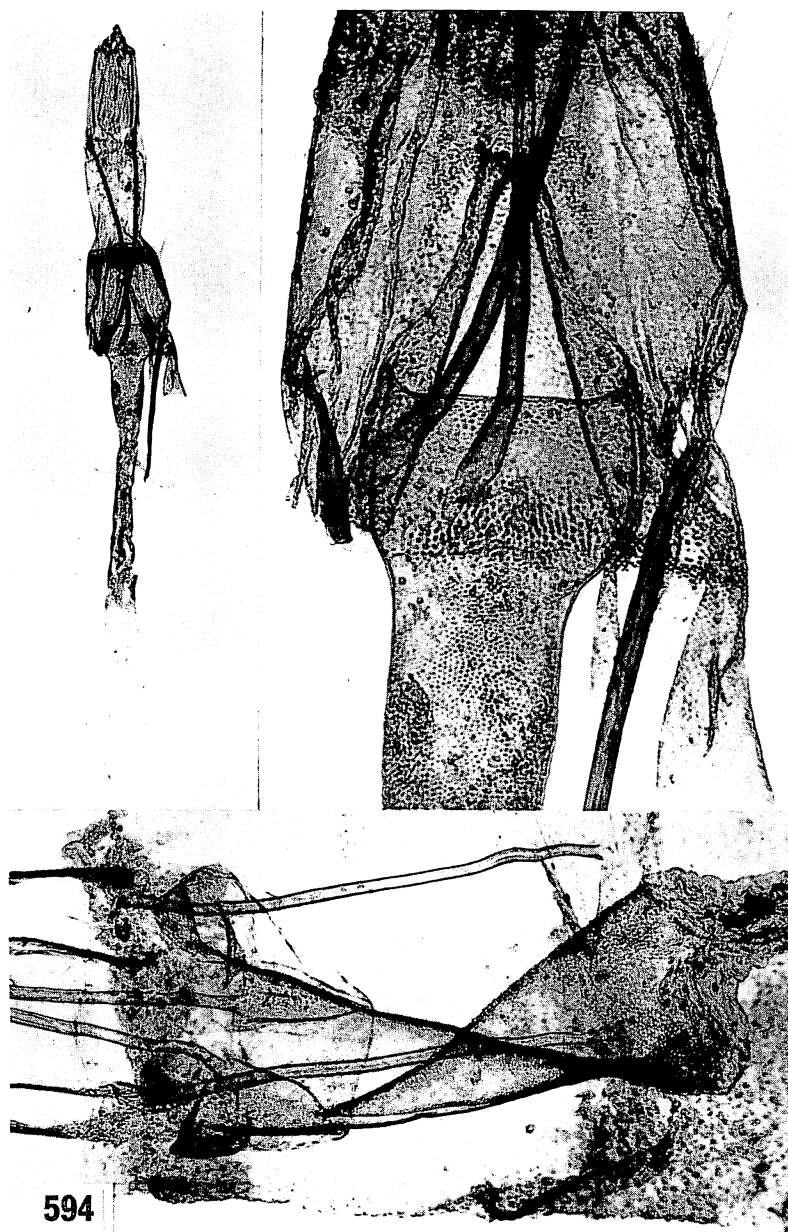


Figure 594—Female genitalia of *Carposina*. Top, *gemmata* (Walsingham), paratype (BM slide 14307); Olaa, 2,000 feet, Hawaii; there are no signa. Bottom, *cervinella* (Walsingham), allotype (BM slide 7533); Kaholuamano, 4,000 feet, Kauai; left is caudad; see figure 589 for entire genitalia.

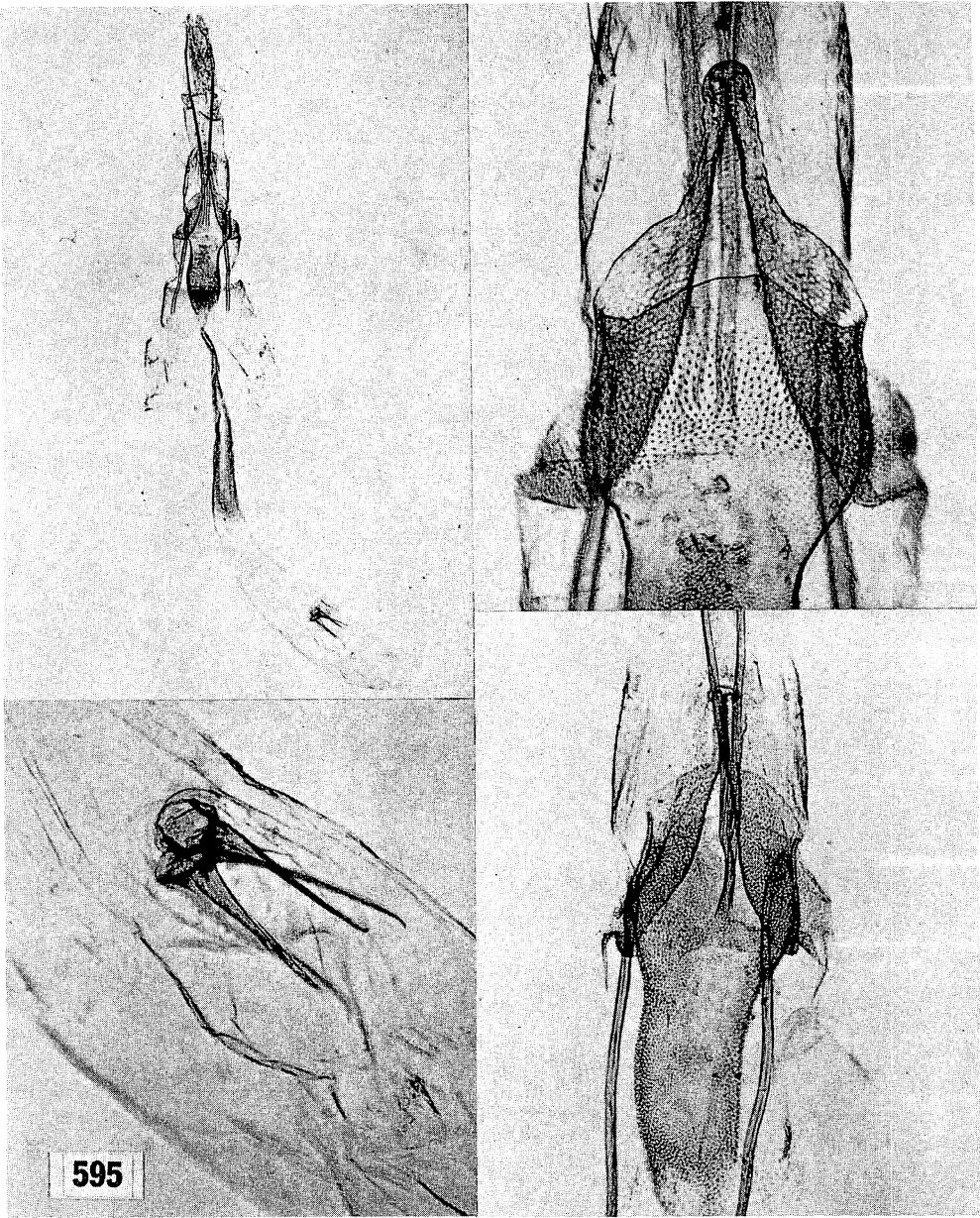


Figure 595—Female genitalia of *Carposina*. Top and bottom left, *graminicolor* (Walsingham), holotype (BM slide 3888); Kaholuamano, 4,000 feet, Kauai. Bottom right *distincta* (Walsingham), holotype (BM slide 3884); Kauai, 3,000 to 4,000 feet.

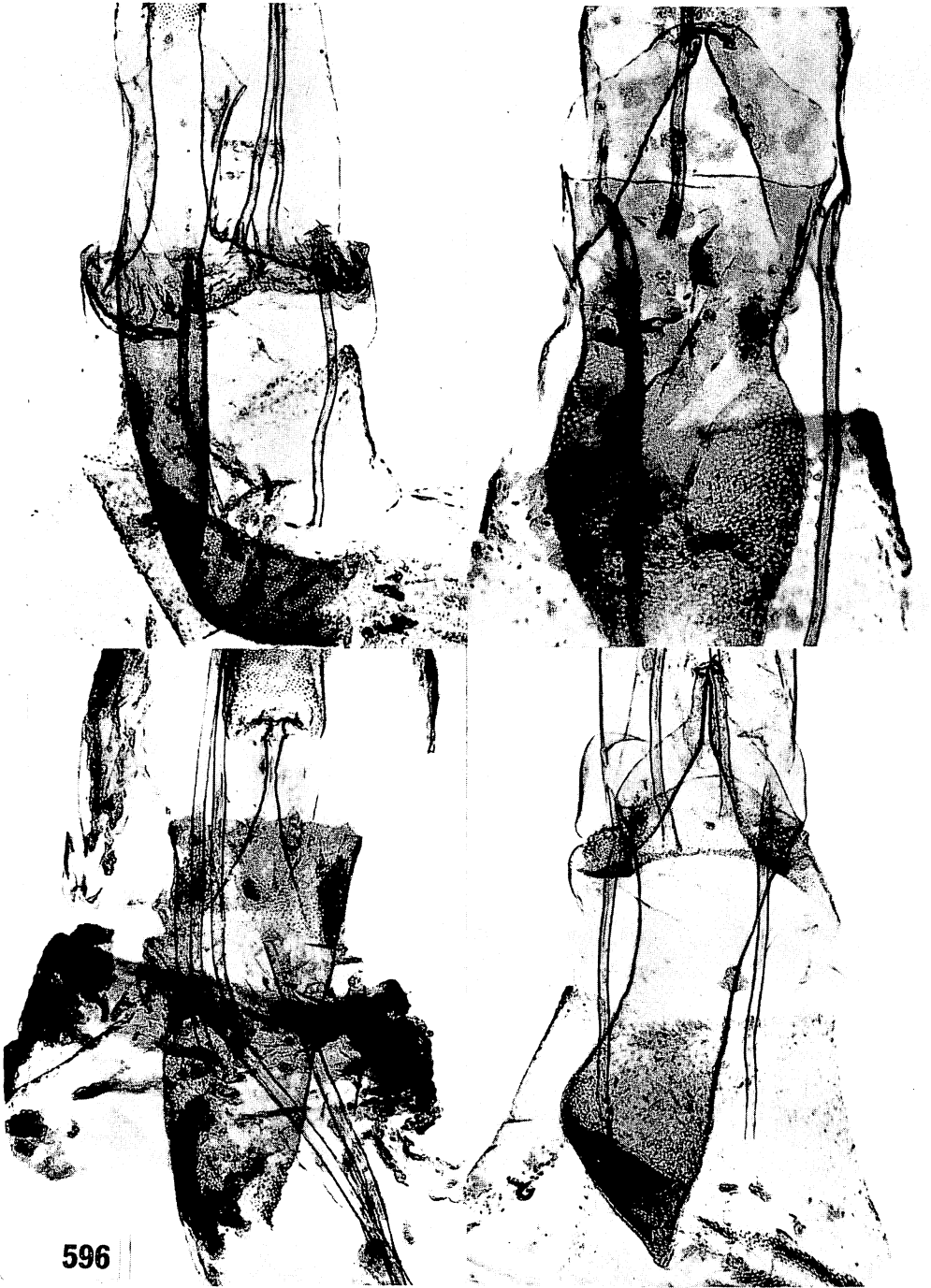


Figure 596—Female genitalia of *Carposina*. Top left, *divaricata* (Walsingham), allotype (BM slide 7536); Kauai, 3,000 to 4,000 feet. Top right, *gracillima* (Walsingham), paratype (BM slide 8481); Kaholuamano, 4,000 feet, Kauai. Bottom left, *graminis* (Walsingham), allotype (BM slide 7539); Kauai 3,000 to 4,000 feet; partly decomposed. Bottom right, *mauii* (Walsingham), holotype (BM slide 7535); Haleakala, 5,000 feet, Maui.

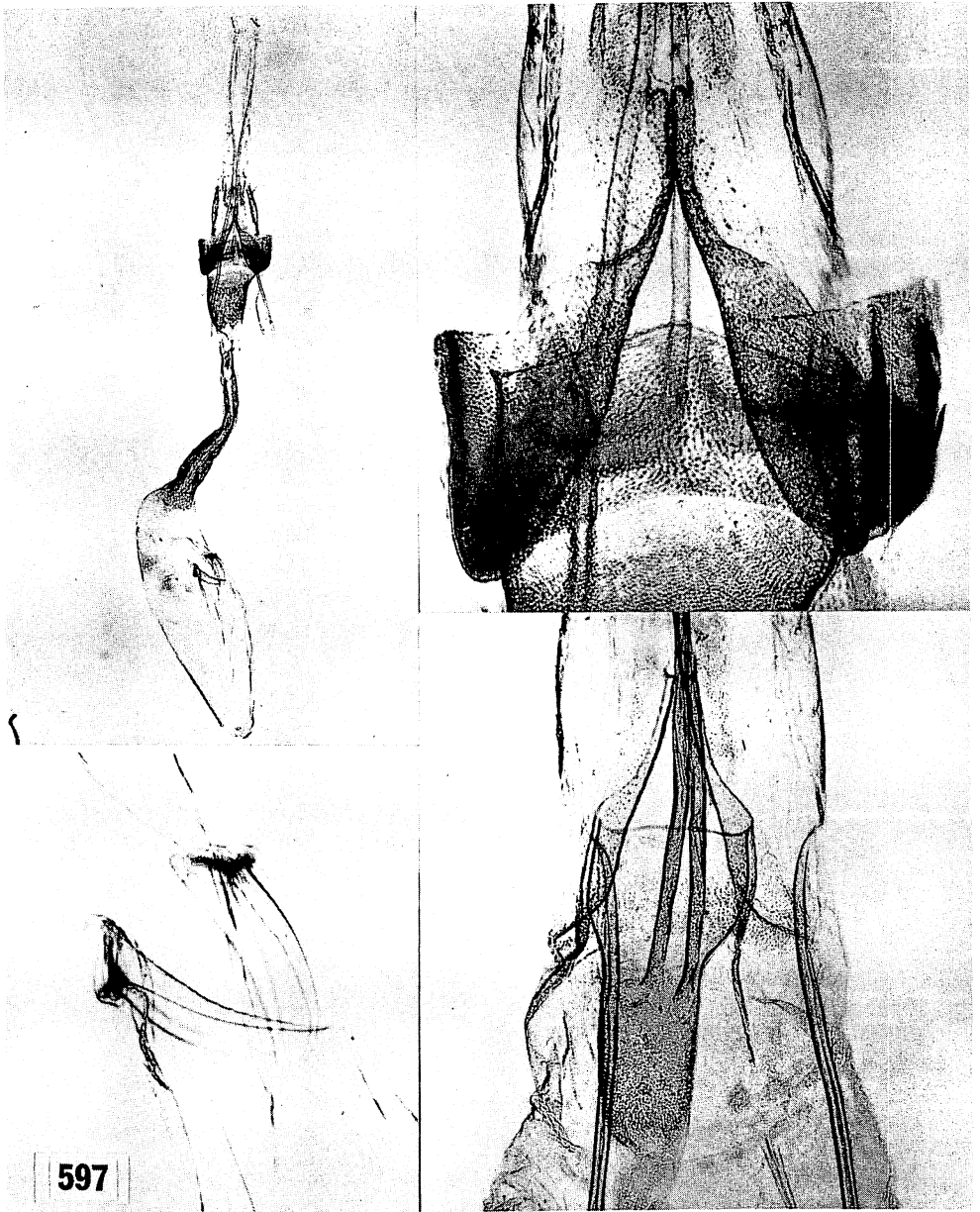


Figure 597—Female genitalia of *Carposina*. The top two figures and the signa at bottom left are *herbarum* (Walsingham), holotype (BM slide 3889); Lanai, 2,000 feet. Bottom right, *gemmata* (Walsingham), holotype (BM slide 3885); Oloa Hawaii.

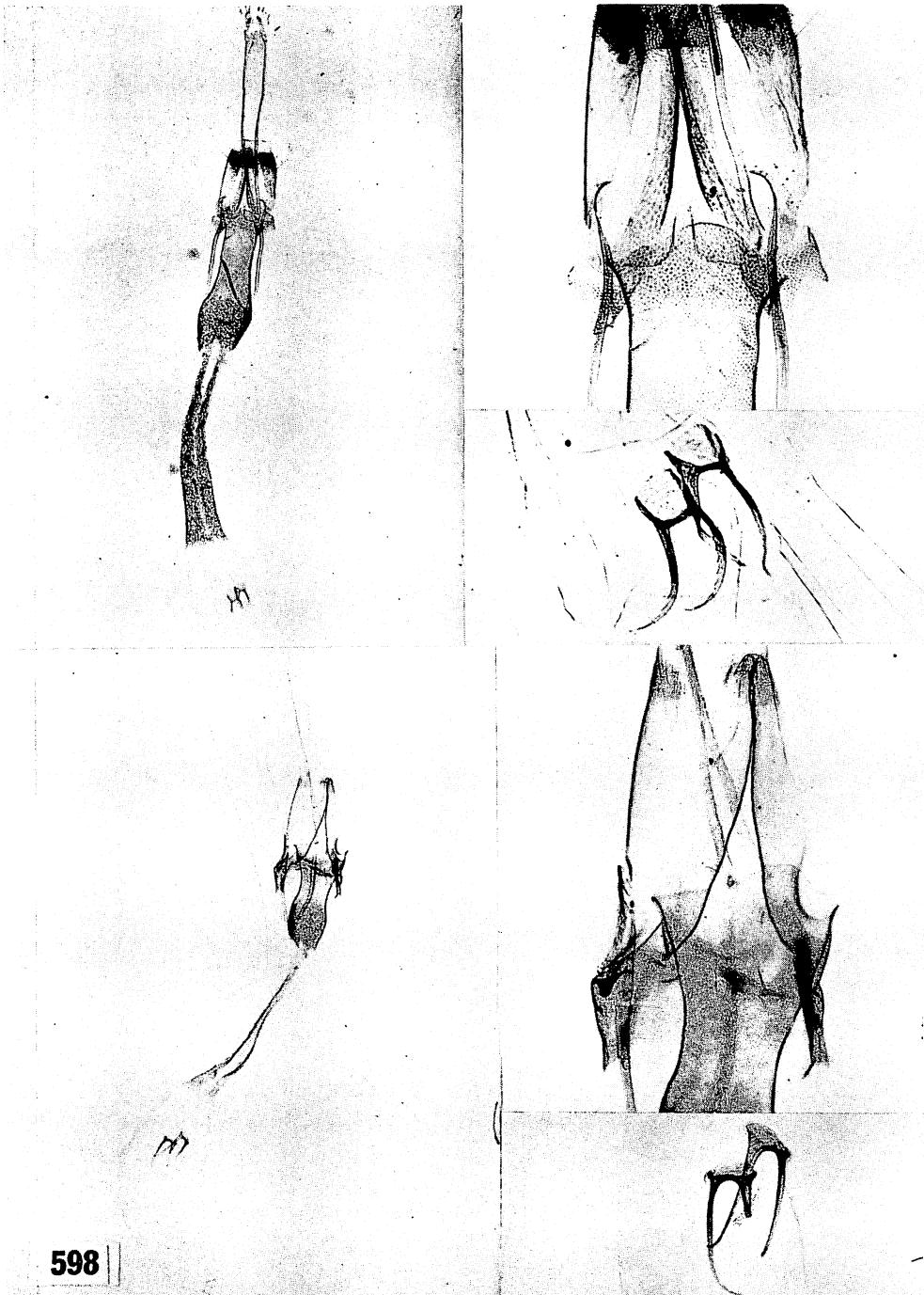


Figure 598—Female genitalia of *Carposina*. Top three figures, *inscripta* (Walsingham), allotype (BM slide 1805); Kilauea, Hawaii. Bottom three figures, *punctulata* (Walsingham), holotype; (BM slide 1844); Molokai, about 4,000 feet.



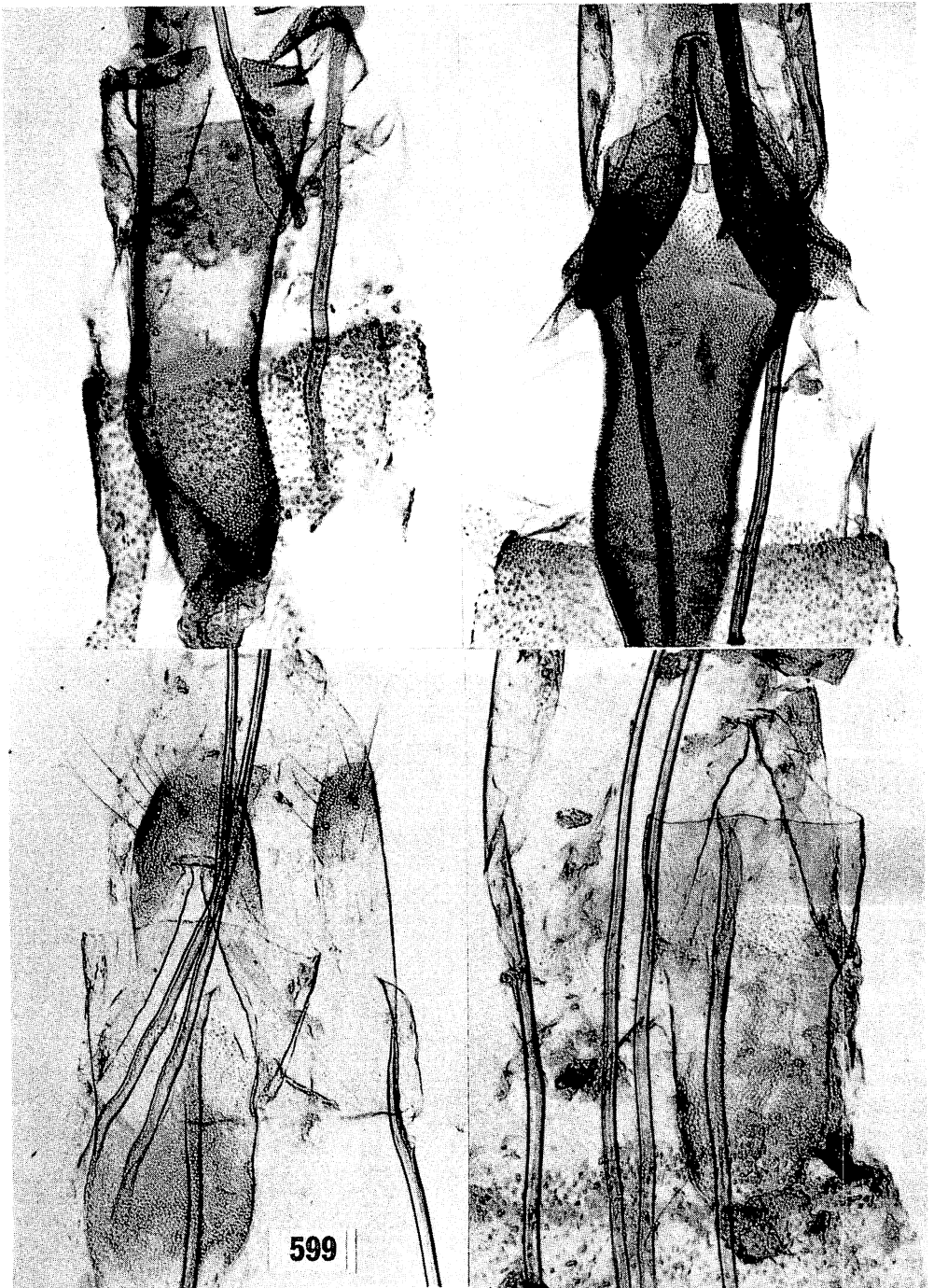


Figure 599—Female genitalia of *Carposina*. Top left, *nigromaculata* (Walsingham), holotype (BM slide 7534); Waianae Mts., 2,000 feet, Oahu. Top right, *nigronotata* (Walsingham), holotype (BM slide 7546); Olaa, 2,000 feet, Hawaii. Bottom left, *piperatella* (Walsingham), holotype (BM slide 7542); Kauai, 3,000 to 4,000 feet. Bottom right, *semitogata* (Walsingham), holotype (BM slide 7543); Kauai, 3,000 to 4,000 feet.

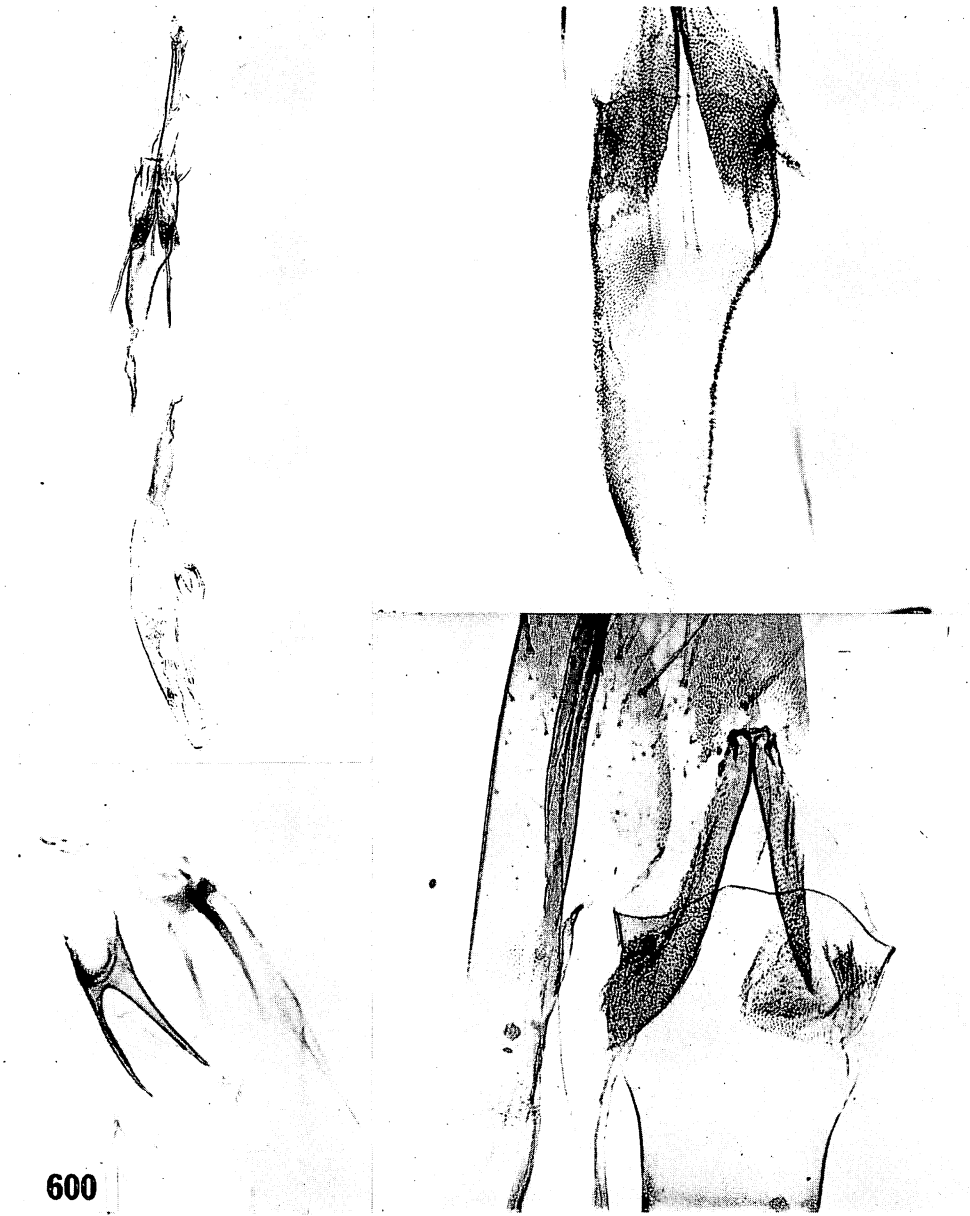


Figure 600—Female genitalia of *Carposina*. Top two figures and signa at bottom left, *latifasciata* (Walsingham), holotype (BM slide 3890); Kona, 3,500 feet, Hawaii. Bottom right, *olivaceonitens* (Walsingham), determined by Dr. Swezey (Busck slide 211); ex *Pouteria* (= *Sideroxylon*).



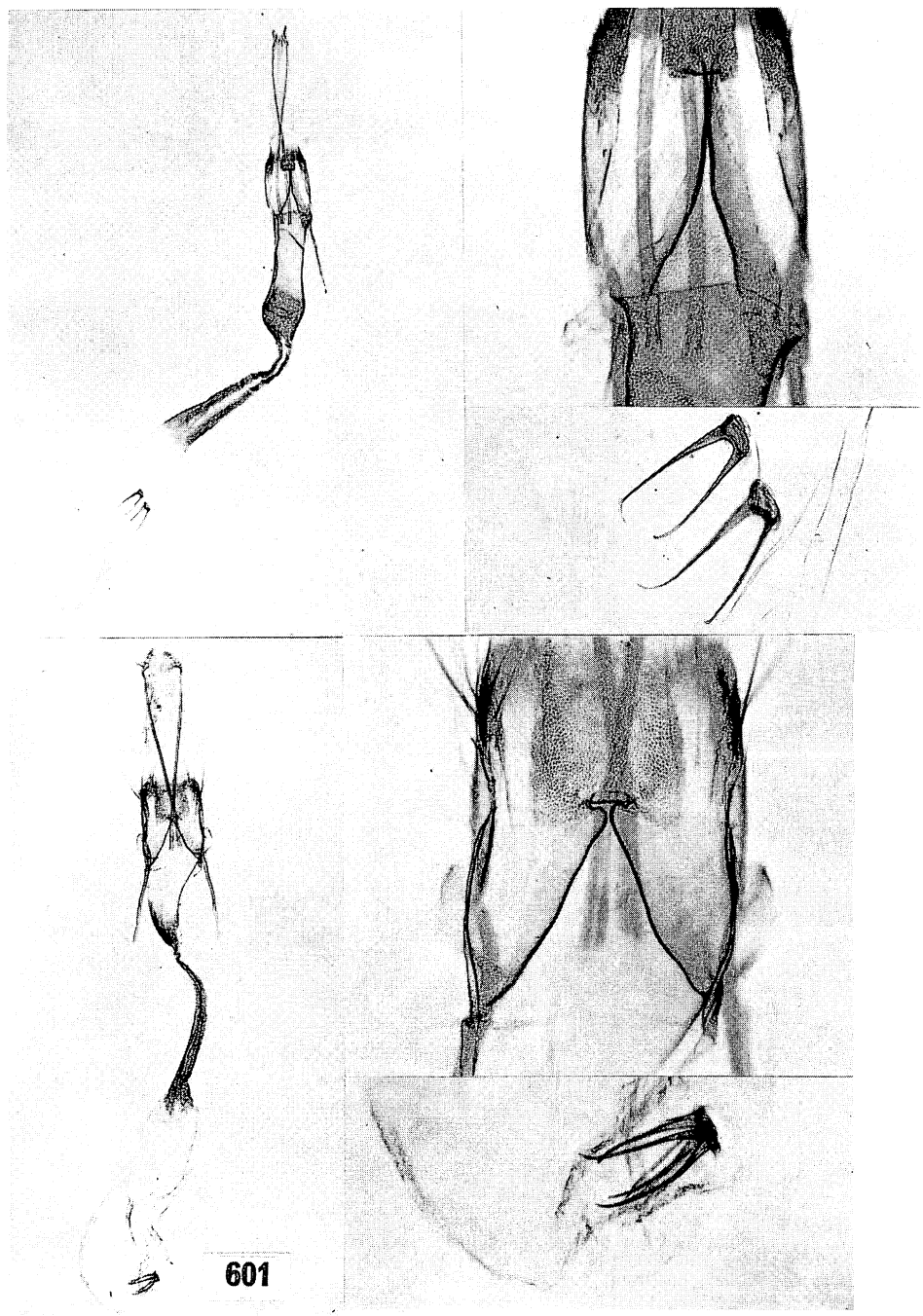


Figure 601—Female genitalia of *Carposina*. Top three figures, *solutella* (Walsingham), holotype (BM slide 1842); Kilauea, Hawaii. Bottom three figures, *tineta* (Walsingham), holotype (BM slide 3892); Olaa, Hawaii. Note the different positions of the signa on the bursa of these two species.



Figure 602—Female genitalia of *Carposina*. Top left, *plumbeonitida* (Walsingham), holotype (BM slide 7541); Kauai, 3,000 to 4,000 feet. Top right, *subolivacea* (Walsingham), holotype (BM slide 7545); Lanai, 2,000 feet. Bottom, left and right, *togata* (Walsingham), holotype (BM slide 7537); Olinda, 4,000 feet, Maui.

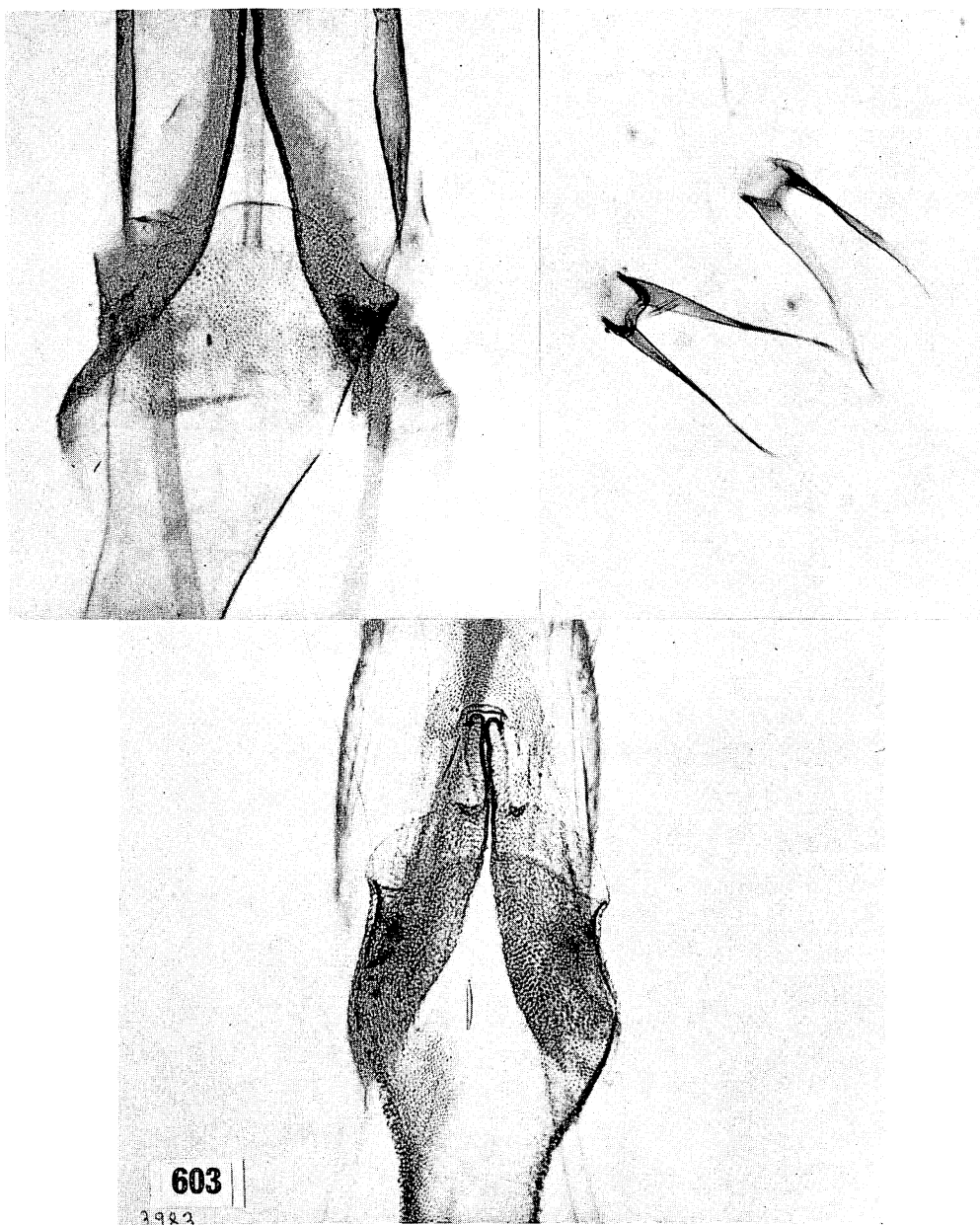


Figure 603—Female genitalia of *Carposina*. Top, *trigonotata* (Walsingham), allotype (BM slide 1847); Molokai, 4,000 feet; the signa are placed slightly caudad of the middle of the membranous part of the bursa. Bottom, *viridis* (Walsingham), holotype (BM slide 3893); Kauai, 3,000 to 4,000 feet; the signa are placed caudad of the middle of the membranous part of the bursa.

**Carposina gracillima** (Walsingham) (figs. 538, wing venation; 546, moth; 570, male genitalia; 589, 596, female genitalia; col. pl. 4:1).

*Heterocrossa gracillima* Walsingham, 1907b:672, pl. 13, fig. 16.

*Carposina gracillima* (Walsingham) Meyrick, 1922b:5.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala, 5,000 feet), Hawaii.

Hostplant: *Styphelia* (= *Cyathodes*).

The larvae feed abundantly in the berries of *Styphelia*. The species is supposed to be widely distributed over all of the main islands. I have not, however, made a comparative study of specimens from all of the islands.

**Carposina graminicolor** (Walsingham) (figs. 540, pupa; 546, moth; 571, male genitalia; 595, female genitalia).

*Heterocrossa graminicolor* Walsingham, 1907b:654, pl. 12, fig. 12.

*Carposina graminicolor* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Oahu, Hawaii.

Hostplants: *Osmanthus sandwicensis*, *Plectronia odorata*.

Parasites: *Pristomerus hawaiiensis* Perkins, *Trathala flavo-orbitalis* (Cameron).

This species was described from seven females from Kauai. The Oahu and Hawaii records and the hostplant and parasite records are Swezey's. I have not compared female specimens from Oahu and Hawaii with the Kauai holotype, and it is possible that more than one species is involved in the records.

**Carposina graminis** (Walsingham) (figs. 547, moth; 572, 573, male genitalia; 589, 596, female genitalia).

*Heterocrossa graminis* Walsingham, 1907b:658, pl. 12, fig. 19.

*Carposina graminis* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: 3,000 to 4,000 feet, holotype and allotype).

Hostplant: *Metrosideros*.

The type series contains more than one species. See figure 572.

**Carposina herbarum** (Walsingham) (figs. 547, moth; 560, male genitalia?; 597, female genitalia).

*Heterocrossa herbarum* Walsingham, 1907b:658, 735, pl. 12, fig. 18.

*Carposina herbarum* (Walsingham) Meyrick, 1922b:6.

Endemic. Oahu?, Lanai (type locality: 2,000 feet), Hawaii?

Hostplant: unknown.

This species was described from one female. I have questioned the determinations of specimens from Oahu (made later by Walsingham) and Hawaii (determined by Swezey), and material from those localities requires careful comparison with the type.

**Carposina inscripta** (Walsingham) (figs. 547, moth; 574, male genitalia; 598, female genitalia; col. pl. 4:4).

*Heterocrossa inscripta* Walsingham, 1907*b*:669, pl. 13, fig. 10.

*Carposina inscripta* (Walsingham) Meyrick, 1922*b*:6.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: *Vaccinium reticulatum* ("ohelo").

Parasite: *Euderus metallicus* (Ashmead).

The larvae feed in the *Vaccinium* berries.

**Carposina irrorata** (Walsingham) (figs. 548, moth; 574, male genitalia).

*Heterocrossa irrorata* Walsingham, 1907*b*:668, pl. 13, fig. 8.

*Carposina irrorata* (Walsingham) Meyrick, 1922*b*:6.

Endemic. Lanai (type locality: 3,000 feet).

Hostplant: unknown.

**Carposina lacerata** Meyrick (fig. 548, moth).

*Carposina lacerata* Meyrick, 1913*c*:74.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

The unique female holotype has lost its abdomen.

**Carposina latifasciata** (Walsingham) (figs. 549, moth; 600, female genitalia).

*Heterocrossa latifasciata* Walsingham, 1907*b*:662, pl. 12, fig. 25.

*Carposina latifasciata* (Walsingham) Meyrick, 1922*b*:6, incorrectly listed as a synonym of *corticella*.

Endemic. Hawaii (type locality: Kona, 3,500 feet).

Hostplant: unknown.

This species was described from one female.

**Carposina mauii** (Walsingham) (figs. 549, moth; 575, male genitalia; 590, 596, female genitalia).

*Heterocrossa mauii* Walsingham, 1907*b*:668, pl. 13, fig. 7.

*Carposina mauii* (Walsingham) Meyrick, 1922*b*:6, misspelling.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Carposina nigromaculata** (Walsingham) (figs. 538, wing venation; 550, moth; 575, male genitalia; 590, 599, female genitalia).

*Heterocrossa nigromaculata* Walsingham, 1907*b*:666, 735, pl. 13, fig. 4.

*Carposina nigromaculata* (Walsingham) Meyrick, 1922*b*:6.

Endemic. Oahu (type locality: Waianae Mountains, over 2,000 feet).

Hostplant: unknown.

The type series of nine specimens was taken by Perkins "on tree trunks". Walsingham later added a series of 12 specimens taken by Perkins in July, 1901, "N.W. Koolau Range, Oahu" to the collection.

***Carposina nigronotata*** (Walsingham) (figs. 550, moth; 577, male genitalia; 590, 599, female genitalia).

*Heterocrossa nigronotata* Walsingham, 1907b:656, pl. 12, fig. 16.

*Carposina nigronotata* (Walsingham) Meyrick, 1922b:6.

Endemic. Oahu?, Hawaii (type locality: male, Kilauea; female, Olaa, 2,000 feet).

Hostplant: *Myrsine* (= *Suttonia*) *lessertiana*; larvae in the berries and seeds?

Parasites: *Euderus metallicus* (Ashmead)?, *Pristomerus hawaiiensis* Perkins?

The hostplant, parasite, and Oahu records are from determinations made by Dr. Swezey. They require confirmation—more than one species may be involved. Some material determined by him to be this species belongs to *subumbrata*.

***Carposina olivaceonitens*** (Walsingham) (figs. 537, heads, wing venation; 551, moth; 577, 578, male genitalia; 600, female genitalia; col. pl. 4:3).

*Heterocrossa olivaceonitens* Walsingham, 1907b:655, pl. 12, fig. 13.

*Carposina olivaceonitens* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Maui, Hawaii.

Hostplants: *Clermontia* (several species, including *kakeana* and *arborescens*), *Planchonella* (= *Sideroxylon*).

This moth was described from three examples from Kauai. The records for the other islands and the hostplant data are from Dr. Swezey who found the larvae of what he determined to be this species feeding in flowers, flower buds, and fruits. Some confusion may be involved in the records.

***Carposina piperatella*** (Walsingham), **new combination, new status** (figs. 543, moth; 583, male genitalia; 591, 599, female genitalia).

*Heterocrossa corticella* variety *piperatella* Walsingham, 1907b:663, pl. 12, fig. 27.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This is not a form of *corticella* as it was originally described by Walsingham, but it is closely similar to, and may be the same as, *semitogata*.

***Carposina plumbeonitida*** (Walsingham) (figs. 551, moth; 579, 578, male genitalia; 561, 602, female genitalia).

*Heterocrossa plumbeonitida* Walsingham, 1907b:654, pl. 12, fig. 11.

*Carposina plumbeonitida* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Hawaii?

Hostplant: unknown.

Dr. Swezey determined material collected at light at Kilauea, Hawaii, as being this species, but the determination requires verification.

***Carposina punctulata*** (Walsingham) (figs. 552, moth; 579, male genitalia; 598, female genitalia).

*Heterocrossa punctulata* Walsingham, 1907b:671, pl. 13, fig. 13.

*Carposina punctulata* (Walsingham) Meyrick, 1922b:5.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.

**Carposina pusilla** (Walsingham) (figs. 552, moth; 581, male genitalia).  
*Heterocrossa pusilla* Walsingham, 1907b:670, 735, pl. 13, fig. 11.  
*Carposina pusilla* (Walsingham) Meyrick, 1922b:5.

Endemic. Oahu (type locality: Waianae Mountains, above 2,000 feet).

Hostplant: unknown.

Only two specimens of this species are listed in *Fauna Hawaiiensis*, but seven additional specimens collected in the "N.W. Koolau Range, Oahu", in July, 1901, by Dr. Perkins, are placed with the paratype in the British Museum. These specimens were probably taken on the trip made by Perkins and Koebele which was mentioned by Dr. Swezey in *Proc. Hawaiian Ent. Soc.* 2:197-198, 1913, when he said:

The northwest portion of the Koolau Mountain Range is very difficult of access and has not been visited by entomologists except when Dr. Perkins and Mr. Koebele made a trip into them about 15 [*sic*] years ago. They reached the main ridge from Wailua, following a large valley and taking three days to reach the higher part of the mountains, where they remained in camp for a few weeks collecting in the surrounding regions. It was found to be a rich collecting field. This part of the Range has now been made easily accessible by a trail which has been cut up the Punaluu Ridge on the windward side of the mountains.

Walsingham gave the expanse as 9 mm., but the expanse of his two original specimens is 6.5 to 7.5 mm. This species and *pygmaeella* are the smallest of the known Hawaiian carposinids.

**Carposina pygmaeella** (Walsingham) (figs. 553, moth; 581, 582, male genitalia).

*Heterocrossa pygmaeella* Walsingham, 1907b:662.

*Carposina pygmaeella* (Walsingham) Meyrick, 1922b:6.

Endemic. Hawaii (type locality: Kona, 3,000 feet).

Hostplant: unknown.

This is one of the two or three species of Hawaiian Microlepidoptera which were not illustrated in Walsingham's *Fauna Hawaiiensis* monograph.

With a wing expanse of only 6.0 mm., this is an extraordinarily small member of the Hawaiian carposinid fauna; its small size is approached only by *pusilla*.

**Carposina saurates** Meyrick (figs. 553, moth; 569, 573, 587, male genitalia).

*Carposina saurates* Meyrick, 1913c:75; 1922b:6, fig. 8.

*Carposina nereitis* Meyrick, 1913c:75; type locality: Koolau Mountains.

**New synonym.**

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

Somewhat confused, Meyrick described this species under two different names on the same page.

**Carposina semitogata** (Walsingham), **new combination, new status** (figs. 543, moth; 583, male genitalia; 511, 599, female genitalia).

*Heterocrossa corticella* variety *semitogata* Walsingham, 1907b:662, pl. 12, fig. 26.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This is not a form of *corticella* as originally described. The genitalia suggest that it may be the same as *piperatella*.

**Carposina solutella** (Walsingham) (figs. 553, moth; 584, male genitalia; 601, female genitalia).

*Heterocrossa solutella* Walsingham, 1907b:672, pl. 13, fig. 15.

*Carposina solutella* (Walsingham) Meyrick, 1922b:5.

Endemic. Oahu?, Hawaii (type locality: Kilauea).

Hostplant: *Hedyotis* (= *Gouldia*)?

Parasites: *Eupelmus peles* Perkins?, *Pristomerus hawaiiensis* Perkins?, *Sierola* species?

Dr. Swezey is responsible for the host, parasite, and Oahu records. I have not verified the determinations.

**Carposina subolivacea** (Walsingham) (figs. 555, moth; 580, 584, male genitalia; 591, 602, female genitalia).

*Heterocrossa subolivacea* Walsingham, 1907b:655, pl. 12, fig. 14.

*Carposina subolivacea* (Walsingham) Meyrick, 1922b:6.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

This may prove to be the same as *viridis*; *nigronotata* is an allied form.

**Carposina subumbrata** (Walsingham) (figs. 540, pupa; 554, moth; 576(?), 585, 586, male genitalia).

*Heterocrossa subumbrata* Walsingham, 1907b:660, 735, pl. 12, fig. 22.

*Carposina subumbrata* (Walsingham) Meyrick, 1922b:6.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplant: *Scaevola chamissoniana*. The larvae form galls on the stems.

Walsingham described this species from only one male. However, he also placed 30 additional specimens taken by Dr. Perkins in the northwest Koolau Mountains in July, 1901, under this name in the *Fauna Hawaiiensis* collection. See the note above under *pusilla* for details concerning the locality where this material was collected as well as the note under *nigromaculata*.

**Carposina tincta** (Walsingham) (figs. 555, moth; 601, female genitalia).

*Heterocrossa tincta* Walsingham, 1907b:659, pl. 12, fig. 20.

*Carposina tincta* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai?, Lanai?, Hawaii (type locality: Olaa).

Hostplant: unknown.

This moth was described from four females from the three islands mentioned. It is possible that the type series is a mixture of species.

**Carposina togata** (Walsingham) (figs. 556, moth; 585, 586, male genitalia; 602, female genitalia).

*Heterocrossa togata* Walsingham, 1907b:665, pl. 13, fig. 2.

*Carposina togata* (Walsingham) Meyrick, 1922b:6.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

There is more than one species included in the material under this name.



**Carposina trigononotata** (Walsingham) (figs. 554, moth; 588, male genitalia; 603, female genitalia).

*Heterocrossa trigononotata* Walsingham, 1907b:670, pl. 13, fig. 12.

*Carposina trigononotata* (Walsingham) 1922b:5.

Endemic. Molokai (type locality: 4,000 feet), Maui.

Hostplant: *Metrosideros*; Dr. Swezey reared moths from the terminal buds.

Parasite: *Pristomerus hawaiiensis* Perkins.

The type series is composed of specimens of more than one species.

**Carposina viridis** (Walsingham) (figs. 555, moth; 587, male genitalia?; 603, female genitalia).

*Heterocrossa viridis* Walsingham, 1907b:656, pl. 12, fig. 15.

*Carposina viridis* (Walsingham) Meyrick, 1922b:6.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu?

Hostplant: *Cyrtandra cordifolia*?

Only the female holotype was known to Walsingham, and it is possible that this may be the same as *subolivacea*. Dr. Swezey told me that he found larvae boring in the stem of *Cyrtandra* on Oahu, but I have not confirmed his report; this may be a different species.

**Carposina new species 1** (figs. 559, male genitalia).

*Heterocrossa* misidentified as *atronotata* by Swezey, (note in *Proc. Hawaiian Ent. Soc.* 8:12, 1932), 1954:221.

Endemic. Oahu, Hawaii?

Hostplant: *Vaccinium*.

Parasite: *Pristomerus hawaiiensis* Perkins.

Dr. Swezey reared this species from the leaves of *Vaccinium* which he collected on Mt. Kaala on Oahu.

**Carposina new species 2** (fig. 565, male genitalia).

*Heterocrossa* misidentified as *crinifera* by Swezey, 1954:42, 113.

Endemic. Oahu (Mt. Kaala, Mt. Tantalus).

Hostplants: *Broussaisia* fruit clusters, *Hedyotis* (= *Kadua*) *grandis* fruit capsules.

Parasite: *Pristomerus hawaiiensis* Perkins.

The genitalia of this species are distinct from those of the holotype of *crinifera* from Molokai.

**Carposina new species 3.**

*Heterocrossa* misidentified as *crinifera* by Swezey, 1913d:222.

Endemic. Oahu (Mt. Olympus).

Hostplant: *Rollandia humboldtiana* (= *racemosa*).

In 1913d:222, Dr. Swezey reported that he had reared *crinifera* from *Rollandia racemosa* from Mt. Olympus, but in 1954:121 he stated "I believe this record is based on an error in determination." It is unfortunate that there is a question regarding this record, because Dr. Swezey's notes are of interest.

I quote them here, but at this writing I do not know to what species they pertain, because Dr. Swezey told me in 1949 that he could not find the specimens. In 1913*d*:222, he wrote:

The larvae mine the leaves of *Rollandia racemosa*. They feed largely in the midrib, following it outwardly, but cut lateral tunnels out into the mesophyll on both sides as they proceed. Usually there is but one larva in a leaf. I have found this in but one locality so far, on Mt. Olympus, Oahu. The leaves of the shrub were very commonly attacked by it. The leaves are quite large and are not entirely killed by the injury, but many may be seen with the injured portion decayed away leaving an irregular hole or space in mid-portion of leaf. The full-grown larva emerges and passes below to pupate in a slight cocoon amongst dead leaves or trash.

#### **Carposina new species 4.**

*Heterocrossa* misidentified as *distincta* by Swezey, 1925:199, 203.

Endemic. Oahu (Koolau Mountains).

Hostplants: *Metrosideros* (terminal buds), *Syzygium* (*Eugenia*) *sandwicensis*.

Dr. Swezey reported that he had reared the moths from the hostplants mentioned and that he had captured an adult on Mt. Olympus, Oahu, from which a *Gordius* worm emerged (note in *Proc. Hawaiian Ent. Soc.* 2:195, 1913). In 1949, however, he told me that these records are in error and that the species in question is not *distincta*, as recorded, but is undescribed. Also see Swezey, 1954:214.

#### **Carposina new species 5** (fig. 567, male genitalia).

*Heterocrossa* misidentified as *divaricata* by Swezey, *Proc. Hawaiian Ent. Soc.* 2:141, 1910.

Endemic. Oahu (Koolau Mountains).

Hostplants: *Elaeocarpus bifidus*, *Syzygium* (*Eugenia*) *sandwicensis*.

Parasite: *Pristomerus hawaiiensis* Perkins.

The male genitalia of this species are highly unusual. They do not appear to be closely related to those of any other Hawaiian species I have seen.

#### **Carposina new species 6.**

"*Heterocrossa* sp., near *bicincta*", Swezey, 1954:116.

Endemic. Maui (Haelaau).

Hostplant: *Clermontia kakeana* and *arborescens*. The larvae mine the leaves.

#### **Carposina new species 7.**

"*Heterocrossa* sp.", Swezey, 1954:25.

Endemic. Kauai (Halemanu).

Hostplant: *Alphitonia ponderosa* (= *excelsa*) (seeds).

#### **Carposina new species 8.**

"*Heterocrossa* sp.", Swezey, 1954:37.

Endemic. Kauai (Kumuwela).

Hostplant: *Bobea* (terminal buds).

**Carposina new species 9.**

"*Heterocrossa* sp.", Swezey, 1954:116.

Endemic. Molokai (Kainalu).

Hostplant: *Clermontia grandiflora* (fruits).

Parasite: *Pristomerus hawaiiensis* Perkins.

**Carposina new species 10.**

"*Heterocrossa* sp. . . . probably new", Swezey, 1954:171.

Endemic. Oahu (Keawaula, Palolo, Wailupe).

Hostplant: *Plectronia* (fruits).

Family **ALUCITIDAE** (Linnaeus)

*Alucitae* Linnaeus, 1758:496, 542, in part. Scopoli, 1763:256, in part.

*Pterophorii* Latreille, 1802:418; 1803:325; 1805:255, all in part.

*Pterophorites* Latreille, 1809:192, 233; 1810:442, all in part.

*Alucitides* Leach, 1815:135, in part. Tutt, 1906, British fauna.

*Alucitaedes* Billberg, 1820:92.

*Alucitidae* Curtis, 1827:161; 1838:695, all in part. Stephens, 1835:369, in part.

*Alucitites* Newman, 1835:180.

*Alucitina* Zeller, 1841:866. Herrich-Schäffer, 1856:387.

*Orneodides* Herrich-Schäffer, 1843:14.

*Orneodidae* Meyrick, 1895:441; 1910*b*; 1913*a*. T. Fletcher, 1910*a*, 1910*c*, 1926.

Hampson, 1918*b*:386. Hofmann, 1898*b*, Palearctic fauna.

For a discussion of the family name, see Franclemont, 1952:310, and Hemming, 1957.

## THE MANY-PLUMED MOTHS

There is one representative of this distinctive group in Hawaii. Both its fore- and hindwings are divided into six long plumes, and the clefts between the plumes extend nearly to the bases of the wings. This character alone easily serves to distinguish this family from all others in Hawaii. Members of the Pterophoridae, the other family in Hawaii whose species have lobed or plumed wings, have the forewings divided into two lobes and the hindwings into three lobes. The proboscis of the Alucitidae is pilose ("naked", not squamose). The maxillary palpi, chaetosemata, and ocelli are absent in the Hawaiian representative although some other species of Alucitidae have maxillary palpi and ocelli.

This is a small but widely distributed family. It has most frequently been associated with the Pterophoridae, which usually has been considered a division of the pyraloids. Because of this I have already reported on the family in Volume 8 of *Insects of Hawaii* on the Pyraloidea. However, the alucitids are not closely allied to the pterophorids. Their true relationship has long been masked because many authors have been misled by the fact that the wings of the well-known species are cleft nearly to the base to form highly unusual plumes. There are, however, various South American and Oriental

species whose wings are only shallowly cleft and which appear nearly entire. These species have such different facies that at first one may easily conclude that they do not belong to the Alucitidae.

Some workers (Diakonoff, 1960: 16, for example) believe the family should be placed near the gelechiids, but the Alucitidae have "naked" proboscides whereas the Gelechioidea have squamose proboscides. Moreover, all of the Gelechioidea have three setae in the prothoracic prespiracular L group whereas the group contains only two setae on the Alucitidae.

Turner (1947: 318–320) placed the Alucitidae with the Pterophoridae in his superfamily Pterophoroidea. T. B. Fletcher long ago (1910a: 150) called attention to how very different are the larvae of the Alucitidae and Pterophoridae: "The Orneodid larva and pupa are extraordinarily different from those of the Pterophoridae, and very closely resemble the forms found in the Tineidae [in the old broad sense]. The larvae of some, but not all, of the species are peculiar in their habit of burrowing within the flower-stalks, stems and shoots of the food plants, in which their presence gives rise to gall-like excrescences."

T. B. Fletcher, translating from Hofmann (1898b: 342–343), quoted as follows:

For the purpose of pupating, the larvae forsake the portions of the plant enclosing them and prepare for themselves on the upper surface of the ground an oval cocoon, which is usually covered with grains of earth or sand, or is composed solely of a wide-meshed web.

On emergence the empty pupa case remains behind in the cocoon. . . .

The moths fly voluntarily only towards evening, shortly before and after sunset, around their food plants. In repose the hindwings are spread out as in flight, but segments of the forewings which cover the first two segments of the hindwings, are so approximated to one another that they occupy only about half the breadth usual in flight, whereby their patterns appears very distinct. The fore part of the body is raised up a little, the palpi are stretched out horizontally and project widely; the recurved terminal joint is erected at an acute angle. The antennal flagellum forms with the basal joint, which lies on the fore part of the eye, an obtuse angle and rests under the wing.

The abdomen of the Hawaiian representative has transverse basal bands of minute cuticular spinules on the tergites. These spinules are not articulated spines as are found in some other groups in Hawaii (oecophorids, blastobasids, xyloryctids, and momphids) and are quite different from anything found on any other group in Hawaii.

I have studied the larvae of *Alucita* and compared them with *Carposina*, and I can report that they are extraordinarily similar. These larvae share the distinctive character of having only two setae in the prespiracular L group on the prothorax as do the Pyraloidea. In all other groups of Ditrysia in Hawaii this setal group is trisetose. The chaetotaxy of the abdomen of *Alucita* (European species) and *Carposina* is essentially similar, seta for seta. Only on the heads have I been able to find characters to separate the Alucitidae from the Carposinidae. The habits of the larvae of both families are similar—they both include species which feed among flower stalks and terminal buds or bore in stems and shoots of the hostplants, and some cause gall formation.

I have not seen the larva of any member of the Copromorphidae and am not aware that any have been described. However, Ian Common has studied the copromorphid *Phycomorpha* larvae, and he has told me personally that they have the following characters: "Crochets uniordinal in a complete

circle; prothorax with 2 prespiracular setae; spiracles prominent, tubular, that on abdominal segment 8 enlarged and arranged more dorsally than on other segments; skin surface finely spinulose; mandibles relatively deeply dentate; 6 ocelli."

Genus **ALUCITA** (Linnaeus)

*Phalaena Alucita* Linnaeus, 1758:542. Type-species: *Phalaena Alucita hexadactyla* Linnaeus, 1758:542.

*Orneodes* Latreille, 1796:148; 1802:418. Type-species: *Phalaena Alucita hexadactyla* Linnaeus; designated by Latreille, 1802:418 and 1810:442.

See Franclemont, 1952:310, and Hemming, 1957, regarding synonymy.

This genus is supposed to be a large, widely distributed group. It is in great need of revision and is evidently composite. The Hawaiian species has no ocelli and no externally distinguishable maxillary palpi, but in some species assigned to *Alucita* these organs are developed.

***Alucita objurgatella*** (Walsingham) (figs. 604, moth; 605, head, wing venation; 606, male genitalia; 607, female genitalia).

*Orneodes objurgatella* Walsingham, 1907b:477, pl. 10 fig. 11. Swezey, 1954:171.

*Orneodes angustestriata* Walsingham, 1907b:477, pl. 10, fig. 10. Synonymy by Zimmerman, 1958:413.

Kauai, Oahu, Maui, Hawaii.

Immigrant? Although I have considered this species not to belong to the endemic Hawaiian fauna, I have been unable to determine whence it has come. The faunas of the world are so poorly known that it is very difficult now to identify such an isolated species as this when one cannot determine its country of origin.

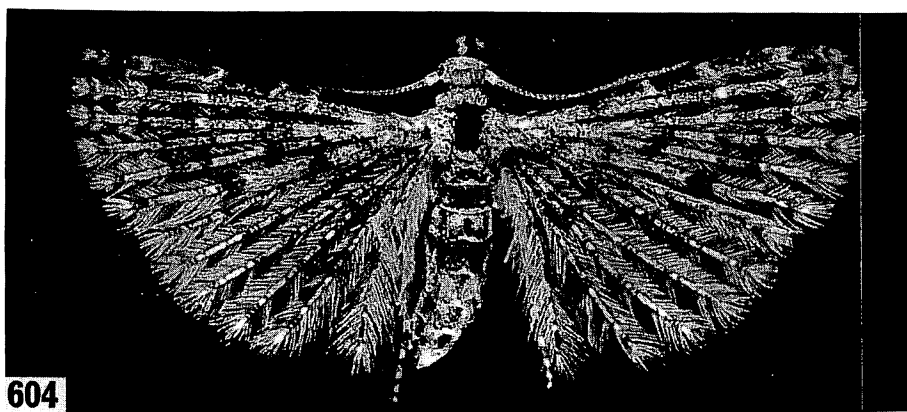


Figure 604—*Alucita objurgatella* (Walsingham); Palolo, Oahu; reared from *Plectronia* fruit; expanse about 10 mm.

Hostplant: *Canthium* (= *Plectronia*) *odoratum*.

Parasites: *Euderus metallicus* (Ashmead), *Eupelmus* near *aporostichus* Perkins, *Pristomerus hawaiiensis* Perkins, *Reikosiella melina* Yoshimoto, *Fidiobia* species.

This distinctive little moth appears to be found in most places where its hostplant grows in Hawaii. Heavy infestations have been reported from flower buds, fruits, and seeds of *Canthium* (a genus that is widely distributed in the Pacific). It is probable that it also occurs on Molokai and Lanai where it may be found by interested collectors.

On 26 January 1967, about 20 terminal twigs of *Canthium odoratum* in various stages of fruiting were collected near Kolekole Pass, Waianae Mts., Oahu. The panicles of this plant contain clusters of about 7 to 10 fruits. Single fruits measure 5–8 mm in diameter, and the ripe fruit is dark green. The larva of *Orneodes objurgatella* attacks the developing fruit when it is small and pale green. About 30 *Canthium* fruits in various stages of maturity were examined. Many of these fruits were near maturity and contained 1 or 2 entrance holes which were probably made by *Orneodes* larvae eating their way into the fruits after hatching from eggs laid on the surface of the fruit or on nearby spikelets. A full-grown moth larva was found within one of the hard-shelled seeds.

A single female *Eupelmus* was found in an empty seed chamber of one of the 30 fruits examined. In other fruits, 10 or 15 cocoons (most of them empty) of *Euderus* lay deep within the mesocarp. Empty cocoons of *Orneodes* were found inside the endocarp. The entrance to the moth larval cell was closed with a thick substance made of the same materials as that of the moth cocoons. Approximately 80–90% of the examined fruits had been infested at one time or another with *Orneodes* larvae. In the abandoned fruits were found scattered frass, empty cocoons, living mites and in some silk webbing was on the inner wall of the seed. (Yoshimoto, 1969:631.)

I have not seen the pupa of this species, but I suppose that it has transverse, mesothoracic spiracles which are not strongly protuberant; slightly produced abdominal spiracles; antennae well separated throughout on the abdomen; exposed front femora; concealed labial palpi except at extreme base; and hidden maxillary palpi.

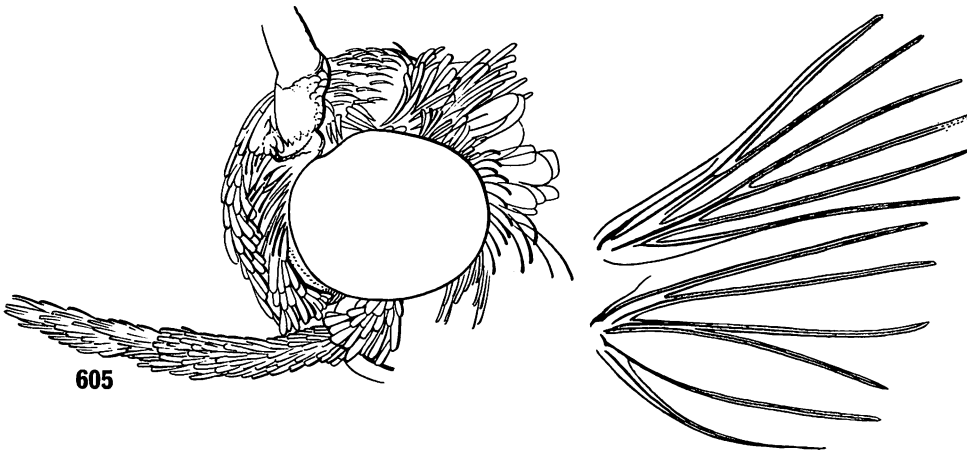


Figure 605—Head and wing venation of *Alucita objurgatella* (Walsingham).

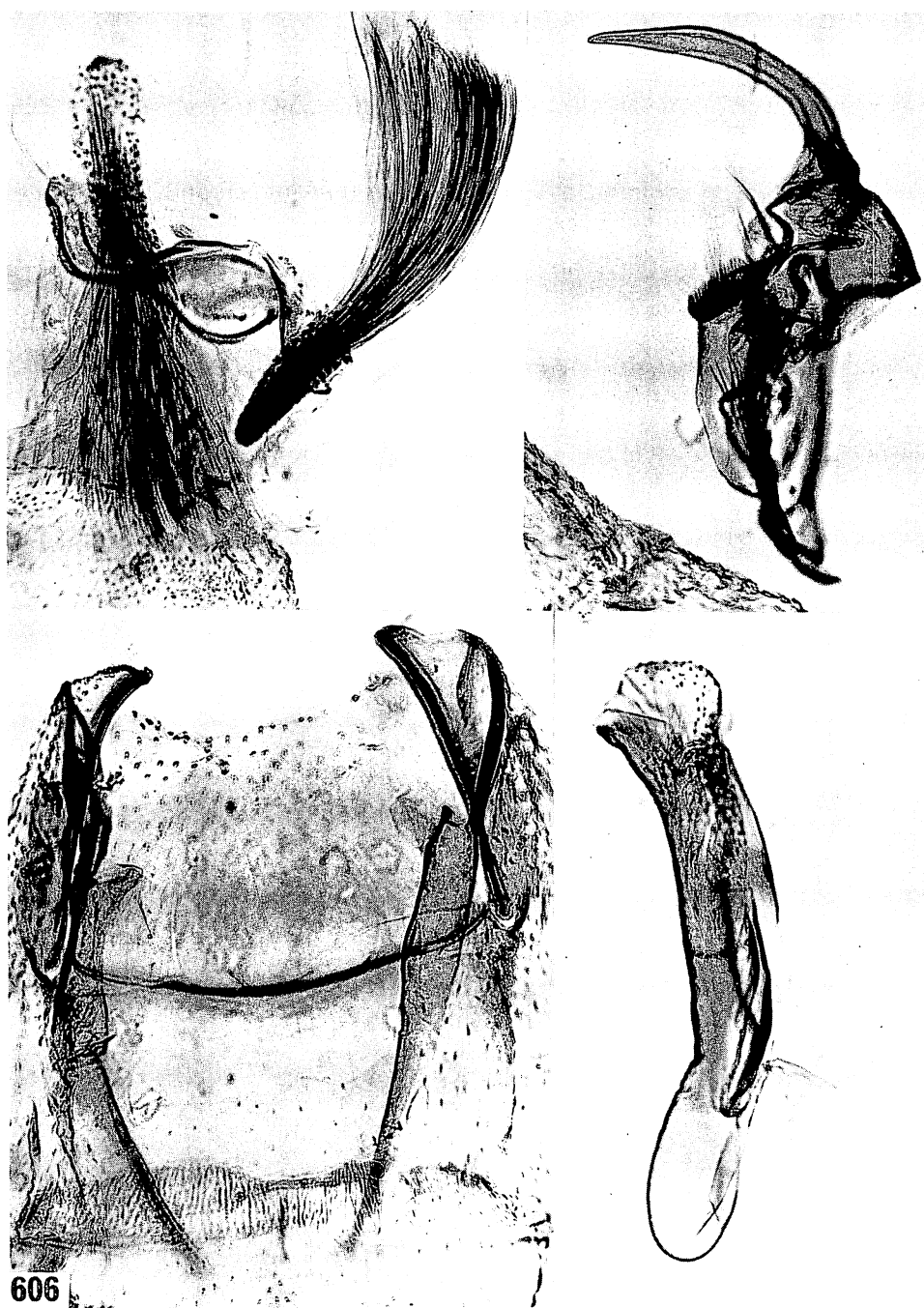
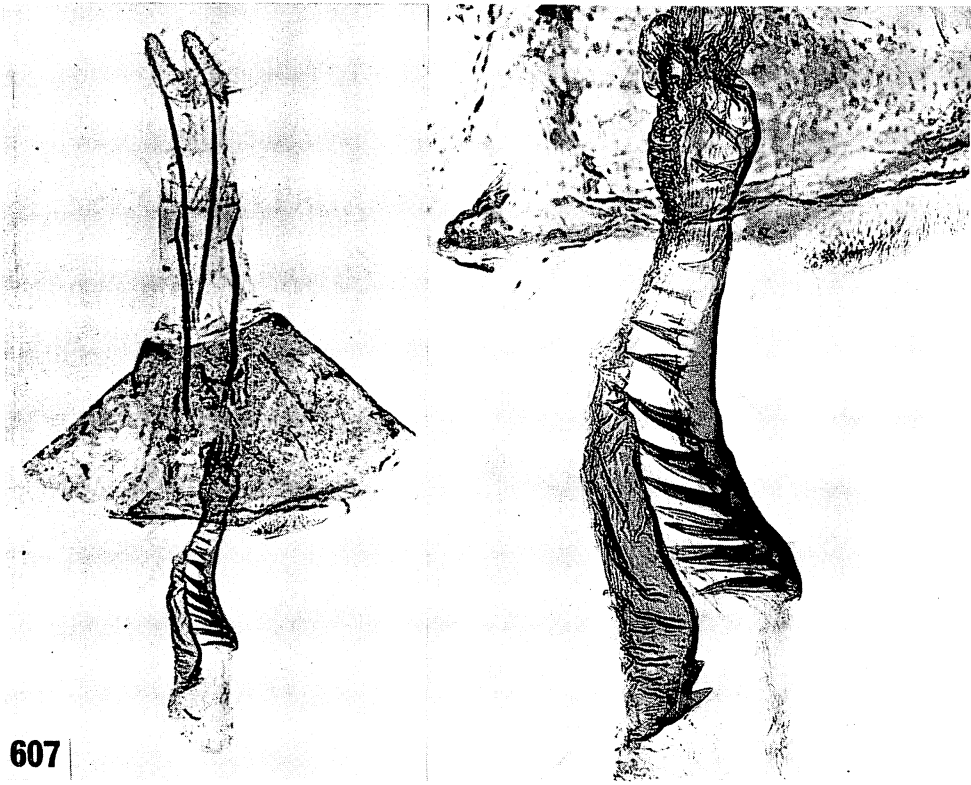


Figure 606—Details of male *Alucita objurgatella* (Walsingham). Top left, coremata at apex of abdomen. Top right, genitalia, ventro-lateral aspect. Bottom left, base of abdomen. Bottom right, aedeagus. CCC Trail, Kealia, Oahu (slide Z-70-7).



607

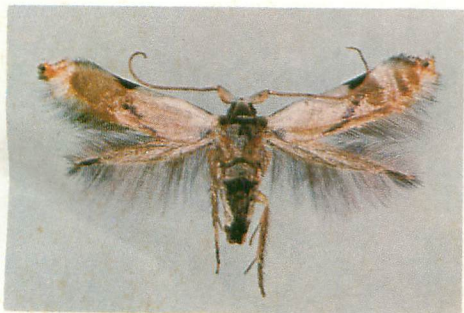
Figure 607—Female genitalia of *Alucita objurgatella* (Walsingham); Keawaula, Oahu; ex *Plectronia* fruits (slide Z-70-8).



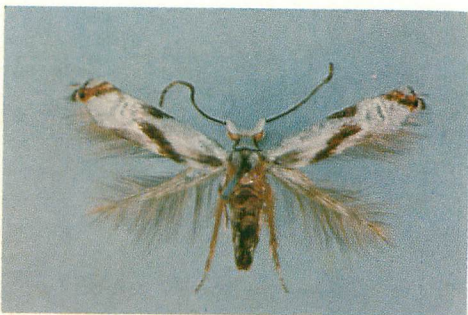
## **NOTES ON THE COLOR ILLUSTRATIONS**

The photographs for the 64 color illustrations on the following pages were made by Edith Sattler from specimens collected by Klaus and Edith Sattler in 1973 and prepared and identified by Dr. Sattler at the British Museum (Natural History). These figures illustrate only a small selection of representative species from the Sattlers' unexcelled collection, but they will convey a modest impression of the moths as they appear in nature.

All of the figures are enlarged, and the wing expanse of each specimen is given in the legends. Further details, such as exact places of capture, are preserved in the British Museum (Natural History). The numbers in parentheses refer to the photograph numbers. Many of the species illustrated are new to science and thus are without trivial names.



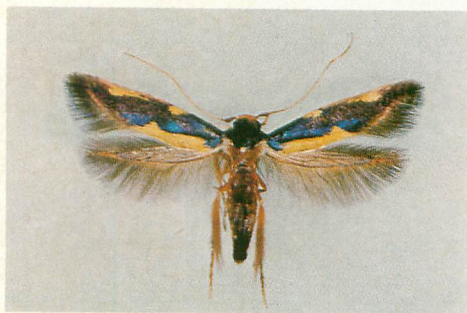
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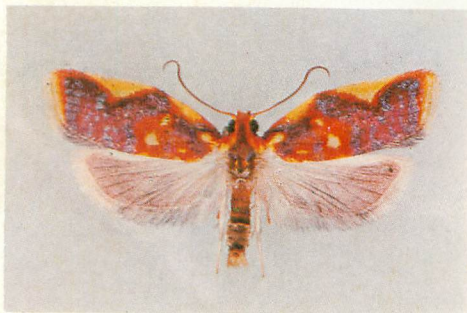
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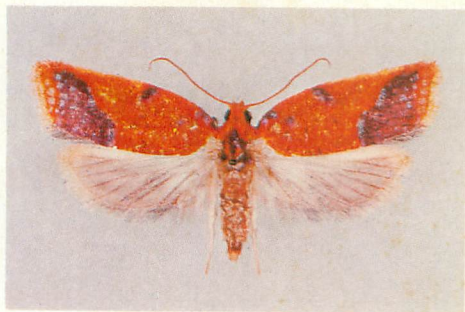
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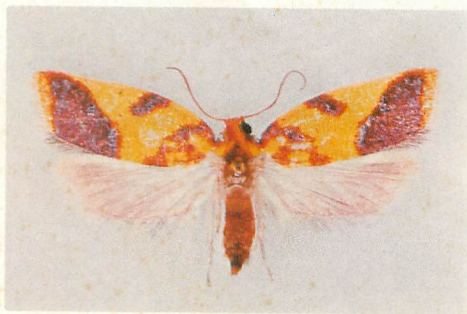
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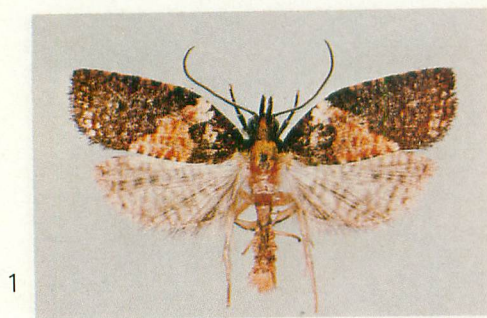


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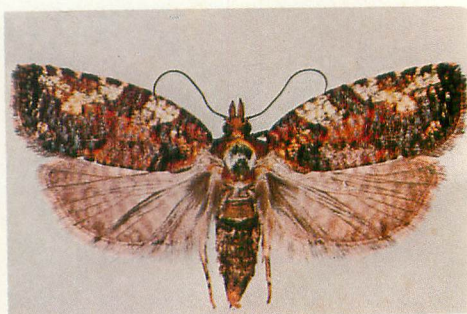
# Plate 1

1. *Opostega* species (63).  
Kauai. 10 mm.
2. *Opostega maculata* Walsingham (137).  
Maui. 7.5 mm.
3. *Opogona omoscopia* Meyrick (151).  
Hawaii. Male. 21 mm.
4. *Opogona purpuriella* Swezey (164).  
Hawaii. Female. 14 mm.
5. *Spheterista pleonectes* (Walsingham) (59).  
Kauai. Male. 20 mm. This is similar to the type  
of the synonymous *castaneana*.
6. *Spheterista flavopicta* (Walsingham) (241).  
Kauai. Male color form. 15.5 mm.
7. *Spheterista flavopicta* (Walsingham) (239).  
Kauai. Female color form. 16 mm.
8. *Spheterista flavopicta* (Walsingham) (240).  
Kauai. Female color form. 16 mm.

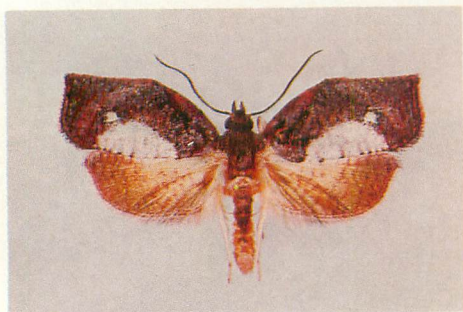




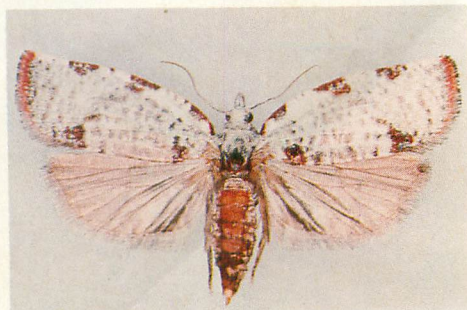
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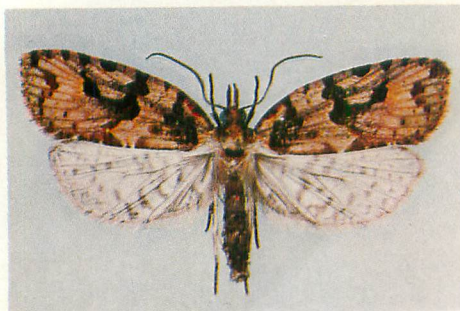
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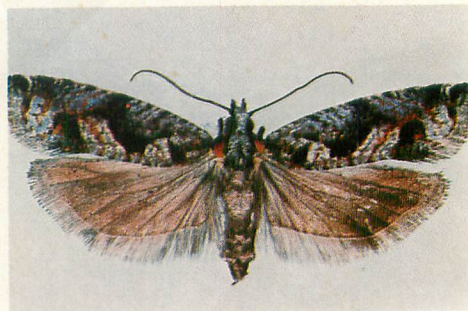
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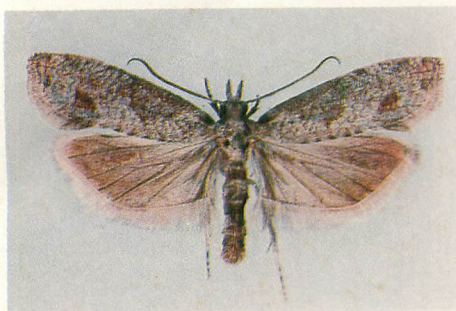
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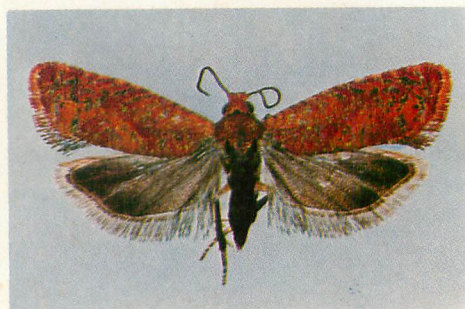
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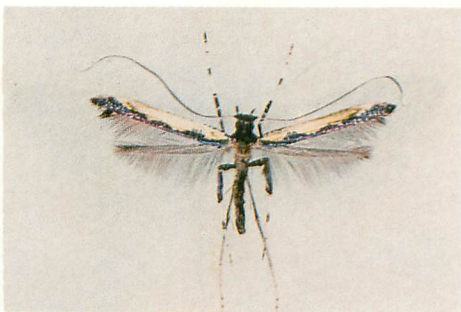


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# Plate 2

1. *Spheterista* species (168).  
Kauai. Male. 17.5 mm.
2. *Spheterista variabilis* Walsingham (75).  
Molokai. Female. 27 mm.
3. *Spheterista ochreocuprea* Walsingham (242).  
Kauai. Male color form. 18.5 mm.
4. *Spheterista* species (77).  
Kauai. Female. 27 mm.
5. *Pararrhaptica* species (99).  
Hawaii. Male. 30 mm.
6. *Eccoptocera* species (73).  
Kauai. Female. 18 mm.
7. *Cydia* species (70).  
Hawaii. Male. 18 mm.
8. *Cydia rufipennis* (Butler) (72).  
Kauai. Female. 10 mm.

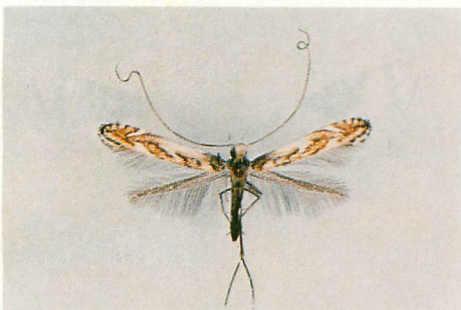




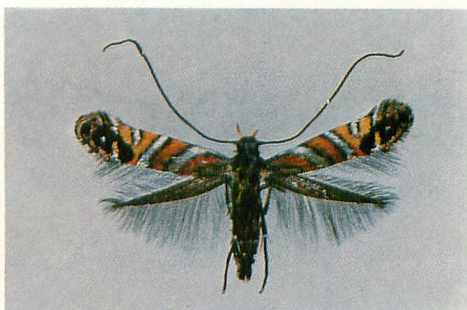
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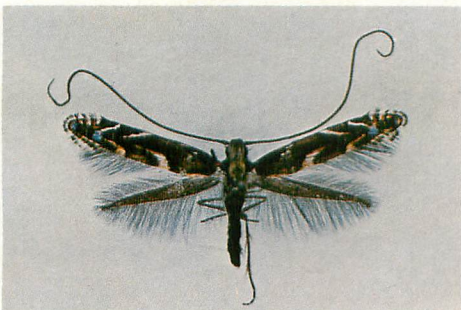
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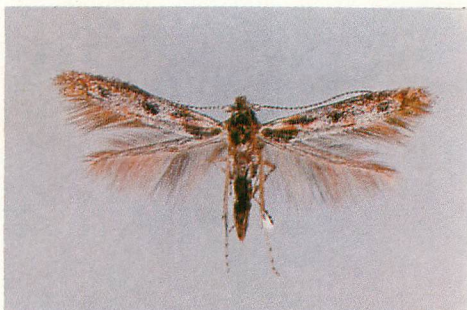
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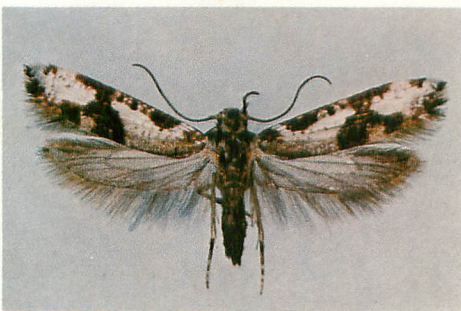
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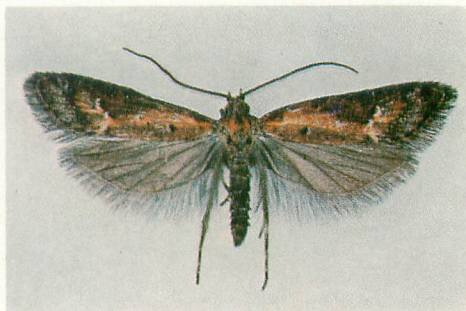
### Plate 3

1. *Caloptilia mabaella* (Swezey) (64).  
Kauai. Male. 11 mm.
2. *Philodoria* species (149).  
Hawaii. Female. 11.5 mm.
3. *Philodoria* species (136).  
East Maui. Male. 9 mm.
4. *Philodoria* species (138).  
Kauai. Female. 7 mm.
5. *Philodoria* species (139).  
Kauai. Male. 7.5 mm.
6. *Bedellia* species (235).  
Kauai. Male. 9 mm.
7. *Prays fulvocanella* Walsingham (94).  
Kauai. Female. 13 mm.
8. *Acrolepia* species (116).  
Kauai. Female. 12 mm.

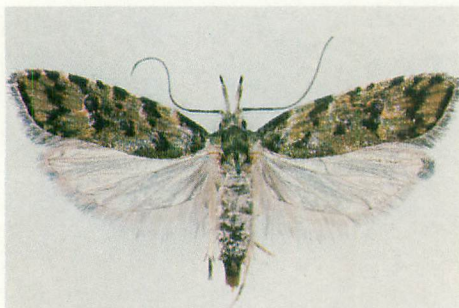




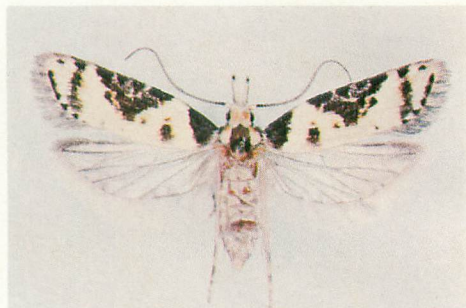
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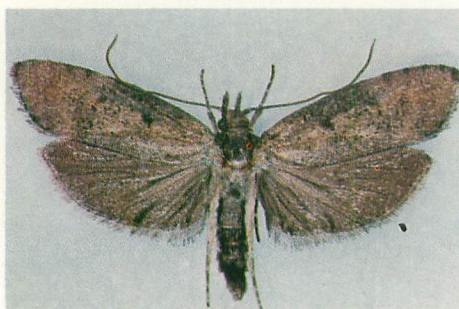
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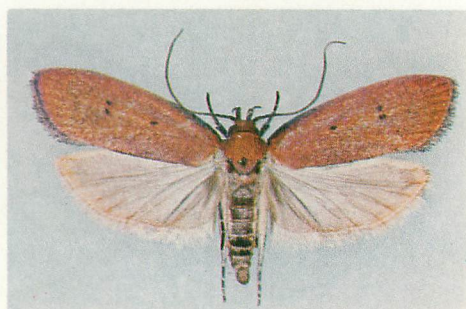
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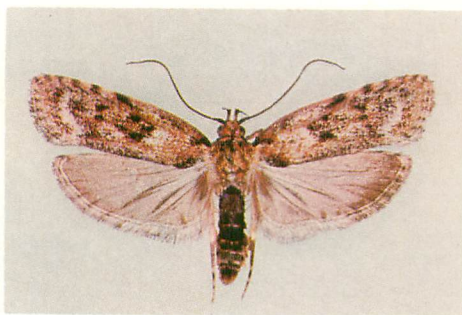


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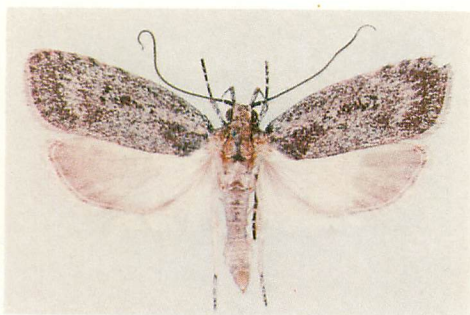
Plate 4

1. *Carposina gracillima* (Walsingham) (29). East Maui. Female. 14 mm.
2. *Carposina* species (36). Kauai. Male. 14 mm.
3. *Carposina olivaceonitens* (Walsingham) (142). Kauai. Female. 24 mm.
4. *Carposina inscripta* (Walsingham) (152). Hawaii. Female. 15 mm.
5. *Carposina* species (170). Hawaii. Female. 19.5 mm.
6. *Mapsidius auspicata* Walsingham (117). Kauai. Female. 15 mm.
7. *Thyrocopa brevipalpis* (Walsingham) (108). Kauai. Male. 24.5 mm.
8. *Thyrocopa* species (110). Kauai. Male. 23 mm.





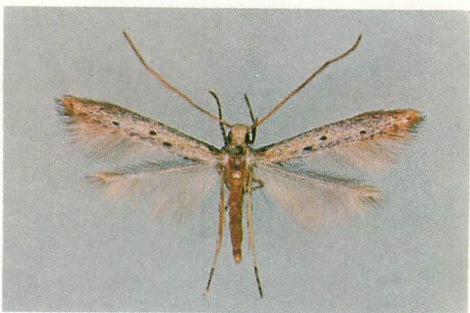
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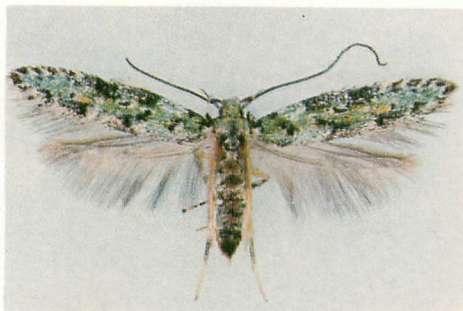
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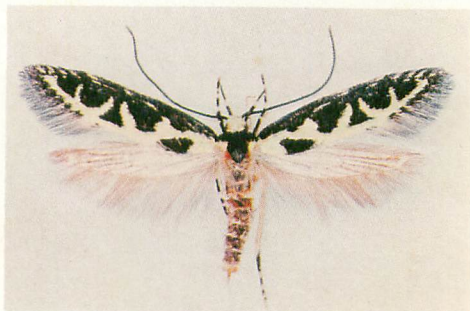
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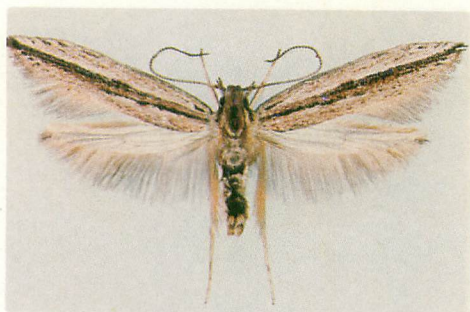
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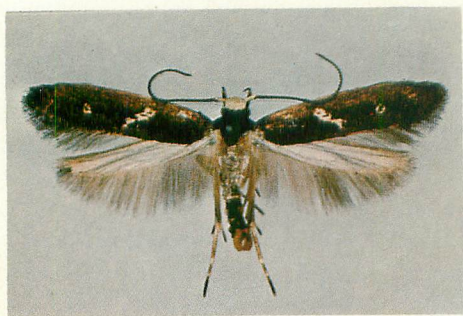


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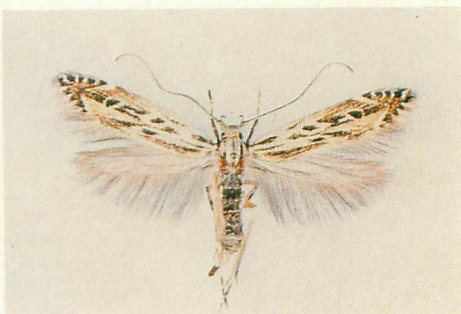
#### Plate 5

1. *Thyrocopa indecora* (Butler) (234). East Maui. Male. 27 mm.
2. *Thyrocopa* species (205). Hawaii. Male. 21 mm.
3. *Thyrocopa albonubila* Walsingham (107). Kauai. Female. 24 mm.
4. *Chedra* species (132). Hawaii. Male. 9.5 mm.
5. *Hyposmocoma* (E.) species (123). Kauai. Female. 15 mm.
6. *Hyposmocoma* (E.) *exornata* Walsingham (197). Hawaii. Female. 19 mm.
7. *Hyposmocoma* (E.) species (65). Kauai. Male. 12.5 mm.
8. *Hyposmocoma* (E.) *longitudinalis* Walsingham (24). Hawaii. Male. 21 mm.

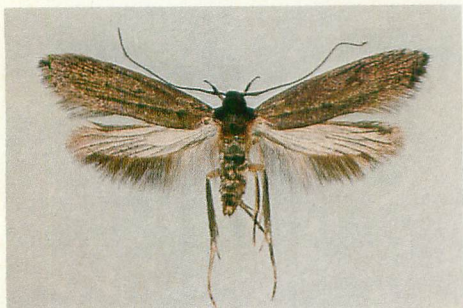




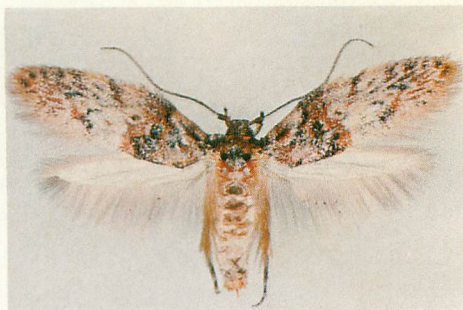
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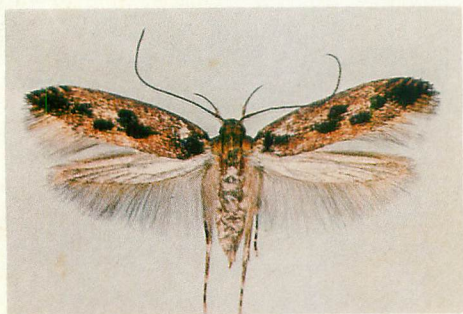
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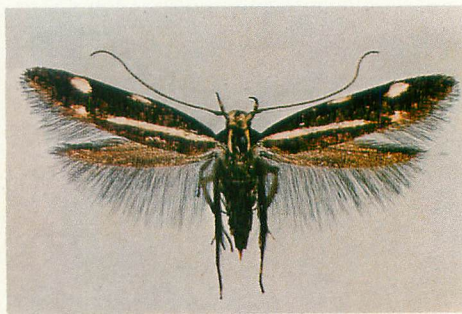
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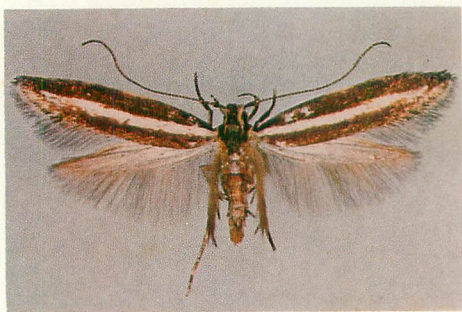
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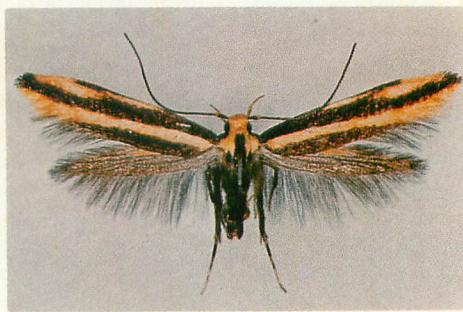
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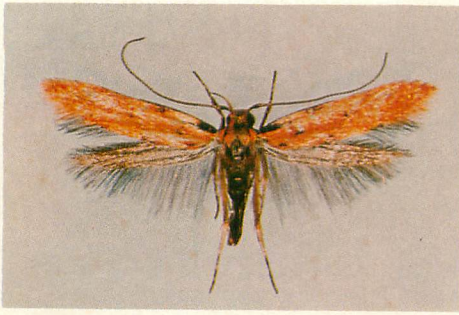


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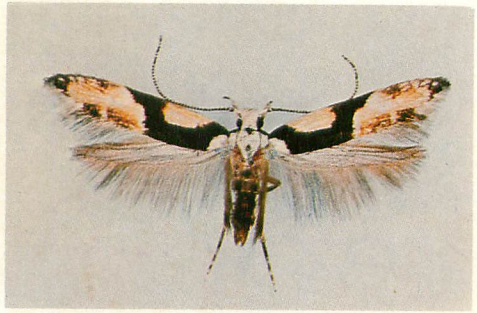
Plate 6

1. *Hyposmocoma (E.) niveiceps* Walsingham (2).  
Molokai. Male. 14 mm.
2. *Hyposmocoma (E.)* species (144).  
Hawaii. Female. 14.5 mm.
3. *Hyposmocoma (E.) sudorella* Walsingham (12).  
Kauai. Male. 17.5 mm.
4. *Hyposmocoma (E.) fluctuosa* (Walsingham)  
(157).  
Kauai. Female. 16 mm.
5. *Hyposmocoma (E.) scandens* Walsingham (11).  
Kauai. Female. 17 mm.
6. *Hyposmocoma (H.) unistriata* Walsingham (5).  
Molokai. Female. 14 mm.
7. *Hyposmocoma (H.) tripartita* Walsingham (6).  
Molokai. Female. 14 mm.
8. *Hyposmocoma (H.) lucifer* Walsingham (1).  
East Maui. Male. 15 mm.

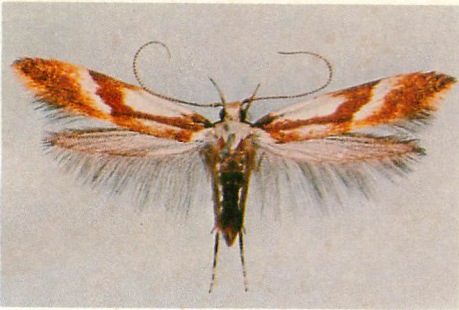




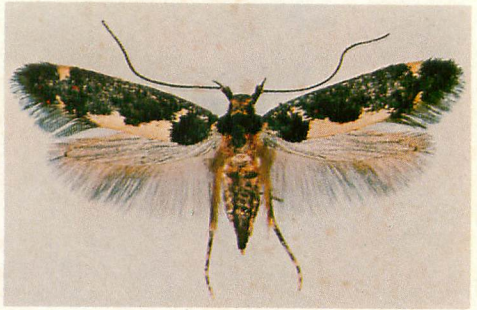
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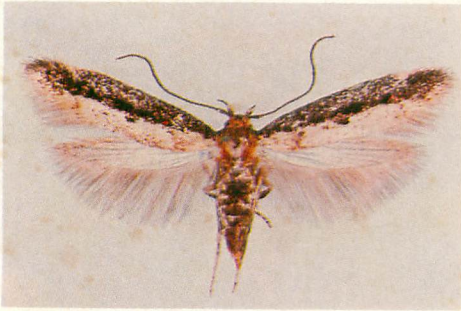
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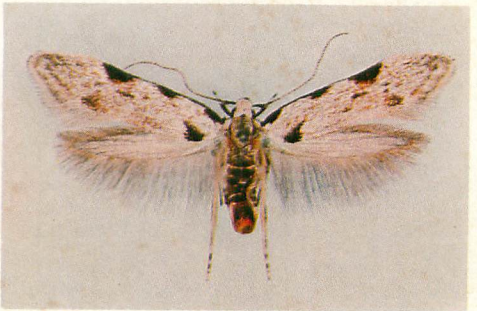
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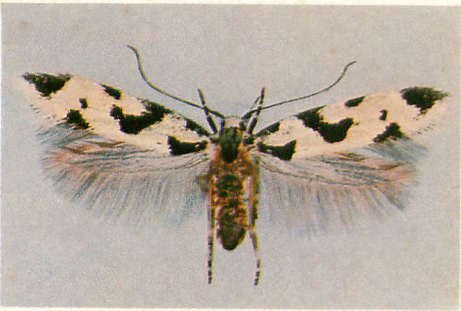
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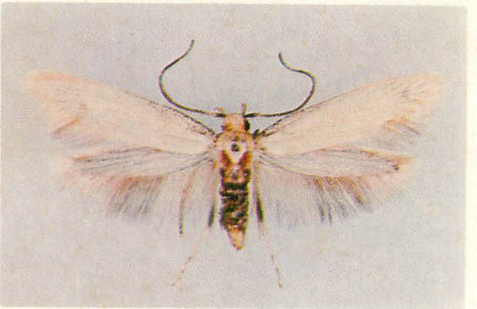
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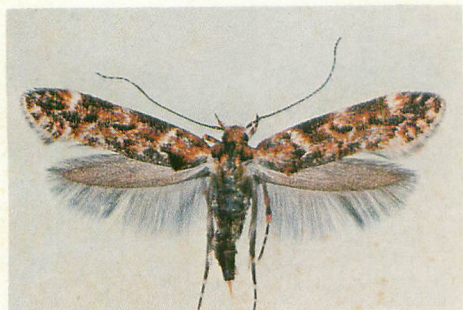


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Plate 7

1. *Hyposmocoma (H.) virgata* Walsingham (4).  
Molokai. Male. 12 mm.
2. *Hyposmocoma (H.)* species (100).  
East Maui. Male. 17.5 mm.
3. *Hyposmocoma (H.)* species (97).  
East Maui. Male. 15 mm.
4. *Hyposmocoma (H.) corvina* (Butler) (7).  
Kauai. Female. 16 mm.
5. *Hyposmocoma (H.) partita* Walsingham (193).  
Hawaii. Female. 13 mm.
6. *Hyposmocoma (H.) hygroscopta* Meyrick (130).  
Kauai. Male. 14.5 mm.
7. *Hyposmocoma (H.) alliterata* Walsingham (95).  
East Maui. Female. 14 mm.
8. *Hyposmoscoma (H.)* species (192).  
Hawaii. Male. 13 mm.

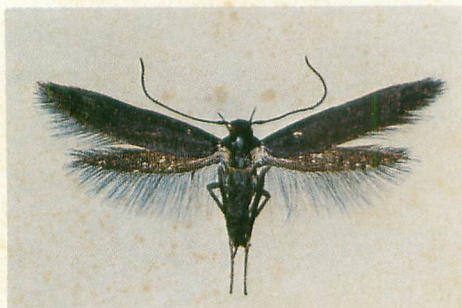




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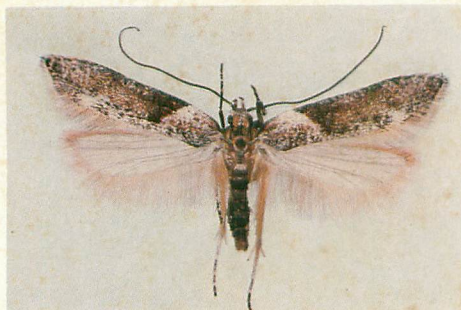
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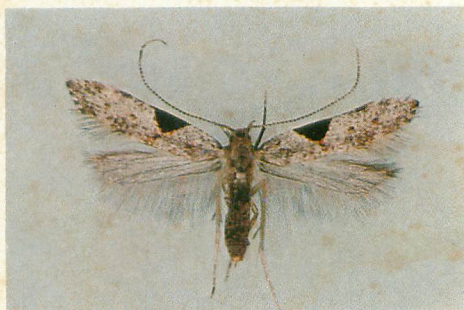
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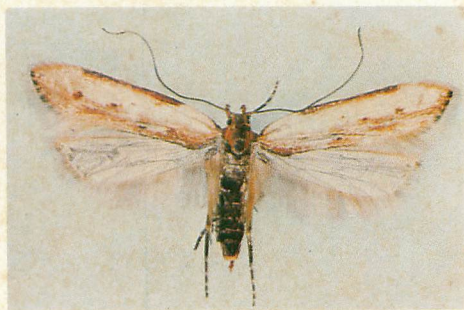
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#### Plate 8

1. *Hyposmocoma* (*H.*) species (159).  
East Maui. Female. 14.5 mm.
2. *Hyposmocoma* (*H.*) species (161).  
Hawaii. Male. 12.5 mm.
3. *Hyposmocoma* (*H.*) species (154).  
East Maui. Male. 11 mm.
4. *Hyposmocoma* (*H.*) species (26).  
Kauai. Male. 26 mm.
5. *Merimnetria* species (60).  
Hawaii. Male. 20 mm.
6. *Merimnetria* species (112).  
Kauai. Female. 11.5 mm.
7. *Merimnetria gigantea* (Swezey) (113).  
Hawaii. Male. 21 mm.
8. *Merimnetria gigantea* (Swezey) (114).  
Hawaii. Female. 22.5 mm.

Superfamily **GELECHIOIDEA** (Stainton)

*Gelechidae* Stainton, 1854: 75.

*Gelechioidea*: Mosher, 1916: 23, 33, 98. Forbes, 1923: 37, 229.

The Gelechioidea is the largest of the superfamilies of the Microlepidoptera, *sensu stricto*. In Hawaii there are more gelechioids than all other Microlepidoptera combined.

In Hawaii, all Lepidoptera which have at least the base of the proboscis clothed with imbricated squamae belong either to the Gelechioidea or to the Pyralidae. The Pyralidae are distinguishable because they have tympana in the bases of their abdomens, whereas tympana are absent in the Gelechioidea. Many Pyralidae (Scopariinae, Nymphulinae, Pyralinae, Crambinae, Phycitinae) have chaetosemata (setose, postantennal sensory organs), but chaetosemata are absent in the Gelechioidea. Although there are exceptions, most Pyralidae have hindwings broader than their forewings, all three branches of vein 1 are fully developed, and veins 7 and 8 are partly, mostly, or entirely fused. These hindwing characters are variable in the gelechioids, but few species have a combination similar to that of the pyralids. Most gelechioids are small, narrow-winged moths, and most (but not all) have conspicuously upcurved, sickle-shaped labial palpi which are notably long and slender on many species.

KEY TO THE FAMILIES OF GELECHIOIDEA IN HAWAII

- 1. Face strongly retreating ventrocaudad, subhorizontal; antennae appearing to be inserted in front of eyes and held stretched out in front of head when at rest; distal segment of labial palpus compressed, very thin, rather bladelike, concave externally; wing venation as in figure 621; forewings with veins 2, 3, and 4 arising from posterior margin of cell instead of 3 and 4 arising from apex of cell; hindwing with anterior margin of cell submedial; female frenulum with only two setae; a small, yellow, leaf eater of palms. . . . . **Agonoxenidae.**  
Without such a combination of characters. . . . . 2
- 2(1). Anterior margin of cell in hindwing submedial; labial palpi drooping or porrect; frenulum of female with only two setae; a small leaf miner in *Lonicera*; as in figures 628, 629. . . . . **Cynodiidae.**  
Not so; labial palpi usually strongly curved dorsad. . . . . 3
- 3(2). Forewing with vein 11 short, only about as long as or shorter than vein 10 and arising distad of middle of wing, venation as in figures 608, 609; frenulum of female with only two setae. . . . . **Scythrididae.**

Forewing with vein 11 normally long, usually arising distinctly basad of middle of wing and usually obviously longer than vein 10; frenulum of female with three setae. . . . . **Gelechiidae.**

Family **SCYTHRIDIDAE** (Staudinger and Rebel)

*Butalidae* Heinemann and Wocke, 1876:436.

*Scythridinae* Rebel, in Staudinger and Rebel, 1901:179, as a subfamily of Elachistidae.

*Scythrididae*: Spuler, 1910 (1901–1910):432.

*Scythridae*: *auctorum*. Included in the Hypsilophidae by Hampson, 1918:387.

*Butalidae* is based upon *Butalis* Treitschke, 1833, which is a homonym of *Butalis* Boie, 1826, Aves, and it is thus not available for use in family-group name combinations in Lepidoptera. Treitschke's name was replaced by *Copida* Sodoffsky, 1837, which is now considered a synonym of *Scythris* Hübner, 1825 (1816–1826):414.

The name Scythrididae has not appeared in Hawaiian literature heretofore, but here I have transferred the peculiar Hawaiian genus *Mapsidius* from the Yponomeutidae, where it obviously does not belong, to this family. The Scythrididae is a poorly known group almost everywhere.

The Hawaiian moths assigned here lack ocelli, have the proboscis squamose, have eleven veins in the forewings with vein 7 stalked with 8 and have vein 11 arising distad of the middle of the cell. The hindwings have "pectens" of long hair on the anal areas.

Some workers have suggested that *Prays* is also a member of the Scythrididae, but that can hardly be true because *Prays* does not have a squamose proboscis and is different in other primary characters.

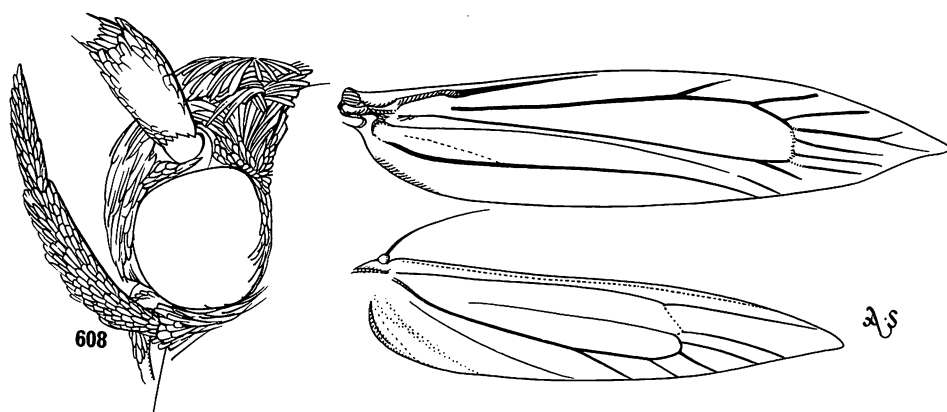


Figure 608—Head and wing venation of *Mapsidius auspicata* Walsingham, holotype (BM slide 4174); Lanai, 2,000 feet. The forking of vein 1b in the forewing is variable in the various *Mapsidius* species—it is strong in some and weak in others. This is the type-species of *Mapsidius*.

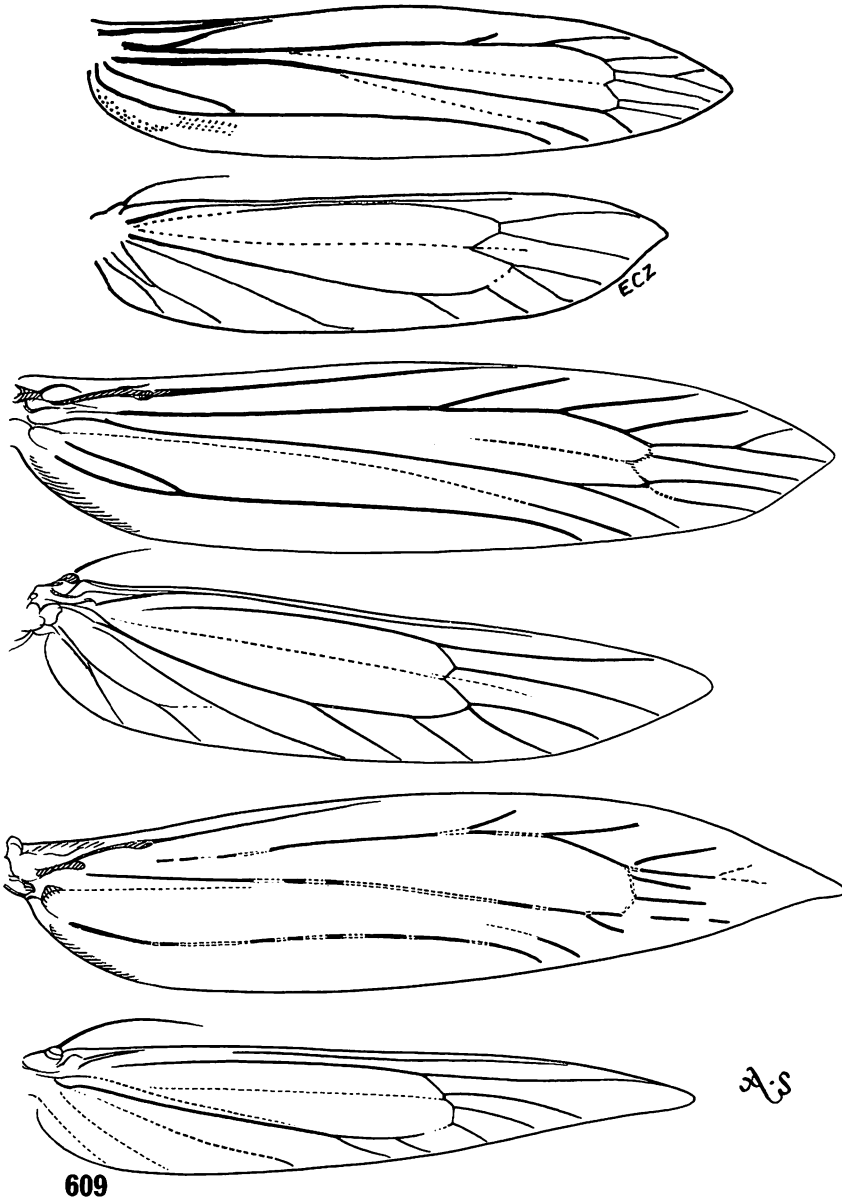


Figure 609—Wing venations of *Mapsidius*. Top, *iridescens* Walsingham (slide Z-70-14); Kamuela, Kauai. Middle, *quadridentata* Walsingham (Busck slide 61); Maui. Bottom, *chenopodii* Swezey (slide Z-XII-21-65); Maui. Note particularly the differences in the forking of the base of vein 1 in the forewings, the origins of veins 4 and 5, and the different wing shapes. Not to same scale.

The scythridids are a confusing group, and the determination of their true taxonomic position is difficult. They appear to combine characters of the yponomeutoids and the gelechioids. Some authors place them in the Yponomeutidae, some in the Gelechiidae, some in the "Elachistidae", and some workers give them full family status.

The larvae are exceptional and appear out of place in either the yponomeutoids or the gelechioids because most of the pinacula bear more than the normal single seta (I have examined larvae of European *Scythris* and the Hawaiian *Mapsidius*). The placement of seta L2 on abdominal segments one to eight is unusual, because it is situated far below seta L1 and on the level of L3. The separation of L1 and L2 is yponomeutoid and certainly not gelechioid (on which group L2 is normally closely approximated to L1 if not on the same pinaculum). The very low placement of L2 in front of L3 is an extreme of the tendency for the separation of L1 and L2 in many yponomeutoids. One must not be confused by the fact that there are two setae on the L1 pinaculum on *Mapsidius* and *Scythris*, because it may appear that the double L1 is L1 and L2, whereas the L2 pinaculum is placed far distant from

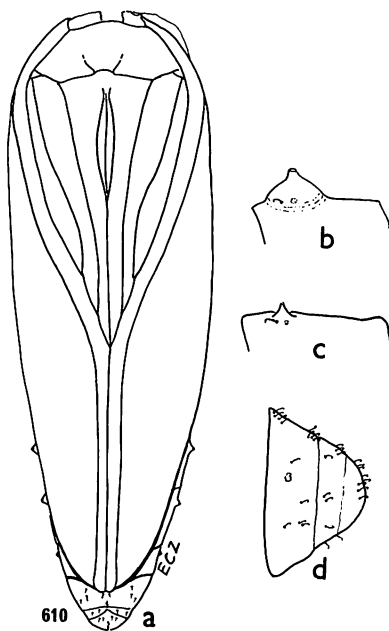


Figure 610—Details of the pupae of *Mapsidius* species. *a*, ventral aspect of a cast skin of *auspicata* Walsingham; length 6 mm. *d*, left lateral aspect of cauda of same. *c*, lateral aspect of the spiracle of the right side of the second abdominal segment as seen from the left side (the spiracles are progressively smaller on each segment caudad of this). *b*, lateral aspect of the spiracle of the right side of the second abdominal segment of *chenopodii* Swezey, as seen from the left side. Note the great differences in the sizes of the spiracles when compared with the lengths of their respective tergites. Except for these differences, the pupae of these species are basically very similar. The pupae are smoothly compact, solidly fused with no possible movement of the abdomen, and with nonprotuberant appendages.



L1 and is in front of the L3 pinaculum. The L2 pinaculum may have two or three setae (perhaps even more in some species?), and the L3 pinaculum bears several setae. On the *Mapsidius chenopodii* larvae that I have seen, the D pinaculum bears three setae, the SD1 pinaculum has two setae, and the SV pinaculum bears a cluster of several setae.

Mosher (1916:100, fig. 89) studied the pupae of two supposed *Scythris*, and she placed the Scythrididae in the Gelechioidea while noting its similarities to the Yponomeutoidea. She illustrates a supposed pupa of *Scythris eboracensis* Zeller in which she shows the antennae touching at their extreme apices. The European *Scythris* I have studied have the pupal antennae separated throughout as they are in most yponomeutoids and obviously different from the arrangement in most, but not all, the gelechioids where the antennae normally lie at least in partial contact on the abdomen. I have seen pupal skins of *Mapsidius auspicata* Walsingham and *Mapsidius chenopodii* Swezey (figure 610). They are solid, smoothly compact pupae whose appendages are tightly fused with the body and are not protuberant. No movement of the abdomen appears possible. The antennae are contiguous for their entire lengths on the abdomen, as figured, and thus they differ from the American and European species discussed above. The labial palpi are exposed on *Scythris* and *Mapsidius* as they are in the yponomeutoids, but some gelechioids also have them exposed. Mosher says that the abdominal spiracles are produced and tubular in some American species assigned to *Scythris*. On the European *Scythris* pupae I have examined they are only moderately produced. On *Mapsidius* they are distinctly produced as illustrated in figure 610, *b*, *c*. Tubular, produced spiracles are found in the Yponomeutidae.

The larvae and pupae appear to be yponomeutoid, and the moths more nearly resemble yponomeutoids than gelechioids if the squamose proboscis is ignored. However, the densely squamose proboscis is a most confusing gelechioid character. The female has a two-spined frenulum as do the yponomeutoids. Although the gelechioids usually have three spines in the frenulum, some of them have only two spines. The strange genitalia are unlike anything I have seen in either the yponomeutoids or the gelechioids. The wing venation is distinctive, and the placement of vein 11 (R1) distad of the middle of the cell is particularly noteworthy.

It would appear that the Scythrididae is a divergent group in which characters of both the yponomeutoids and gelechioids are strangely combined. For convenience, I shall treat the family tentatively as a member of the gelechioids so that it is associated with all other Hawaiian Microlepidoptera which have squamose proboscides.

#### Genus **MAPSIDIUS** Walsingham

*Mapsidius* Walsingham, 1907b:650. Type-species: *Mapsidius auspicata* Walsingham, 1907b:650, by original designation.

*Mapsidius* is known only from the Hawaiian Islands and is one of the most unusual genera of the endemic Lepidoptera. I do not have any information concerning its relationships except that it appears allied to *Scythris*. The fore-



Figure 611—*Mapsidius*. Top, *auspicata* Walsingham, allotype male (BM slide 4174); Lanai, 2,000 feet; forewing 6.5 mm. Middle, *charpentieri* Swezey, holotype; Mohiakea, Waianae Mts., Oahu. Bottom, a cocoon of *charpentieri*; length 2.5 mm.

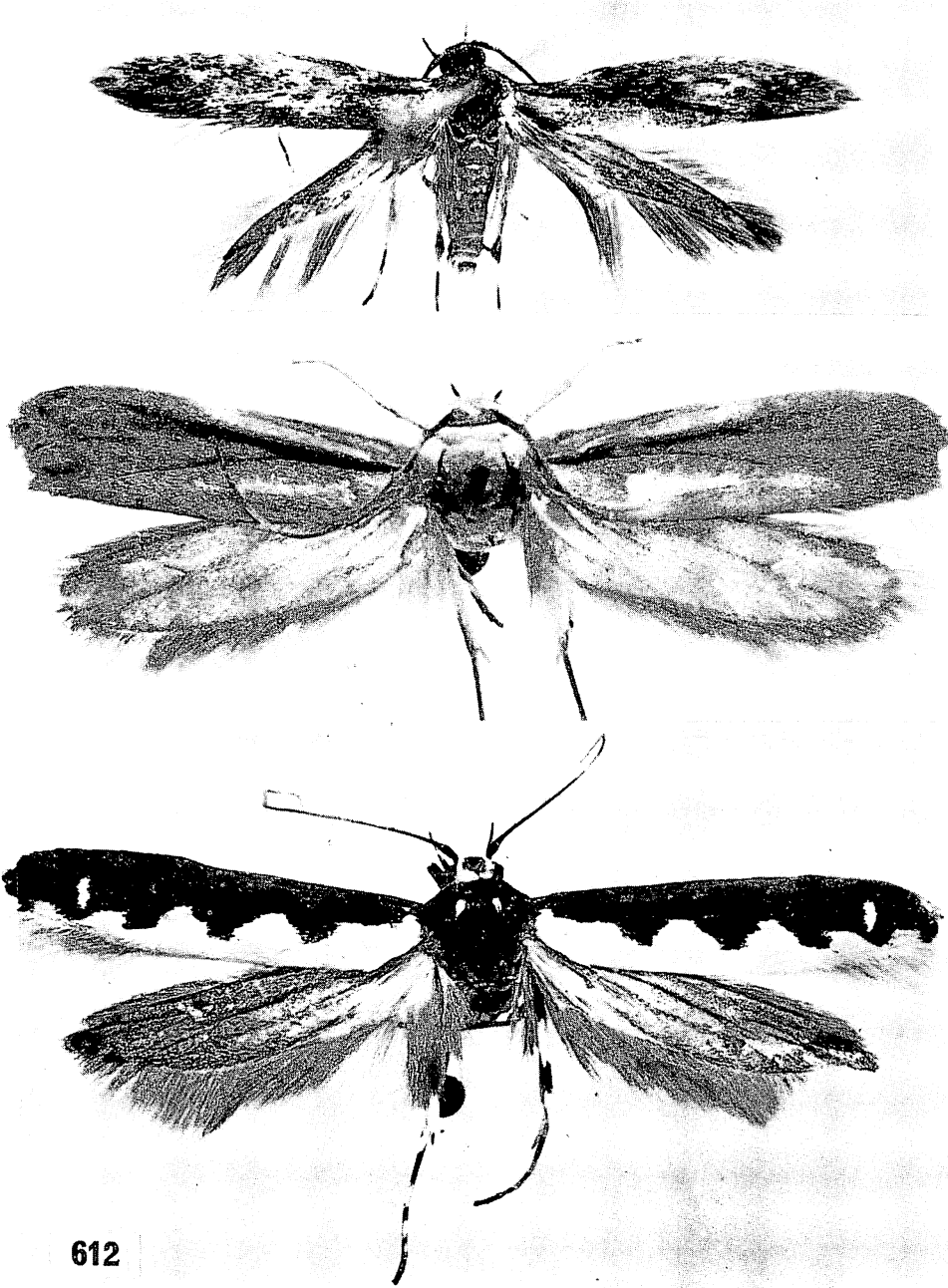


Figure 612—*Mapsidius*. Top, *chenopodii* Swezey, holotype; Saddle Road, Hawaii; forewing 6 mm. Middle, *iridescens* Walsingham, holotype female (BM slide 3954); Kauai, 3,000 to 4,000 feet; forewing 12.5 mm. Bottom, *quadridentata* Walsingham, holotype female (BM slide 3953); Lanai, 2,000 feet; forewing 12.5 mm.



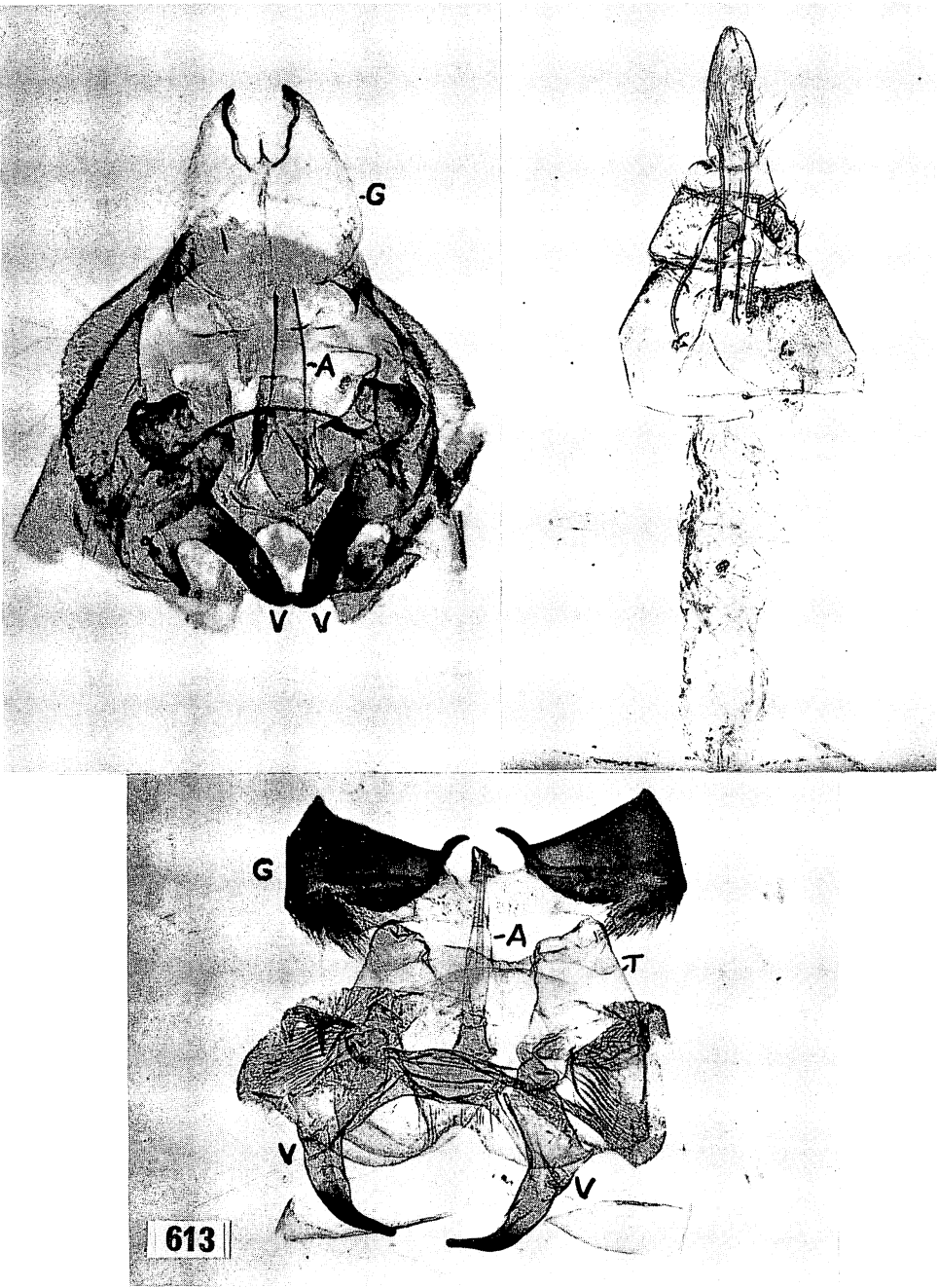


Figure 613—*Mapsidius*, genitalia. Top left, male genitalia of *auspicata* Walsingham, holotype (BM slide 4174), aedeagus in situ; Lanai, 2,000 feet. Note the fused gnathus at top. Top right, female genitalia of *quadridentata* Walsingham, holotype (BM slide 3953); Lanai, 2,000 feet. Bottom, genitalia of a male paratype of *charpentieri* Swezey (Busck slide 63), aedeagus in situ; Waianae Mts., Oahu. Note the heavily sclerotized arms of the divided gnathus. Compare figure 614. A, aedeagus; G, gnathus; T, tegumen; V, valva.

wings have only 11 veins (evidently 3 and 4 are fused), and veins 7 and 8 are stalked when fully developed. The wing shape and venation are subject to rather unusual specific variation. The male genitalia are heavy and peculiar—bearing no resemblance to the genitalia of any other genus in Hawaii. The pilifers are well developed, and the vestiture that they bear crosses over the base of the rostrum so as to make them appear to resemble maxillary palpi.



Figure 614—Male genitalia and apex of abdomen of, supposedly, *Mapsidius charpentieri* Swezey (slide Z-XII-19-62-15); Haleauau, Oahu; aedeagus at top right. Compare figure 613 and note the differences in the contours of the arms of the gnathus and the valvae. It would appear that two forms are involved. If not, the variation is unusually great. G, gnathus; V, valva.

There is specific variability in the development of the maxillary palpi. Walsingham, in his original description, said that the proboscis is "naked". This statement is a serious error, because the rostrum is densely and conspicuously squamose. Walsingham also said in his original description that the basal antennal segment lacks a pecten. This is true for his species *auspicata* and *iridescent* and *chenopodii* Swezey, but Walsingham's *quadridentata* has a conspicuous pecten as does Swezey's *charpentierii*.

Five species have been described in *Mapsidius*, but there are many undescribed species in the islands. Four of the five known species have *Charpentiera* (Amaranthaceae) as hostplant. The fifth known species feeds upon *Chenopodium* (Chenopodiaceae). "The caterpillars of these moths feed within webs on the new apical foliage; later, when the leaves are fully expanded they are some-

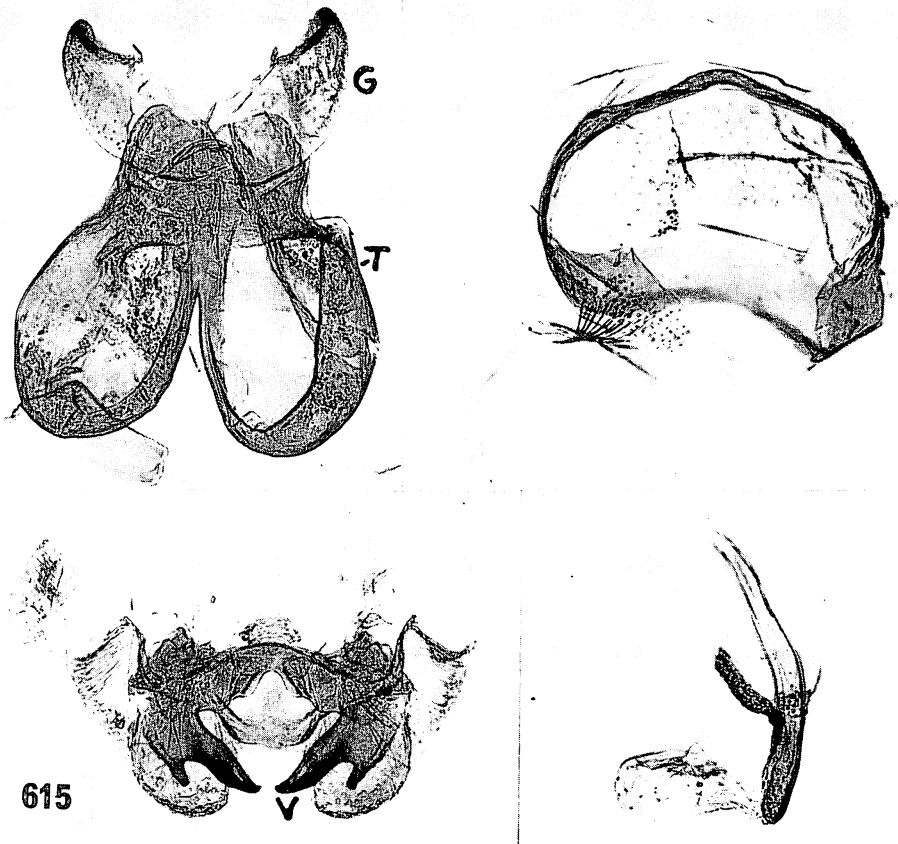


Figure 615—*Mapsidius chenopodii* Swezey, dismembered male genitalia (slide Z-XII-21-65); Saddle Road Hawaii; ex *Chenopodium*. Top left, tegumen and arms of the gnathus. Top right, caudal abdominal segment. Bottom left, valvae and associated parts. Bottom right, aedeagus. G, gnathus; T, tegumen; V, valva.

times very ragged from the work of these larvae. The white, densely spun cocoons are made on the leaves.” (Swezey, 1954:45.)

Some of the moths have striking and beautiful color patterns. It is strange that so few specimens have been captured. Dr. Perkins collected three species, but he found only one specimen each of two of the species and only two specimens of the third during all of his extensive Hawaiian explorations over a period of several years. Much remains to be recorded about these unusual moths.

I have examined the larvae of *Mapsidius chenopodii* Swezey, and they have much in common with the larvae of true *Scythris*. Some details of the larva of *Mapsidius chenopodii* are as follows: Head with the frons reaching only about half the distance to the vertical triangle; each mandible has four sharp apical teeth. The three prespiracular L setae of the prothorax are in a subhorizontal line. On abdominal segments one to eight the D1 and D2 pinacula are in line

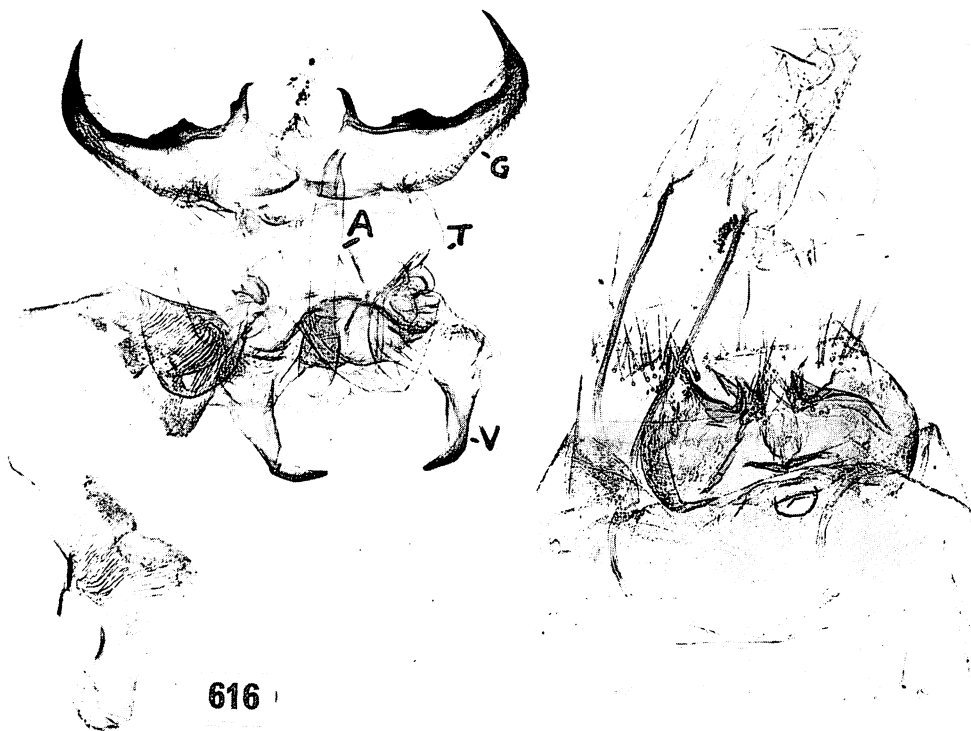


Figure 616—*Mapsidius quadridentata* Walsingham, male and female genitalia (male, Busck slide 61; female, Busck slide 62); Maui. A, aedeagus; G, gnathus; T, tegumen; V, valva.

and each contains about four setae; seta SD1 is single, directly above the spiracle and longer than the D setae; the L1 pinaculum has two setae (one of which is short and may easily be overlooked); the L2 pinaculum has two setae and is far below L1; the L3 pinaculum has about six setae; the SV and V setal groups on abdominal segments one and two have four or five setae; the SV groups on abdominal segments three to six have about 10 to 12 setae but only two setae on segments seven, eight, and nine; the V setal groups on segments three to nine are single but sometimes have a second very small seta on segment seven. The spiracles are very small. Ventral proleg crochets are arranged in biordinal circles.

The multiple setae on the abdominal pinacula are a diagnostic character for *Mapsidius* in the Hawaiian microlepidopterous fauna.

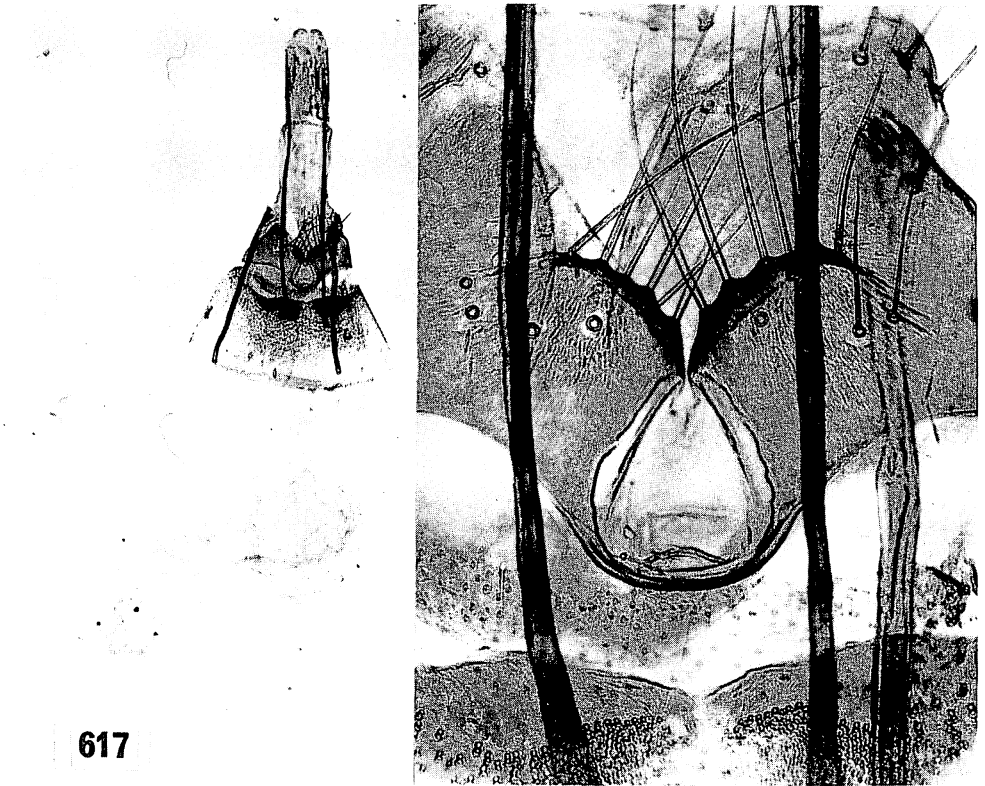


Figure 617—*Mapsidius auspicata* Walsingham, female genitalia (slide Z-XII-24-65); Kamokuiki Valley, Oahu; ex *Charpentiera*.

## KEY TO THE SPECIES OF MAPSIDIUS

1. Forewings immaculate, iridescent greyish; figure 612;  
Kauai . . . . . **iridescens** Walsingham.  
Not as above forewings variously maculate. . . . . 2
- 2(1). Forewings very boldly marked with the posterior part  
of the wing white and the anterior part black with  
the black extended into the white area as four or  
five subtriangular, toothlike projections, as in figure  
612; Lanai and Maui . . . **quadridentata** Walsingham.  
Without such a color pattern. . . . . 3
- 3(2). Forewings basically fuscous with a scattering of white  
scales which do not form distinct maculae; figure  
612; Hawaii. . . . . **chenopodii** Swezey.  
Forewings basically white scaled with fuscous to black  
scaling, some of which form distinct maculae. . . . . 4
- 4(3). Forewing pattern as in figure 611; expanse about 15  
mm.; antennal pecten absent; on various islands. . .  
. . . . . **auspicata** Walsingham.  
Forewing pattern as in figure 611, the maculae more  
discrete and more sharply angled than on *auspicata*;  
expanse about 20 to 25 mm.; antennal pecten  
conspicuous; Oahu . . . . . **charpentierii** Swezey.

**Mapsidius auspicata** Walsingham (figs. 608, head, wing venation; 610, pupa; 611, moth; 613, male genitalia; 617, female genitalia; col. pl. 4:6).  
*Mapsidius auspicata* Walsingham, 1907b:650, pl. 25, fig. 5.

Endemic. Kauai (female holotype locality: Kaholuamano, 4,000 feet),  
Oahu, Lanai (male allotype locality: 2,000 feet), Hawaii.

Hostplant: *Charpentiera*.

Parasites: *Horogenes blackburni* (Cameron), *Pristomerus hawaiiensis* Perkins.

"Larva in dense white silken tunnel on leaves. . . ." (Swezey, 1910e:141.)

See also notes under *charpentierii* below.

There have been several species mixed under this name, and the recorded distribution is suspect. The basal antennal segment does not have a pecten.

**Mapsidius charpentierii** Swezey (figs. 611, moth, cocoon; 613, 614, male genitalia; 618, female genitalia).

*Mapsidius charpentierii* Swezey, 1932:201, pl. 13, fig. 5; 1954:45, fig. 14.

Endemic. Oahu (type locality: Mohiakea Valley, Waianae Mountains).

Hostplant: *Charpentiera obovata*.

Similar to *auspicata* Walsm., but of larger size, and the black marks on the forewings (as shown by the figure) are more distinct and angulated. The cocoon is different, also. It is elongate spindle-shaped, densely made of white silk, placed on underside of leaf and beneath a thin lacework of silk which has several large circular meshes. This is similar to the way the cocoon of *M. quadridentata* is constructed, whereas the cocoon of *auspicata* is broad spindle-shaped beneath a closely-woven layer of white silk.

Pupa 10 mm., dark brown, lighter on the wing sheaths, which extend as far as the apex of 6th abdominal segment. Apical margin of abdominal segments with a raised rim. Spiracles of abdominal segments raised. Cremaster obtuse. (Swezey, 1932:201.)

The basal antennal segment bears a squamose pecten.

The holotype is now in the Bishop Museum.

**Mapsidius chenopodii** Swezey (figs. 609, wing venation; 610, pupa; 612, moth; 615, male genitalia; 619, female genitalia).

*Mapsidius chenopodii* Swezey, 1947b:103.

Endemic. Hawaii (type locality: near Pohakuloa).

Hostplant: *Chenopodium oahuense*.

Parasites: *Bracon* species [misidentified as *terryi* (Bridwell)], *Horogenes* ("Olesicampe") *blackburni* (Cameron).

The larvae (described briefly before the key immediately above) have on occasion been found to be numerous on the foliage of the hostplant. It will be noted that all the other described species of *Mapsidius* have been found to feed upon *Charpentiera* (Amaranthaceae).

The basal antennal segment of the moth lacks a pecten.

The holotype is now in Bishop Museum.

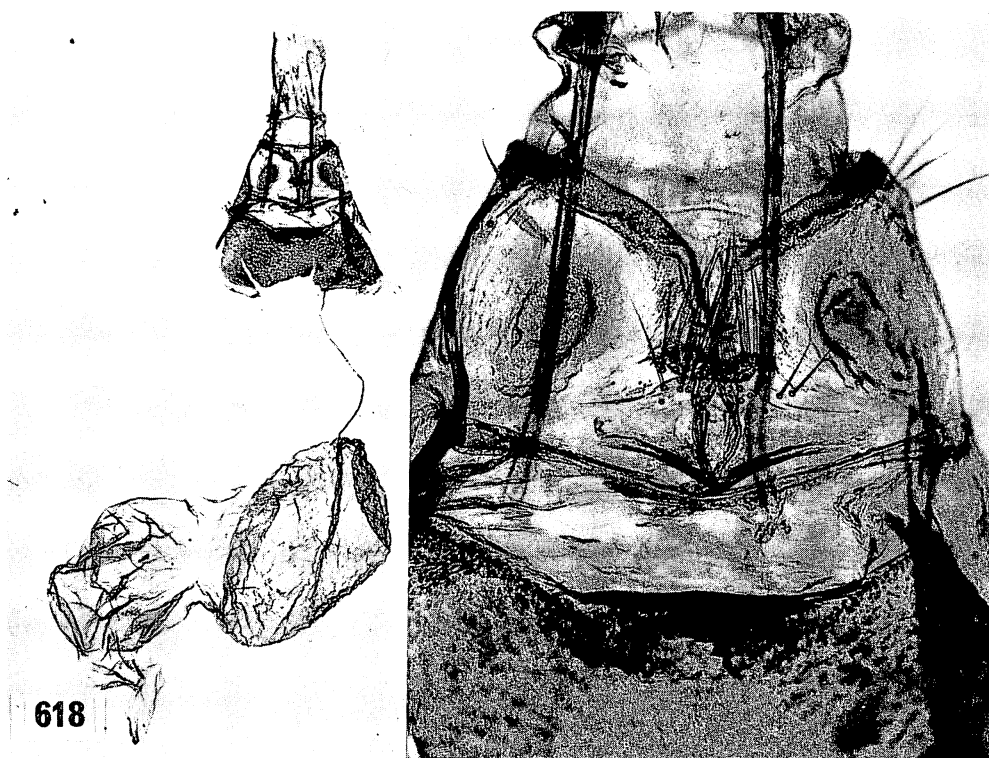


Figure 618—*Mapsidius charpentieri* Swezey, female genitalia (slide Z-XII-19-62-14); Kamokuiki Valley, Oahu; ex *Charpentiera*.

**Mapsidius iridescens** Walsingham (figs. 609, wing venation; 612, moth; 620, male, female genitalia).

*Mapsidius iridescens* Walsingham, 1907b:651, pl. 25, fig. 7.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: *Charpentiera* leaves.

Parasite: *Frontina archippivora* Williston (Diptera).

This species is distinctive because of the immaculate, somewhat iridescent coloration of the forewings. The peculiar maxillary palpi are much reduced. It was described from one female collected in May, 1894, by Dr. Perkins. A male, determined as this species by Dr. Swezey, which I have compared with the type (and whose genitalia I have illustrated), has a different appearance from the type. Perhaps this is because of its having been faded by the tropical sun while it was in the Sugar Planters' collection in Honolulu. It has a strange, narrow, thinly scaled, shiny band along part of the posterior margins of the forewings to beyond their middles, and the scaling at the bases of the wings

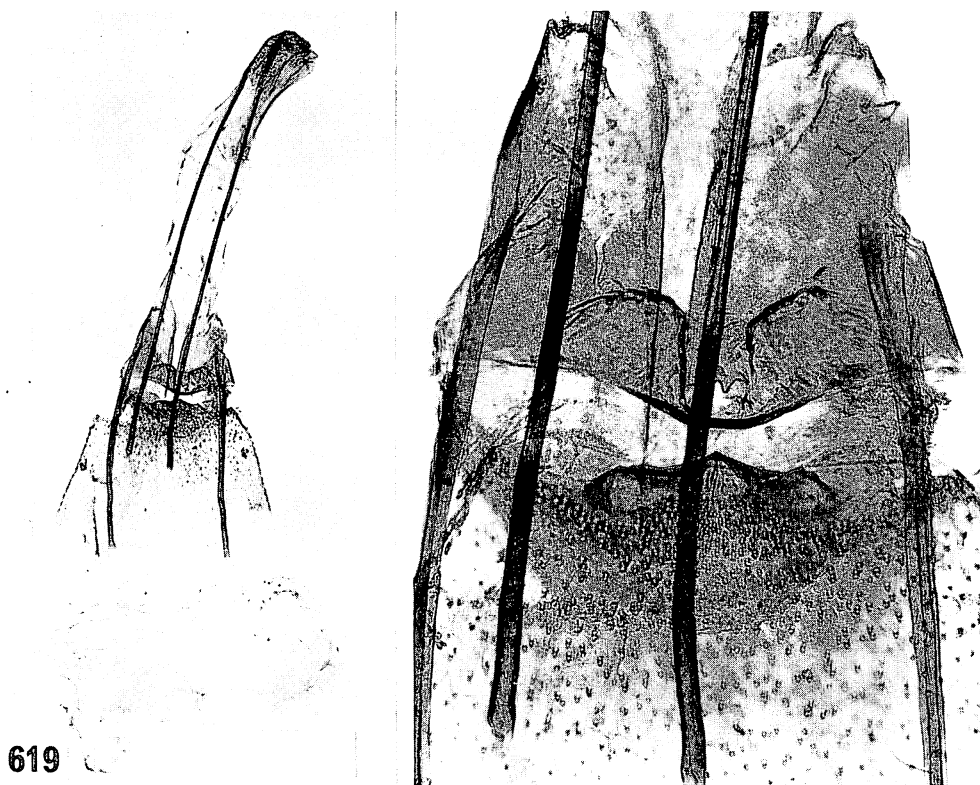


Figure 619—*Mapsidius chenopodii* Swezey, female genitalia (slide Z-XII-22-65); Saddle Road, Hawaii; ex *Chenopodium*.





Figure 620—Genitalia of *Mapsidius iridescens* Walsingham. Top, female genitalia of the holotype (BM slide 3954); Kauai, 3,000 to 4,000 feet. Bottom, male genitalia from a specimen reared from *Charpentiera*; Kauai (Busck slide 75).

is different. If these characters are not sexual, then two species have been mixed under this name. The basal antennal segment lacks a pecten.

**Mapsidius quadridentata** Walsingham (figs. 609, wing venation; 612, moth; 613, female genitalia; 616, male, female genitalia).

*Mapsidius quadridentata* Walsingham, 1907b:651, pl. 25, fig. 6. Swezey, 1954:45, fig. 13.

Endemic. Lanai (type locality: 2,000 feet), Maui.

Hostplant: *Charpentiera*.

As the illustration displays, the forewings of this species are the most boldly maculate of any of the described species of the genus.

The Maui record, and that of the hostplant, are by Dr. Swezey who reared a specimen taken at Wailuku in 1922 [*Proc. Hawaiian Ent. Soc.* 5(3):343, 1924]. In his *Forest Entomology in Hawaii*, 1954:45, he also listed the species from Iao Valley, Maui.

The basal antennal segment has a squamose pecten.

#### Family **AGONOXENIDAE** Meyrick

*Agonoxenidae* Meyrick, 1926a:245. T.B. Fletcher, 1929:ii. Brues and Melander, 1932, 1945:225. Brues, Melander and Carpenter, 1954:245. Bradley, 1966:453, revision.

Meyrick erected this family to receive *Agonoxena* and *Haemolytis*.

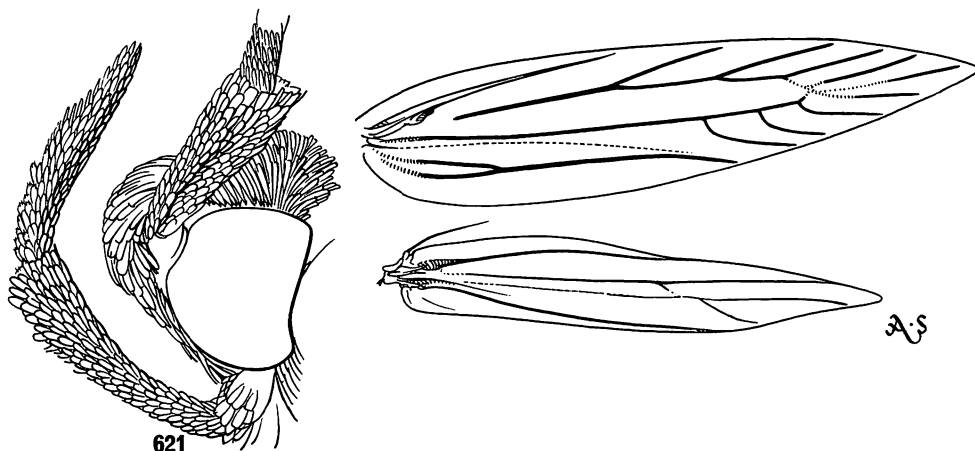


Figure 621—Head and wing venation of *Agonoxena argaula* Meyrick (BM slide 2318); Ellis Islands. There is individual variation in the origins of veins 6, 7, and 8 in the forewing and veins 5 and 6 in the hindwing. The female frenulum contains only two setae.

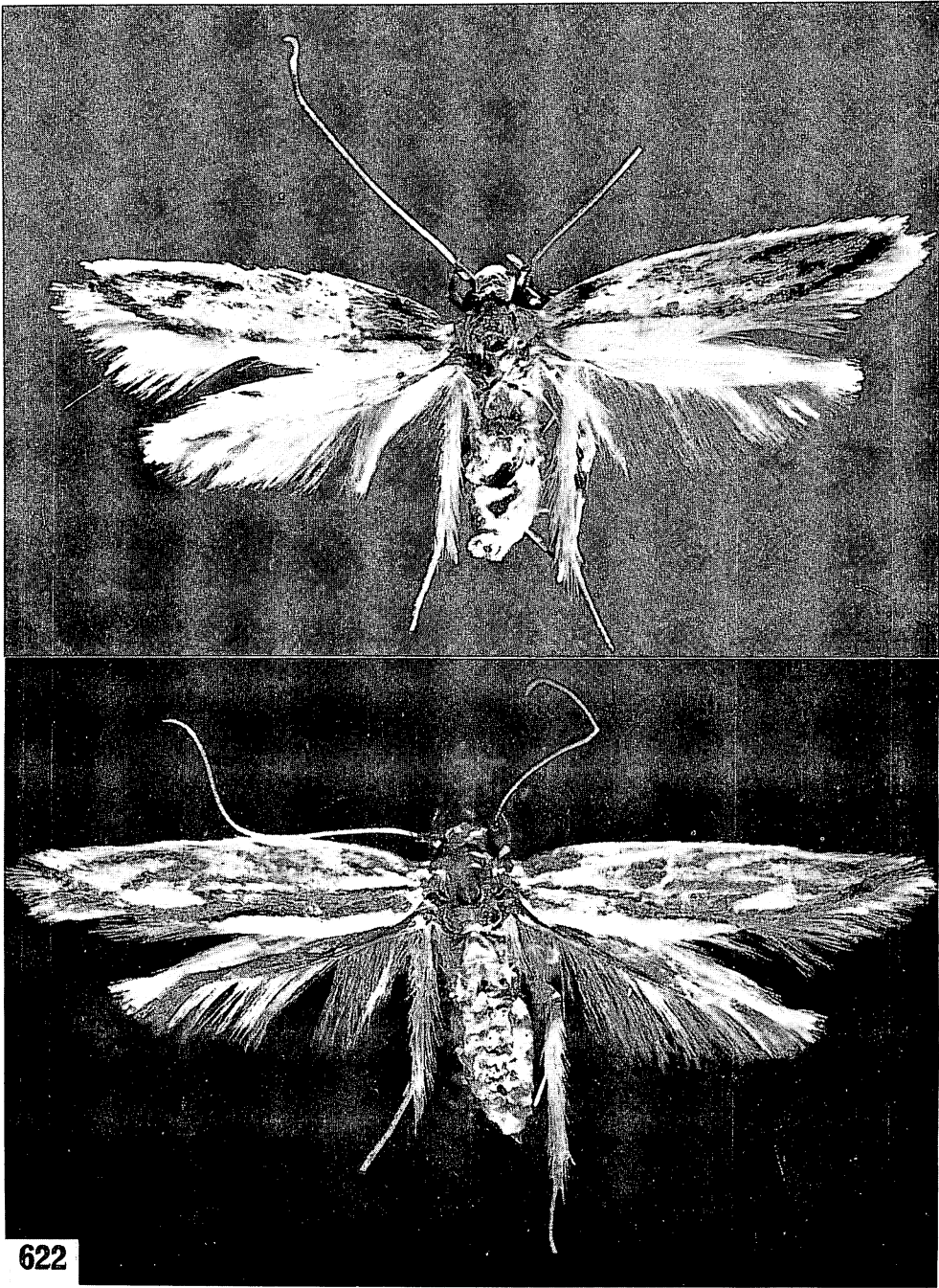


Figure 622—*Agonoxena argaula* Meyrick, color forms. Honolulu specimens. Expanse about 12 to 16 mm.

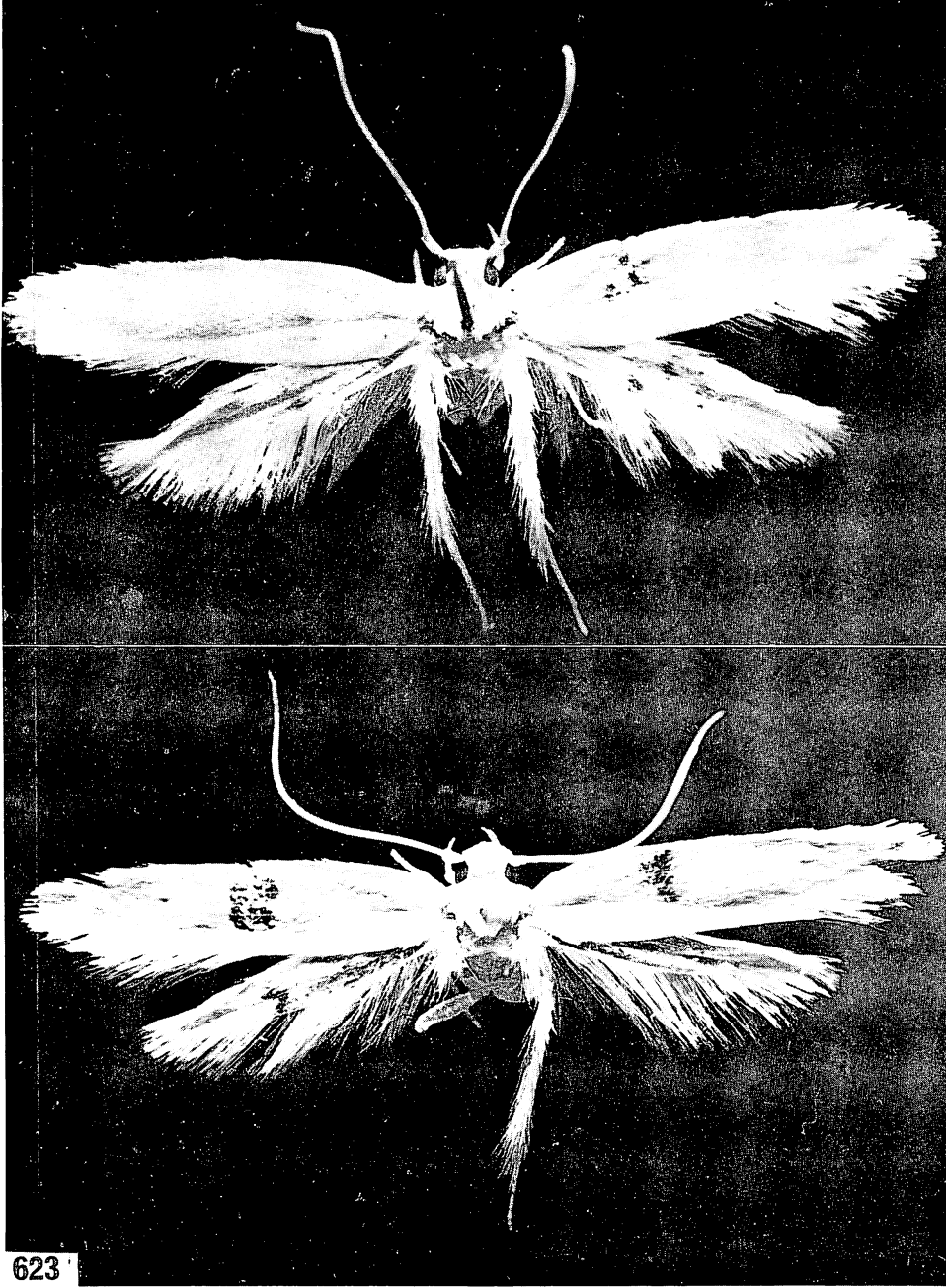


Figure 623—*Agonoxena argaula* Meyrick, color forms. Honolulu specimens. Expanse about 12 to 16 mm.

The phylogenetic position of the family evidently puzzled Meyrick, who, basing his classification mainly on wing venation and external characters, suggested that it might be connected with the Cosmopterigidae. Previously (Meyrick, 1921, p. 471), he had placed *Agonoxena* in the family Coleophoridae, but had expressed the opinion that it was an aberrant form of doubtful reference.

In the present study, a wider range of characters than used hitherto has been considered and has included genitalic and pupal structure and larval chaetotaxy. These combined have provided evidence which supports Meyrick's hypothesis that the family belongs in the Gelechioid complex, but which indicates a closer affinity with the Oecophoridae than with the Cosmopterigidae.

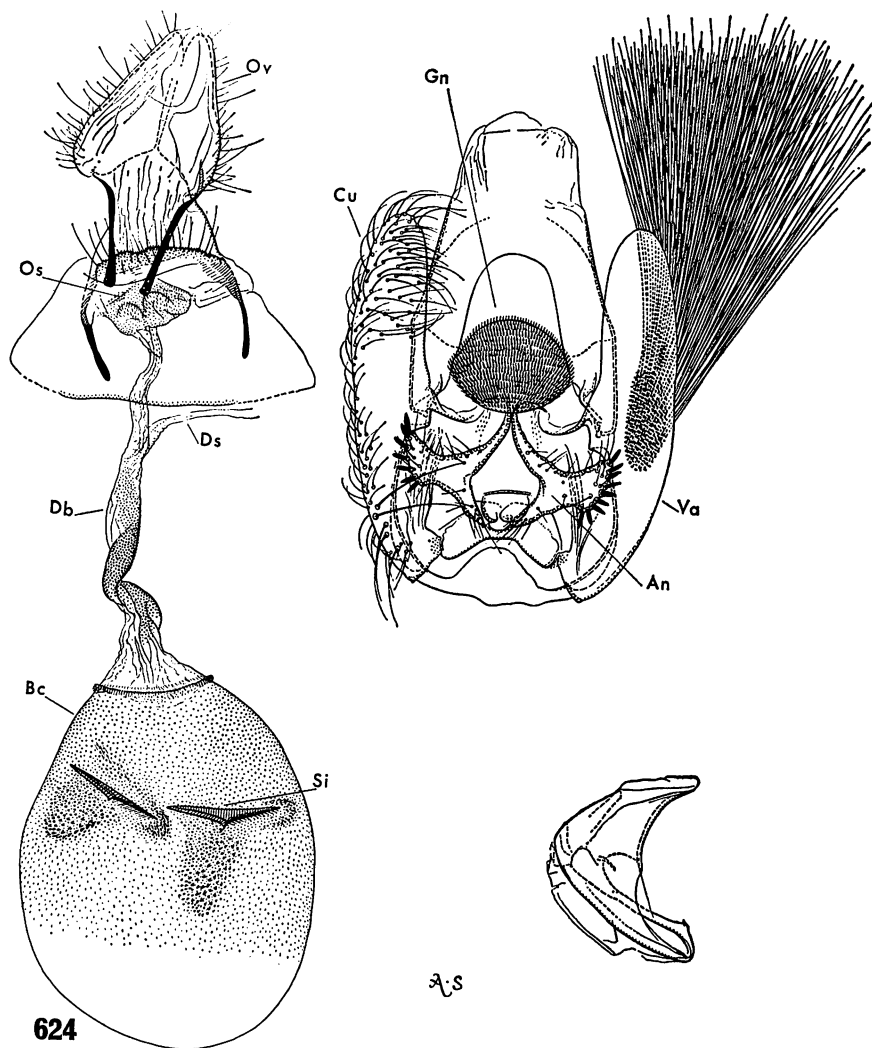


Figure 624—*Agonoxena argaula* Meyrick, female and male genitalia (rearranged from Bradley, 1966). Aedeagus at bottom right. *An*, anellus; *Bc*, bursa copulatrix; *Cu*, cuculus; *Db*, ductus bursae; *Ds*, ductus seminalis; *Gn*, gnathus; *Os*, ostium; *Ov* ovipositor; *Si*, signum; *Va*, valva.

The adults of the . . . described species representing this family are broadly similar in both superficial and internal structure and form a homogeneous and distinctive group. The forewing coloration and pattern, flattened head and explanate labial palpi are characteristic and diagnostic characters of members of this family. (Bradley, 1966:453–454.)

Brues and Melander, 1932:225, 1945:225 (and repeated on p. 233 of the 1954 edition) erroneously say that the “frenulum of female [is] simple”, but it is composed of two bristles.

### Genus **AGONOXENA** Meyrick

*Agonoxena* Meyrick, 1921a:471. Type-species: *Agonoxena argaula* Meyrick; monotypic.

*Haemolytis* Meyrick, 1926a:245. Type-species: *Haemolytis miniana* Meyrick; monotypic. Synonymy by Bradley, 1966:454.

Bradley, 1966:453, revision.

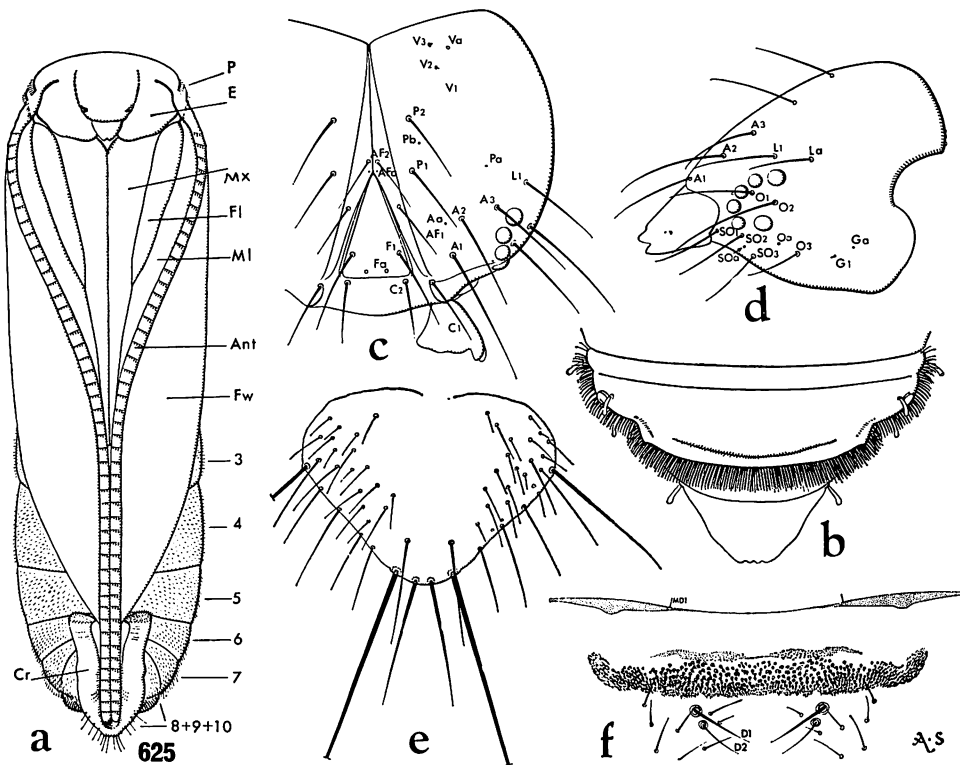
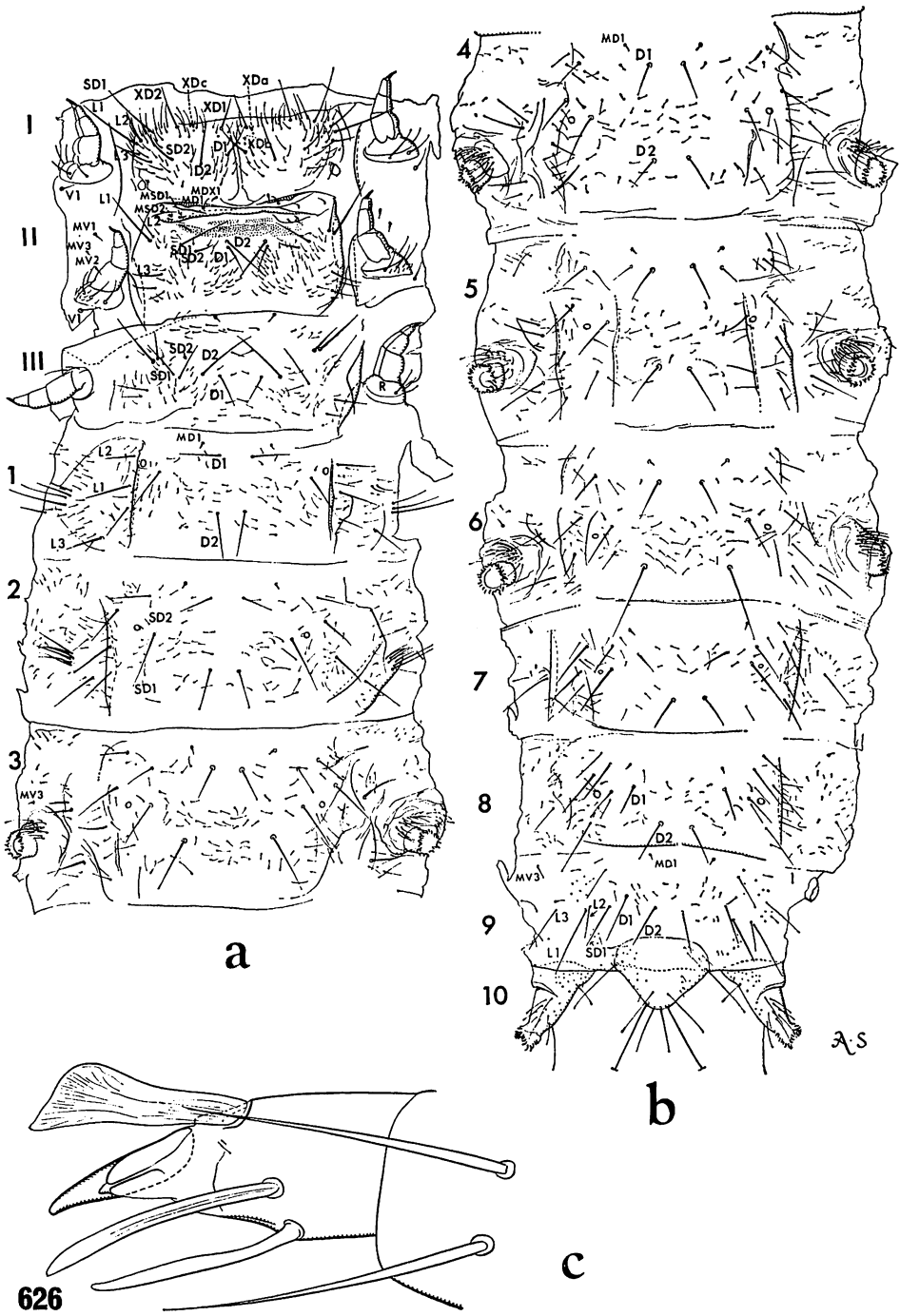


Figure 625—*Agonoxena argaula* Meyrick, details of the larva and pupa (rearranged from Bradley, 1966). *a*, ventral aspect of pupa (*Ant*, antenna; *Cr*, cremaster; *E*, eye; *Fl*, front leg; *Fw*, forewing; *Ml*, middle leg; *Mx*, maxilla; *P*, antennal pecten; 3 to 10, abdominal segments). *b*, dorsal aspect of the caudal end of the pupa. *c* and *d*, frontal and lateral aspects of the larval head. *e*, dorsal aspect of the caudal (10th) tergite of the larva. *f*, dorsal aspect of the mesonotum of the larva. The mesothoracic spiracles are of the transverse type. (Note: In the original paper the maxilla is wrongly labeled labial palpus.)



As now constituted, this genus contains four described species. It is a Pacific genus with species occurring from Java to Australia and Melanesia. The representative in Hawaii is a widespread immigrant of economic importance. It is a moth of depressed form about 7 mm. in length when the wings are in repose. It is cream color beneath and mostly yellow above with white streaks on the forewings of the females. The underside has a definite flattened appearance, and the face is subhorizontal. The labial palpi diverge against the trochanters when at rest. The maxillary palpi are small and the proboscis is squamose basad. The wings diverge caudad. The depressed form of the moth is a reflection of its habit of insinuating itself between the folded leaflets of its palm hosts. Meyrick said that ocelli were present in this group, but that was a mistake—the ocelli are absent in *Agonoxena*.

***Agonoxena argaula*** Meyrick (figs. 621, head, wing venation; 622, 223, moths; 624, male and female genitalia; 625, 626, larva, pupa; 627, larval damage).

*Agonoxena argaula* Meyrick, 1921a:472; 1927c:84. Swezey, 1942:215; 1954:57. Bradley, 1966:453, redescription, larva, pupa, adult, many figures. See *Proc. Hawaiian Ent. Soc.* after 1949 for numerous references by various authors in Hawaii.

The coconut flat moth.

Kauai, Oahu, Hawaii.

Immigrant. Described from Fiji and known also from Guam, the New Hebrides, Tonga, Samoa, Ellice, Wallis, Futuna, and Palmyra islands. First recorded in Hawaii by Van Zwaluwenburg in 1949 [*Proc. Hawaiian Ent. Soc.* 13(3):334, 1949] from specimens collected at Kahala, Honolulu by him and Pemberton in June, 1948. It was first found on Kauai in 1952 and on Hawaii in 1953. Artificially spread by commerce.

Hostplants: *Chrysalidocarpus lutescens* (areca palm), *Cocos nucifera* (coconut), *Hyophorbe amaricaulis* (bottle palm), *Kentia*, *Pritchardia* ("loulou").

Parasites: *Apanteles agonoxenae* Fullaway, *Brachymeria agonoxenae* Fullaway (as much as 85% parasitism of pupae), *Brachymeria polynesialis* (Cameron), *Eupelmus cushmani* (Crawford), *Gelis tenellus* (Say), *Trathala flavo-orbitalis* (Cameron). (Are *Eupelmus* and *Gelis* hyperparasites?) For an account of parasitism, with particular reference to Fiji, together with lists of parasites and a discussion of predation, see Hinckley, 1963. See Van Zwaluwenburg, 1949:447, for parasites in Hawaii.

This, the largest known species of the genus, is a pest of coconut and some other palms. The attacks of the larvae give the leaves an unsightly appearance. "Feeding is confined to the epidermis on the underside of the leaves. The feeding scar of the young larva is long and narrow, spreading into wide, irregular blotches as the caterpillar grows. Feeding areas turn brown and are conspicuous. The caterpillar is yellowish green and feeds beneath a web; it does not tie up the leaf as *Omiodes* [*Hedylepta*] does. Pupation takes place beneath a close, elongate, white web on either side of the upper or lower leaf surface." [Van Zwaluwenburg, *Proc. Hawaiian Ent. Soc.* 13(3):334, 1949.] During a



heavy attack, several thousand larvae may infest a single palm tree. Where the dead tissue has fallen out of the elongate feeding scars, the leaves may be perforated by myriads of slitlike holes.



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Figure 627—Characteristic linear feeding scars made on a coconut leaflet by the larvae of *Agonoxena argaula* Meyrick. (Photograph supplied by C. J. Davis.)

The slender *Agonoxena* caterpillar feeds beneath a slight web on the underside of the leaflet; it eats the lower epidermis and green parenchyma, leaving the upper epidermis as a narrow, dry, dead patch. As the larva grows it moves about, producing several of these dead spots in the course of its life, so that there may be hundreds of narrow dead areas on each leaf of badly infested trees. In appearance these spots differ distinctly from the work of the coconut leafroller, so the presence of either *Agonoxena* or [*Hedylepta*] *blackburni* can be distinguished readily. (Swezey, 1954:57.)

Tothill, Taylor, and Paine (1930:13, 30, 63, 156, 180, 250, 260), who studied the moth in Fiji during their extensive research on the *Levuana* coconut moth, illustrated the feeding scars of the larvae on their plate 23, figures D and F.

The pale yellowish to greenish larvae are, when mature, about 16 to 18 mm. long, and they have been described in detail by Bradley (1966:462). His figures are reproduced here, and they should suffice to enable the identification of the larva in Hawaii. Attention is called particularly to the numerous secondary setae. Bradley's paper may be consulted when more detailed information is required.

[The cocoon] consists of two main sections: an inner flimsy fusiform case, containing the pupa and cast larval skin, slightly wider than the pupa and almost twice as long, and an outer, comparatively thick, protective mantle which is spread over the inner case. The inner case is smooth-lined and has the lateral walls strengthened with a series of closely spaced vertical struts exteriorly. The outer mantle forms a closely adpressed tent-like covering, the peripheral margin adhering to the leaf surface and the intervening space between the margin and the inner case being partly filled with numerous minute struts formed from agglutinated silken threads fixed to the leaf surface and supporting the underside of the mantle. (Bradley, 1966:470.)

Bradley (1966:468) noted that the pupa is pale brown, slightly depressed, has the abdomen setose laterad, and the cremaster is an "elaborate . . . device in the form of a pair of strongly developed arm-like processes projecting cephalad from ventral surface of terminal segments, apices of arms pad-like and clad ventrally with short wiry hairs which engage in the silken cocoon and thus anchor the pupa; structure of cremaster . . . recalling that of the cremaster found in certain species of *Ethmiidae*."

There is much variation in the color and color pattern of the moths (see the illustrations). The male genital valvae bear great tufts of long hair.

Family **CYCNODIIDAE** Busck

*Elachistidae* Stainton, 1854:224. Spuler, 1898a:33. Busck, 1909:92. Braun, 1948:1, revision of North American species (7 genera, 57 species).

*Elachistinae*: Walsingham, 1890:148.

*Cynodioidea* Busck, 1909:92. Forbes, 1923:36, 218.

*Cynodiidae* Busck, 1914a:53, pl. 2. Forbes, 1923:218.

*Cynodiidae*: Brues, Melander, and Carpenter, 1954:258.

*Cynodiadae*: Hampson, 1918:387.

*Aphelosiadae* Hampson, 1918:387. Hampson does not claim credit for this name, but I have been unable to find an earlier usage.

*Aphelosiidae*: Brues, Melander, and Carpenter, 1954:258.

Because of confusion in the identity of the type-species, true *Elachista* does not belong to the family that has been known as the Elachistidae, and Cynodiidae replaces it. J. D. Bradley (1970:231) has said that "if the designations of type-species in Boisduval, 1836 are rejected, the earliest valid type-species designation for the genus *Elachista* appears to be *Tischeria com-*

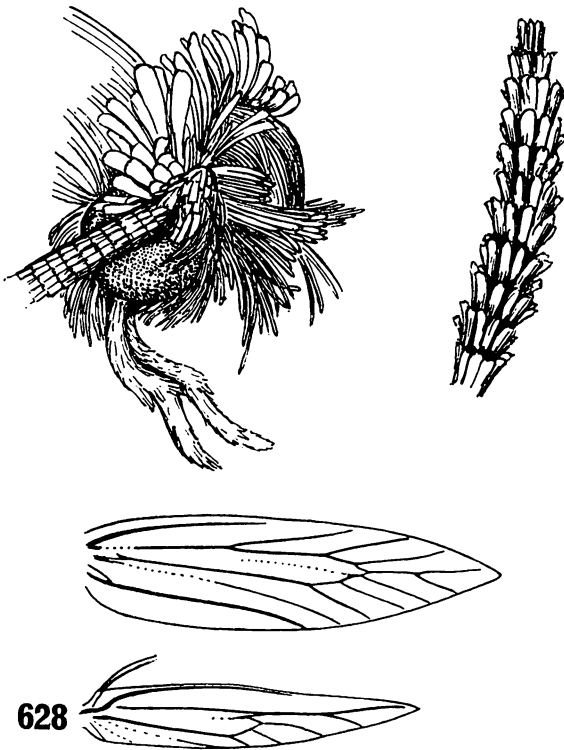


Figure 628—*Swezeyula loniceræ* Zimmerman and Bradley; head, in lateral aspect with scales erected, and apical part of antenna to show the rough scaling and the wing venation.

*planella* (Treitschke) by Duponchel in 1838. If this type-species designation is upheld then the genus *Elachista* Treitschke, 1833 becomes a senior objective synonym of *Tischeria* Zeller, 1839 and would be replaced by *Aphelosetia* Stephens, 1834. The family name Elachistidae would then replace Tischeriidae, and the name [Cynodiidae (Busck, 1909)] would be available for Elachistidae sensu auctt."

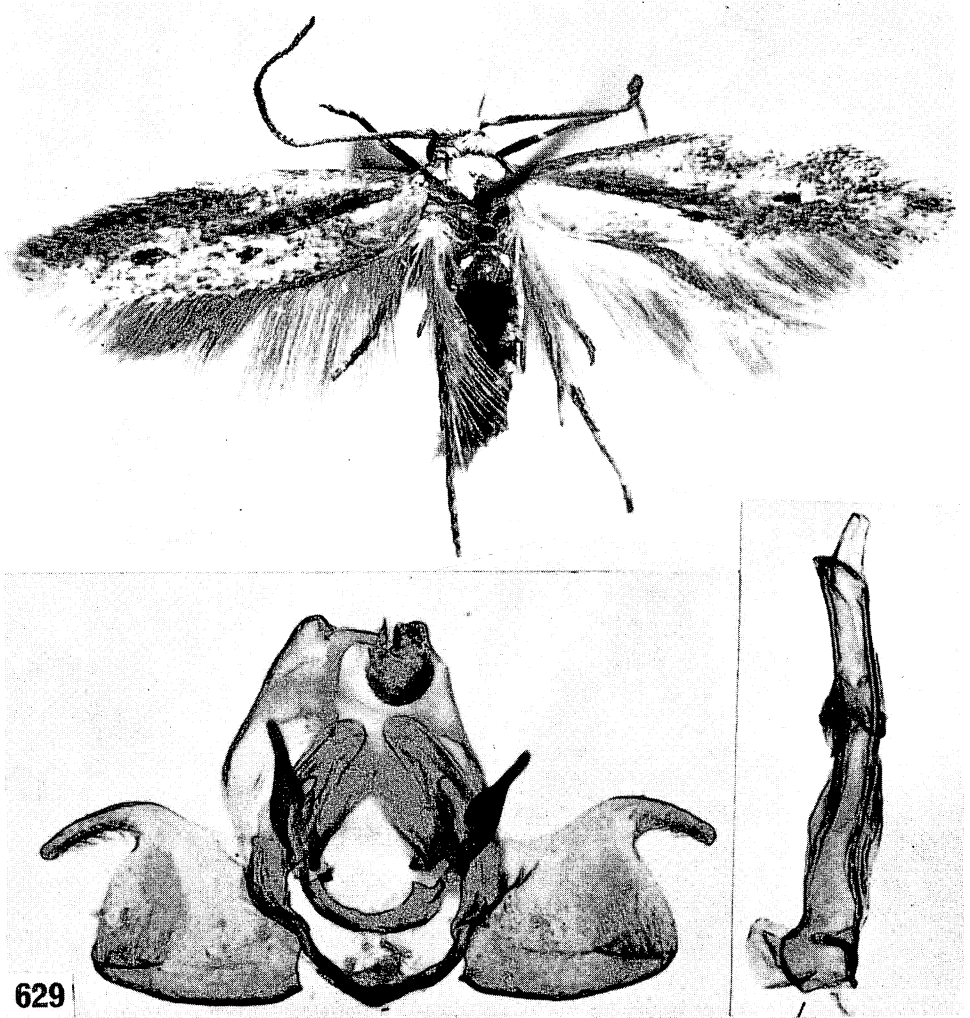


Figure 629—*Swezeyula loniceræ* Zimmerman and Bradley. Top, a paratype from Honolulu, expanse 8 to 9 mm.; forewings greyish with two small dark maculae. Bottom, male genitalia from another paratype from Honolulu.

In *Fauna Hawaiiensis*, Walsingham described two new species which he erroneously placed in *Elachista*. These species were never recognized by subsequent workers in Hawaii. During this study it was found that one of them (*longisquamella*) is the same as "*Petrochroa*" *nigrella* Swezey, which I now place in *Hyposmocoma* in the Cosmopteriginae. The other (*spilota*) belongs to *Philodoria* in the Gracillariidae. Thus, there are no representatives of the Cynodiidae (Elachistidae) in the endemic Hawaiian fauna. A foreign species has, however, become established in Hawaii.

Braun, in her revision of the American species (1948:1) said:

The relationships of the family are somewhat obscure. The presence of an additional branch of radius of the hind wing in some of the genera suggests primitive affinities; however, the retention of such a character in some members of a group is not inconsistent with a high degree of specialization of the group as a whole. Neither pupal characters or genitalia bear out the assumption of a primitive position for the family. Pupal characters indicate Gelechioid affinities with relationship closer to the Oecophoridae, a view supported by certain features of the genitalia. Meyrick (1927, *Revised Handbook of the British Lep.*, p. 600) derives the family from Hyponomeutoid stock; this view is supported by imaginal structure. I would derive the family from primitive Hyponomeutid stock, in which there is a tendency for preservation of additional branches of the radial sector of the hind wing (Braun, 1933. *Trans. Amer. Ent. Soc.*, LIX, p. 245), with development proceeding along Gelechioid lines, but along the Oecophorid rather than the Gelechiid branch, with considerable affinity to the Scythridae.

It should be noted that the cynodiids have squamose proboscides, as is the normal condition in the gelechioids, whereas the yponomeutoids have "naked" proboscides.

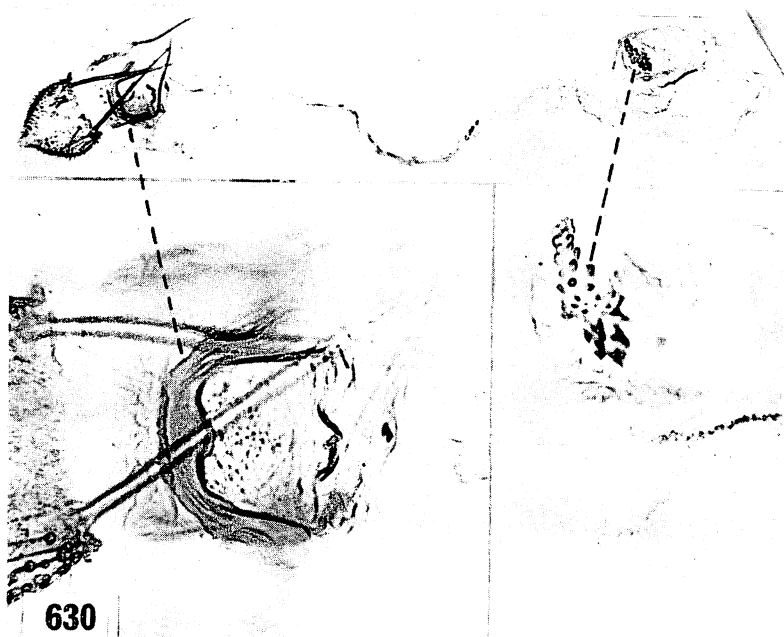


Figure 630—*Swezeyula lonicerae* Zimmerman and Bradley, female genitalia from a Honolulu specimen.

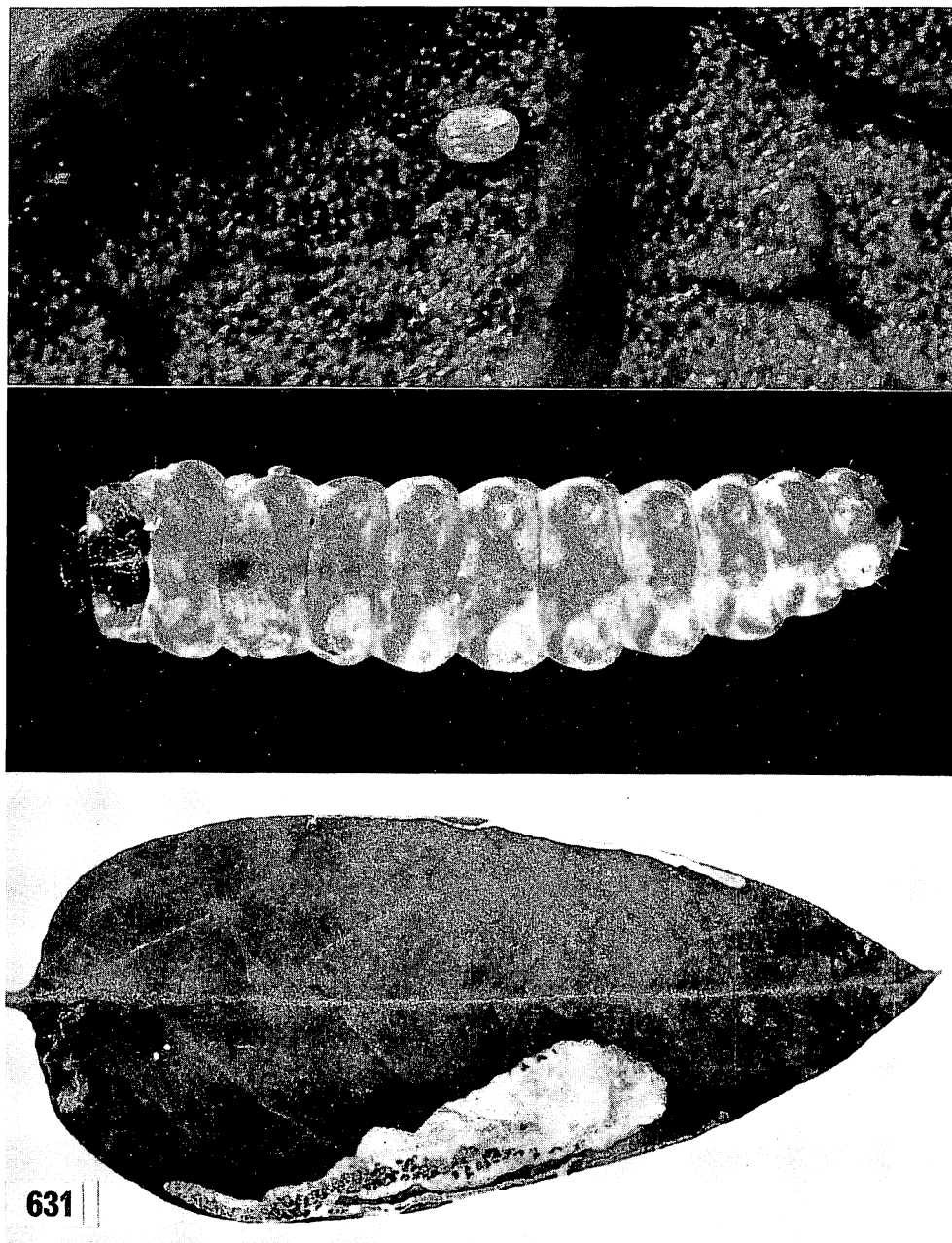


Figure 631—*Swezeyula lonicerae* Zimmerman and Bradley. Top, an egg on a *Lonicera* leaf. Middle, a larva. Bottom, a larval mine in a *Lonicera* leaf. Honolulu specimens.

Genus **SWEZEYULA** Zimmerman and Bradley

*Swezeyula* Zimmerman and Bradley, 1950: 191. Type-species: *Swezeyula loniceræ* Zimmerman and Bradley, 1950: 194, by original designation and monotypy.

This generic name was erected to include a foreign species which became established in Hawaii following the Second World War and for which no acceptable place could be found. *Swezeyula* is closely similar to *Perittia* Stainton, whose type-species feeds on *Lonicera* as does *Swezeyula*. It is possible that detailed study of more species may demonstrate that the characters upon which we erected *Swezeyula* are not sufficient to separate it from *Perittia*. The complex to which these moths belong is in such a taxonomic muddle that it will take much study before the truth is made known.

*Swezeyula* has a strong, multisquamose pecten on the first antennal segment; the latter is arcuate and concave beneath. The antennae are shorter than a forewing. The proboscis is squamose. The labial palpi are slender and drooping or semiporrect and obviously not strongly sickle shaped. The maxillary palpi are obsolete, and there are no ocelli. The metatibiae have long hairs above and beneath, and the ventral hairs are about as long as the submedial spurs.

***Swezeyula loniceræ*** Zimmerman and Bradley (figs. 11–A, g, antenna; 628, head, antenna, wing venation; 629, moth, male genitalia; 630, female genitalia; 631, egg, larva, mine; 632, pupa).

*Swezeyula loniceræ* Zimmerman and Bradley, 1950: 194, figs. 1–5.

The honeysuckle leaf miner.  
Oahu.

Immigrant. Source not known, but possibly Asiatic. First discovered in Hawaii by Miss Wilhelmina Tenney in Honolulu in 1949.

Hostplant: *Lonicera japonica*.

Parasites: *Pnigalio externa* (Timberlake), *Sympiesis vagans* (Timberlake), *Zagrammosoma flavolineatum* Crawford.

The larvae of *Swezeyula* are distinctive in the Hawaiian fauna. The microsculpture of the derm is dark, coarse, and conspicuous, and the larvae appear highly pigmented. The head is depressed and the vertical triangle is deep and narrow, extending to about the middle of the head. The ventral prolegs are short, and they have only about five to ten crochets which are arranged in a single caudal row. The SD1 seta of the ventral proleg-bearing abdominal segments is above and just cephalad of a line drawn from the spiracle; setae L1 and L2 are below and behind the spiracle with L1 separated from L2 by a distance about equal to four or more times the diameter of a spiracle.

For a detailed discussion of the habits of this moth, see Swezey, 1950: 197, figs. 1–3, from which the following details have been abstracted: There is usually only one mine per leaf, but occasionally two mines will be found in a single leaf. The mine starts from the place where the egg is deposited near the margin of the upper surface of the leaf. The slender mine follows the leaf margin for some distance, enlarges gradually, forms an extensive blotch by expanding towards the middle of the leaf, and often doubles back along the slender part

of the mine. The full-grown larva has a reddish tint; the head is dark; the pronotum has two wide, dark vittae. The length is 4 to 5 mm., with a nearly even breadth. It is segmentally crenate laterally with the thoracic segments only slightly broader than the abdominal segments.

The pupa is about 4 mm. long; wings extend to fifth abdominal segment; abdominal segments are laterally crenate as in the larva; cauda is blunt, not attached to the cocoon; pupa not extruded from cocoon upon emergence of the moth; pupal period is about three weeks. The larva separates the epidermis from the other leaf tissues to form a kind of pocket in which pupation takes place. If it is supplied with certain kinds of paper it has the astonishing ability to split a sheet of paper to form a pupal chamber without disturbing either surface of the thin material. Generation follows generation continuously throughout the year in Honolulu.

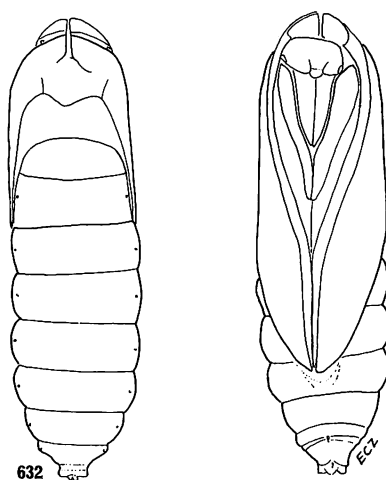


Figure 632—*Swezeyula loniceræ* Zimmerman and Bradley; dorsal and ventral aspects of the cast skin of a pupa; Honolulu; length 4 mm. The derm is coarsely, conspicuously microgranular all over. The setae are not obvious, and the spiracles are very small.

**GELECHIIDAE (Stainton), revised concept.**

Stainton, 1854:75

The Gelechiidae is a very large, systematically difficult, worldwide complex of genera. I do not know of a correct or adequate published definition of the family. Its literature is mostly in a state of confusion. The taxonomy of the Gelechioidea is "inflated"—many of the so-called families assigned to the superfamily surely deserve no higher ranking than subfamilies within the Gelechiidae, and some should not be ranked higher than tribes or subtribes. It is difficult to understand why so many authors desire to maintain such a confusingly inflated classification. Overemphasis of minor differences obfuscates true relationship. It is more meaningful to associate than to separate.

I have chosen, tentatively, to treat the Gelechiidae of Hawaii as including the following groups as subfamilies: Oecophorinae, Ethmiinae, Xyloryctinae, Blastobasinae, Chrysopeleinae, Momphinae, Cosmopteriginae, and Gelechiinae. These do not, however, all have equal weight, and further modification of the taxonomy is required. Some of these groups might better be reduced further to tribal status. Most authors consider them families, but some workers (Riedl, 1969, and Common, 1970, for example) treat the Chrysopeleinae (= Walshiinae), Momphinae, and Cosmopteriginae as subfamilies under one family name (which should, under such a system, be called Momphidae and not Cosmopterigidae as incorrectly used by some authors). An extensive revision of the generic classification of the Gelechioidea of the world is urgently required. See Forbes, 1923:229, 255, etc., for further discussion.

Many species of major and minor economic importance belong to the Gelechiidae, and a number of the pest species have been accidentally introduced to Hawaii.

**KEY TO THE SUBFAMILIES OF GELECHIIDAE IN HAWAII**

1. Forewings with a pterostigma between vein 11 and costa and with veins 2, 3, 4, and 5 all arising peculiarly from the posterior apical corner of the cell; abdominal tergites with strong transverse bands of spines; basal antennal segment with a well-developed pecten; as in figures 105*a*, 696–700  
..... **Blastobasinae.**
- Without such a combination of characters.....2
- 2(1). Hindwing of characteristic "normal gelechiine" shape with apex slightly or strongly produced and termen concave or sinuously concave; termen rather well separated in contour from posterior margin of wing, as in figures 1263, 1294, for example; vein 1c usually not developed.....  
..... part of **Gelechiinae.**
- Hindwing not so shaped; vein 1c variable.....3



- 3(2). Hindwing obviously broader than forewing; large species, about 20 to 50 mm. in expanse. . . . . 4  
 Hindwing usually narrower than forewing, at most about as broad as forewing, but never broader; mostly smaller species. . . . . 6
- 4(3). Forewing with vein 2 arising close to 3 at apex of cell; vein 1c not fully formed apically; wings shaped as in figure 1272 of *Crasimorpha*. . . . . part of **Gelechiinae**.  
 Forewing with vein 2 arising far from apex of cell and from vein 3; vein 1c fully formed at apex; wings obviously differently shaped and hindwing obviously proportionately broader than in figure 1272. . . . . 5
- 5(4). Hindwing with vein 5 closer to 6 than to 4 and veins 6 and 7 separate and parallel; abdominal tergites lacking apical bands of spines; one beautiful and strikingly colored species with black-spotted, pinkish grey forewings and yellow hindwings tipped with black, as in figure 639. . . . . **Ethmiinae**.  
 Hindwing with vein 5 closer to 4 than to 6 and veins 6 and 7 approximate or stalked at base; abdominal segments with characteristic transverse bands of spines on caudal parts of the tergites, as on figure 668 (best seen upon dissection or abrasion of the squamae but often distinctly visible as golden spinules; the only other moths in Hawaii with rather similar *transverse* bands of spines belong to the Oecophorinae and Blastobasinae). . . . . **Xyloryctinae**.
- 6(3). An unusual, flightless form with reduced wings from Haleakala, Maui, and as in figure 650; labial palpi long and sickle-shaped and rising far above the top of the head; abdominal tergites with typical rows of spines as described in the paragraph immediately above. . . . . part of **Xyloryctinae**.  
 Not such species. . . . . 7
- 7(6). Ocelli present; hindwings very narrow, venation of both pairs of wings as in figure 701 of *Ithome*; one small, dark colored, introduced species that breeds in blossoms of *Prosopis* and *Acacia*. . . . . **Chrysopeleiinae**.  
 Ocelli absent; venation different. . . . . 8

- 8(7). Hindwings with greatly reduced venation and with only one vein forked, as in figure 706; abdominal tergites with *longitudinal* bands of spines (figure 710) ..... **Momphinae.**  
Hindwings obviously with more complex venation; abdominal tergites not longitudinally spinose ..... 9
- 9(8). Cell in hindwing less than one-half of length of wing in the species in Hawaii; venation as in figure 633 of *Endrosis* ..... **Oecophorinae.**  
Venation different, cell much longer ..... 10
- 10(9). Proboscis absent; wing venation and genitalia as in figures 634, 1260 of *Oecia* ..... part of **Gelechiinae.**  
Proboscis well developed; wing venation and genitalia different ..... 11
- 11(10). Vannal area (posterior basal area) of hindwing broad and expanded; hindwing somewhat broader than forewing, as in figure 1272; one introduced gall-maker on *Schinus* in Hawaii; as in figure 1273 of *Crasimorpha* ..... part of **Gelechiinae.**  
Vannal area of hindwing narrow, rounded off, hindwing narrower than forewing ..... **Cosmopteriginae.**

Subfamily **OECOPHORINAE** (Stainton), **revised status.**

*Epigraphidi* Guenée, 1845*b*:68. Morris, 1870:5.

*Epigraphidae*: Anonymous, 1858:75.

*Oecophoridae* Stainton, 1859*c*:280, 353.

*Oecophoridae*: Sauveur and Fologne, 1863:107. Meyrick, 1906:34.

*Oecophorinae*: Walsingham, 1890:147. Spuler, 1898*a*:31.

*Aecophoridae*: Lower, 1897:53.

*Poeciloptina* Herrich-Schäffer, 1857:58.

*Dasyceridae* Meyrick, 1883:119.

*Depressariidae* Meyrick, 1883:123.

Busck, 1908*b*:187, 207, early generic revision for America.

Meyrick, 1922*c*:1, in *Genera Insectorum*, and many other monographs.

Clarke, 1941*a*:33–286, pls. 1–48, revision for North America.

Diakonoff, 1954*b*:150, key to New Guinea genera.

The nearly forgotten family-group name *Epigraphidae* (Guenée, 1845*b*:68) has priority, but more confusion than uniformity would be introduced by its resurrection.

It appears impossible to maintain the oecophorids as a family distinct from the Gelechiidae as some authors continue to do. The groups blend together when they are viewed worldwide. Long ago, Walsingham, in 1890, and Spuler, in 1898, treated the oecophorids as a subfamily of the Gelechiidae as some other authors have considered them. Fracker, 1915:85, said, "This is

one of the families formerly included in Gelechiidae and the larvae are so similar to the latter that no satisfactory character has been found to distinguish the two groups." One of the characters usually suggested for the separation of adult oecophorids and gelechiids is that vein 1c is supposed to be developed as a tubular vein in the oecophorids but not developed in the gelechiids. This is a variable character in many groups of moths. Although it may serve to separate various clusters of species or genera in some faunas, it is of no basic significance. Once such characters get into the literature, they are often difficult to extinguish from general use although they may be shown to be of little or no value when large numbers of species are considered.

One of the most interesting features of the Hawaiian fauna is its lack of endemic oecophorids. The group is strongly developed in Eurasia and America, and evidently more than 2,500 species occur in Australia where it is by far the most extensively speciated family of Lepidoptera.

The one immigrant oecophorid in Hawaii has wide, transverse bands of stout spinules on the abdominal tergites that somewhat resemble those of the Xyloryctinae and Blastobasinae. The spinules can be revealed by abrading the squamae from the abdominal tergites.

#### Genus **ENDROSIS** Hübner

*Endrosis* Hübner, 1825:401. Type-species: *Phalaena Tinea sarcitrella* Linnaeus (= *Tinea lactella* Denis and Schiffermüller).

For a detailed description of the genus and other details, see Clarke, 1941:262. Benander, 1937:70, who described the larva, erroneously assigned the genus to the subfamily Blastobasinae in his arrangement. Perhaps he followed Fracker, 1915:86, who also wrongly included it in the Blastobasidae. Hinton, 1943:209, has shown that Fracker's observations were erroneous and that Benander did not know the larvae of the blastobasids. The genus has also been wrongly placed with the Cynodiidae (Elachistidae).

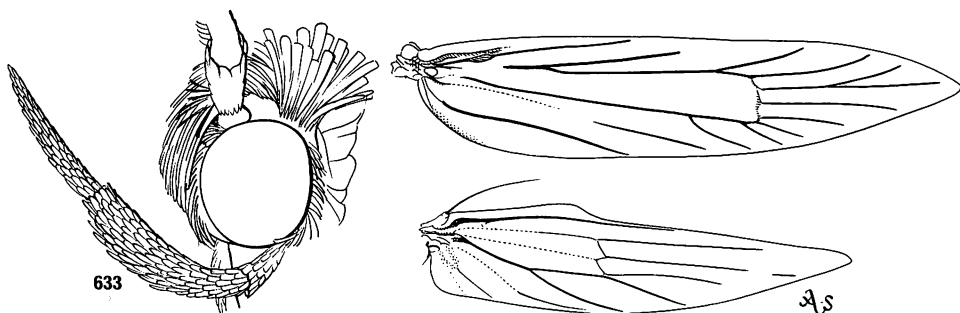


Figure 633—Head and wing venation of *Endrosis sarcitrella* (Linnaeus) (BM slide 4295).

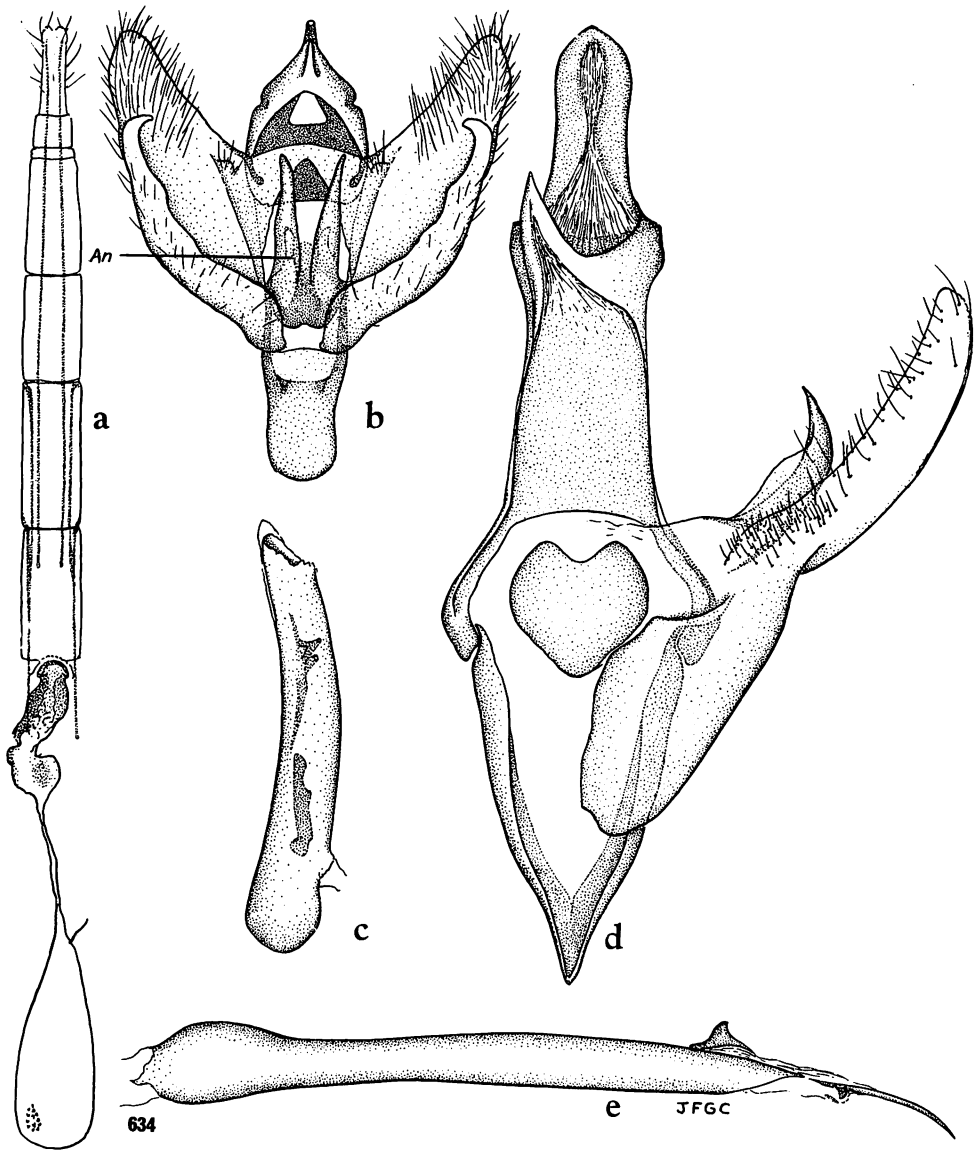
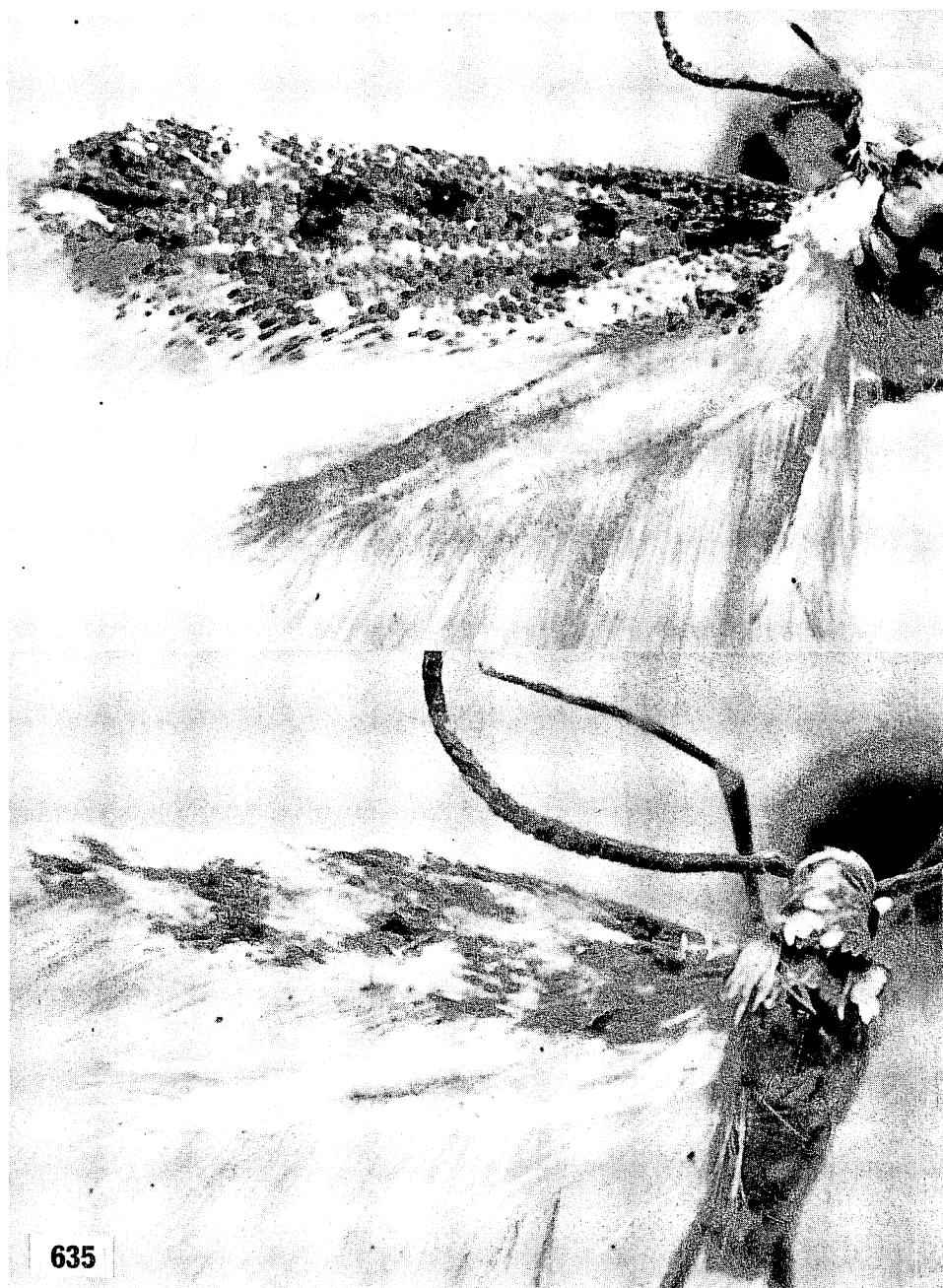


Figure 634—Oecophorid and gelechiid genitalia. *a, b, c, Endrosis sarcitrella* (Linnaeus), male and female (*An* = lobe of anellus). *d, e, male Oecia oecophila* (Staudinger). (Drawings by J. F. G. Clarke.)



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Figure 635—Top, *Endrosis sarcitrella* (Linnaeus), a European specimen; forewing = 5.0 mm (BM slide 4295, male); the head and most of the thorax are white, and the forewing is white with pale brown and dark brown or fuscous maculae. Bottom, *Oecia oecophila* (Staudinger), holotype male of the synonymous *maculata* Walsingham from St. Thomas, U.S. Virgin Islands, West Indies; forewing = 4.0 mm (BM slide 4202); the head and thorax are cream-colored or pale brownish, and the forewing is cream-colored with pale brown maculae.

**Endrosia sarcitrella** (Linnaeus) (figs. 633, head, wing venation; 634, male, female genitalia; 635, moth; 636, larva; 637, male genitalia).

*Phalaena Tinea sarcitrella* Linnaeus, 1758:536.

*Tinea lactella* Denis and Schiffermüller, 1775:139.

*Endrosia lactella* (Denis and Schiffermüller) Walsingham, 1907b:649.

For synonymy, see Corbet and Tams, 1943a:15. For description, bibliography, and general account in America, see Clarke, 1941:264–268, figs. 5, 51, 60, 60a, 116. Benander, 1937:70, fig. 15, larva. Hinton, 1943:171, 209, figs. 109, 112, 113, 115, 116, larva.

The white-shouldered house moth.

Hawaii.

Immigrant. A nearly cosmopolitan species. First recorded from Hawaii by Walsingham in 1907 from three specimens collected at Kona, Hawaii, by Perkins in 1902.

This is a household species in some regions. It is of some economic importance as a pest of stored grains, cereals, dried fruit, and foodstuffs. It has been recorded as feeding on animal matter, and it is occasionally found in birds' nests and in fungi. Linnaeus originally recorded it, evidently erroneously, from clothing (woolens). It has been collected, to my knowledge, only three times in Hawaii: once at Kilauea, once at 4,000 feet in Kona, and once at Paauhau.

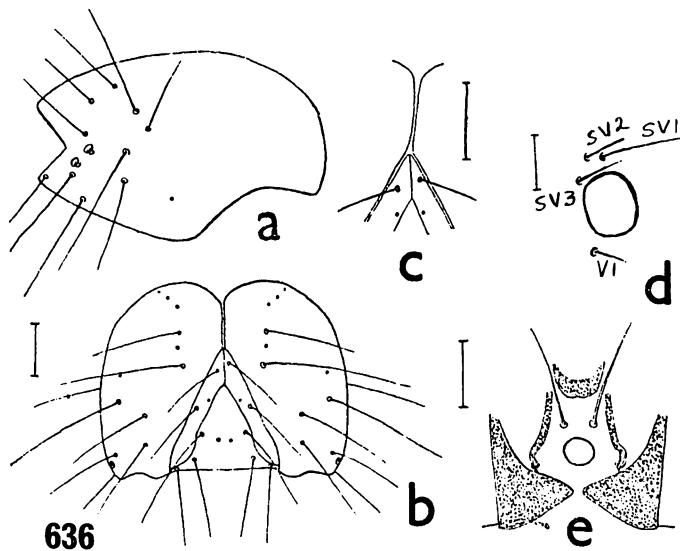


Figure 636—Details of the mature larva of *Endrosia sarcitrella* (Linnaeus) (modified from Hinton, 1943). *a*, left lateral, and *b*, frontal aspects of head capsule; *c*, enlarged diagram of the junction of the adfrontal sclerites and the long epicranial suture; *d*, setae adjacent to a proleg on the third abdominal segment; *e*, labium to show the subcircular mark, which is sometimes pitlike, on the postmentum (this "postmental pit" is not always clearly defined on whole specimens). Note particularly that there are only two ocelli and the adfrontal sclerites are far removed from the frontal triangle. The magnification reference lines represent 0.20 mm.

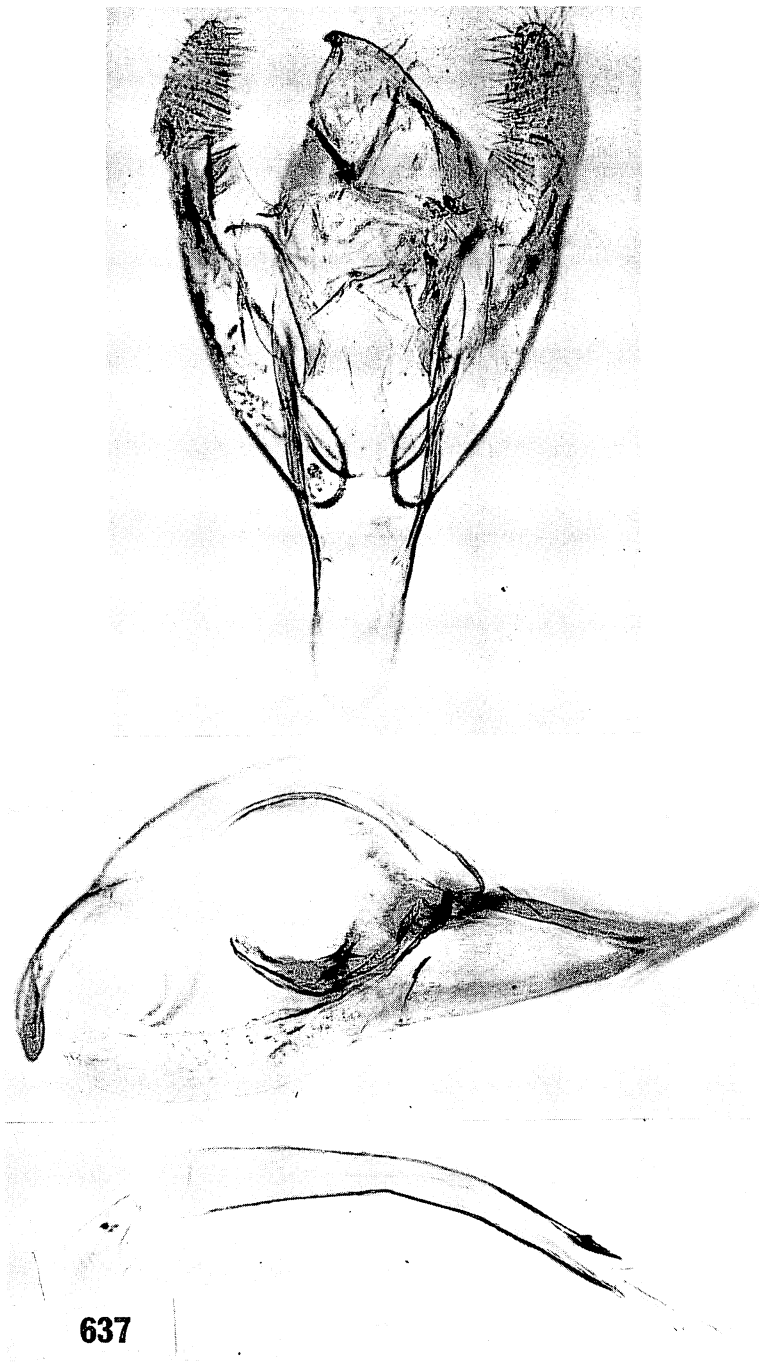


Figure 637—Top, male genitalia of *Endrosis sarcitrella* (Linnaeus), Europe (BM slide 4295). Bottom, male genitalia in lateral aspect of *Oecia oecophila* (Staudinger) from the holotype of the synonym *maculata* Walsingham, St. Thomas, U.S. Virgin Islands, West Indies (BM slide 4202).

All of these are on the island of Hawaii. It was probably introduced to that island with feedstuff used by the large cattle-raising industry. It is possible that it may be confined to the cooler uplands of Hawaii.

The larva has only two ocellar lenses on each side of the head, and the adfrontal sclerites are far removed from the vertical triangle. The submentum usually has a large ovate pigmented area or impression—in this it resembles the larvae of *Blastobasis*. Each of the trochanters of the prothoracic legs has an internal gibbosity.

Subfamily **ETHMIINAE** (Busck), **new status**.

*Azinidae* Walsingham, 1906:177.

*Ethmiidae* Busck, 1909:91–92. Brues and Melander, 1932:229. Sattler, 1967, a detailed study of the Palaearctic fauna; an excellent, well-illustrated monograph.

*Ethmiadae*: Meyrick, 1909*b*:422.

*Ethmiinae* of the Oecophoridae, Brues, Melander, and Carpenter, 1954:257.

It would appear that the correct family-group name for this assemblage should be *Azinidae* Walsingham, 1906, but that name has generally been overlooked or ignored. Walsingham proposed it in a rather obscure and indirect way when he said (1906:177), "I would now rather incline to placing *Tamarrha* with the *Azinidae*, founded on an Asiatic genus and characterized by the continuation of the discoidal vein direct to vein 8." Strictly applied priority would dictate that *Azinidae* be used. But in view of the longstanding, frequently used, and universally accepted name *Ethmiidae*, it would appear less confusing and a contribution to stability if we continue to use *Ethmiinae* and suppress *Azinidae*.

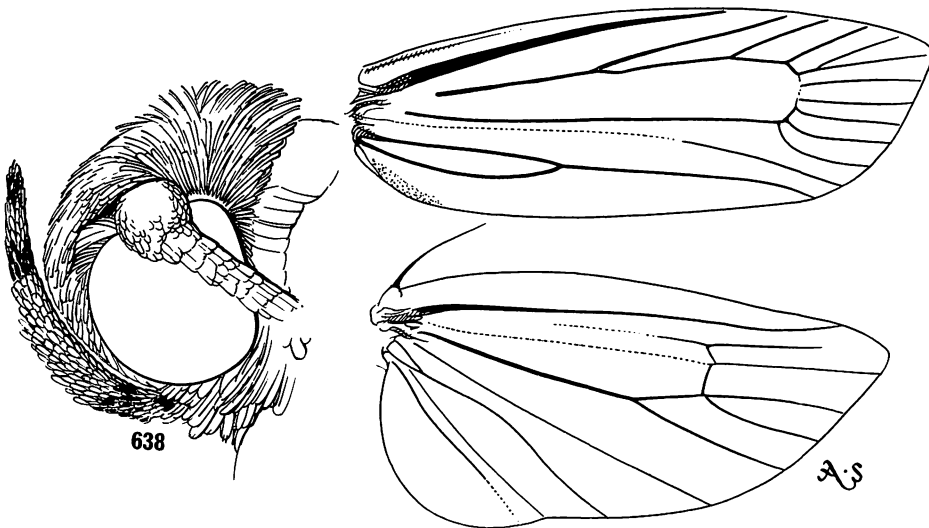


Figure 638—Head and wing venation of *Ethmia nigroapicella* (Saalmüller) from the holotype male of the synonymous *colonella* Walsingham from Honolulu (BM slide 7441).



I do not believe that this group represents a distinct family—I consider it only a subdivision of the Gelechiidae. It might best be assigned to the Oecophorinae as a tribe. Some authors have included it in the Oecophoridae, and others have wrongly placed it in the Yponomeutidae. The latter course is untenable because, among other things, the ethmiids have squamose proboscides whereas the yponomeutids have “naked” proboscides.

When Busck erected the family (1909:91–92), he said, “The main structural character by which this family may be distinguished from the Oecophoridae is the proximity of vein 5 in the hindwings to vein 6 instead of to vein 4, as in Oecophoridae, it being radial, not cubital; but the general habitus is very different from that of the hitherto supposed allies and the genus *Ethmia* has no near relationship with *Depressaria*, which has been regarded as a derivative from it.”

Sattler, in his admirable monograph of the Palaearctic ethmiids (1967:24), noted that with the close relationship between the ethmiids and the oecophorids firmly established one must ask whether the ethmiids should be included in the Oecophoridae as a subfamily as was done by Brues, Melander, and Carpenter (1954:257). (I do not know what led Brues, Melander, and Carpenter to their conclusion. Forbes, 1923:244, included *Ethmia* in the Oecophoridae.) Sattler said that to answer the question of relationship all known ethmiid genera and most of the oecophorid genera must be considered, and, in addition, precise definitions of all the families of the Gelechioidea (which we lack) are required. He noted that the most important “family characters” now accepted for the ethmiids are that vein 5 is nearer to vein 6 than to vein 4 in the hindwing, and the costa of the male genital valva is “segmented”. Sattler noted, however, that the nature of the venation is not always a reliable character, as can be demonstrated by the incorrect transfer of the typical North American oecophorid *Schiffermuelleria coloradella* Walsingham to the Ethmiidae by Clarke (1941:247).

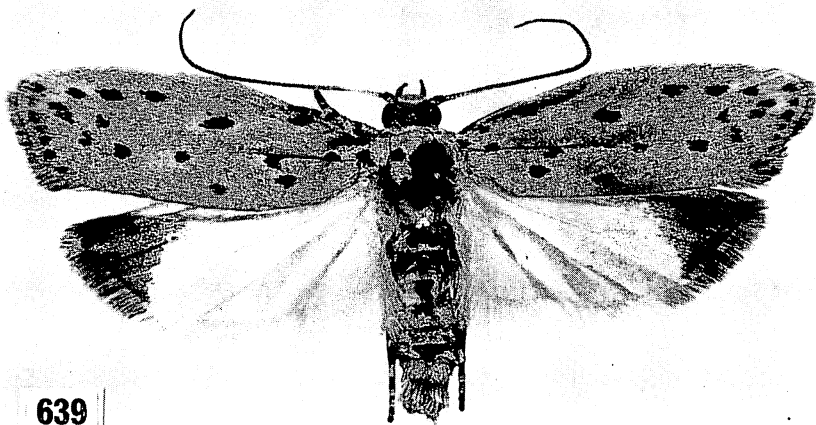


Figure 639—*Ethmia nigroapicella* (Saalmüller); forewing = 12 mm.; Barber's Point, Oahu; ex *Cordia subcordata*.

Sattler said that, in addition to the "segmented" nature of the costa of the male genital valva, the peculiar gnathus and the distinctive ventrocaudal processes on the pupa (see my figure 643) are characters which differentiate the ethmiids. Although they did not come within the scope of Sattler's study, it should be noted that the agonoxenids have remarkably similar, but undoubtedly separately evolved, ventrocaudal processes on their pupae (see figure 625). After careful consideration, Sattler stated that the specialized ethmiid features which he studied prevented him from merging the ethmiids with the oecophorids, and he was unable to demonstrate a close relationship

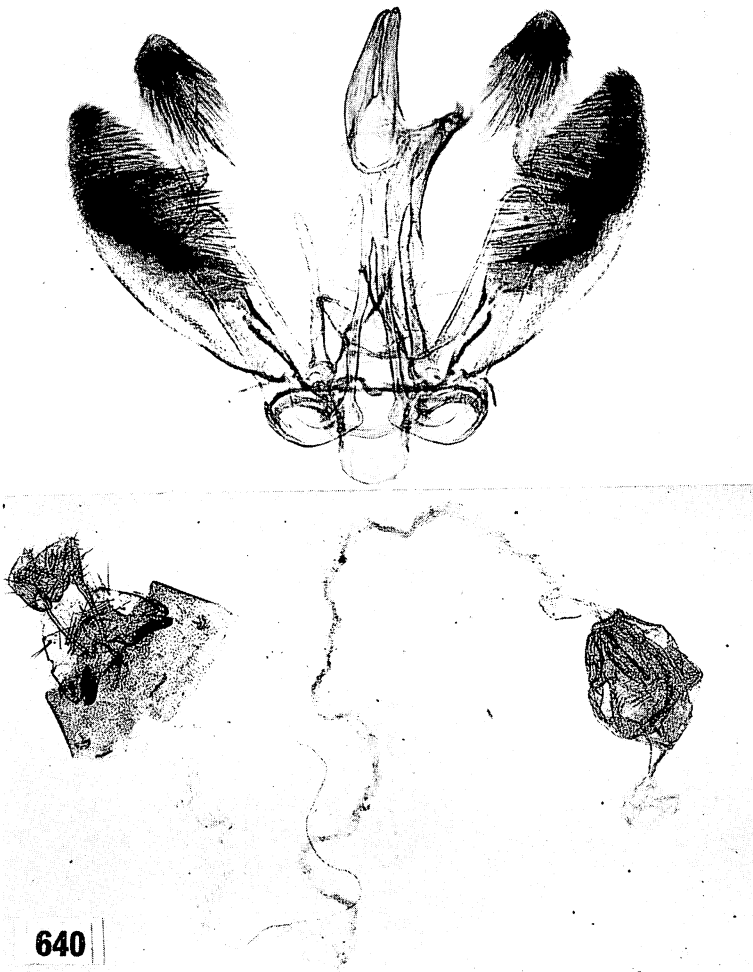


Figure 640—*Ethmia nigroapicella* (Saalmüller). Top, male genitalia (BM slide 2031); Honolulu. Bottom, female genitalia (BM slide 2032); Honolulu; see also figure 641.

with any true oecophorid genus known to him. He concluded, therefore, that he would treat the ethmiids as a full family.

The Ethmiinae is represented in Hawaii by only one immigrant species of the large, widely distributed genus *Ethmia*.

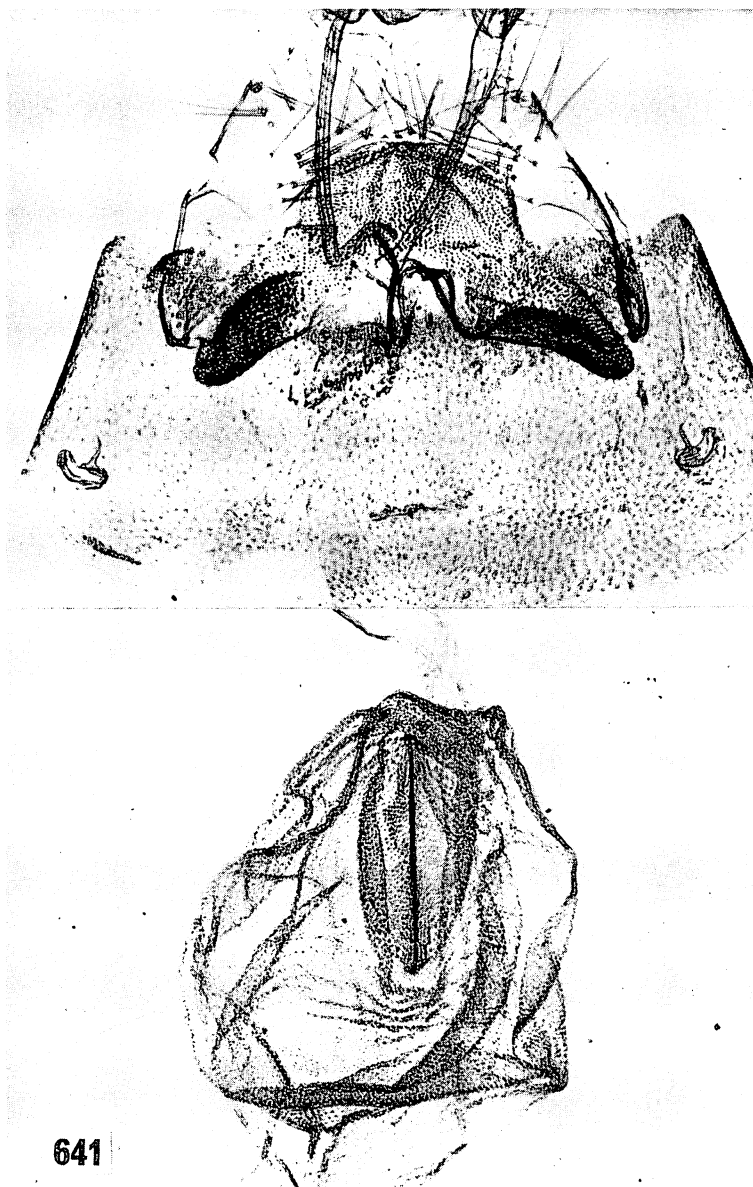


Figure 641—Female genitalia of *Ethmia nigroapicella* (Saalmüller) (BM slide 2032); Honolulu; see also figure 640.

Genus **ETHMIA** Hübner

*Ethmia* Hübner, 1819 (1816–1826): 163. Type-species: (*Ethmia pyrausta* Hübner, not Pallas) = *Tinea aurifluella* Hübner.

*Azinis* Walker, 1863: 541. Type-species: *Azinis hilarella* Walker.

Sattler, 1967: 37, detailed synonymy, redescription, and discussion.

***Ethmia nigroapicella*** (Saalmüller) (figs. 638, head and wing venation; 639, moth; 640, male and female genitalia; 641, female genitalia; 642, male genitalia; 643, larva, pupa).

*Psecadia Nigroapicella* Saalmüller, 1880: 310. Type locality: Nossi-Bé, Madagascar.

*Azinis hilarella*, as a misidentification by Butler, 1883: 180, not of Walker.

*Ethmia colonella* Walsingham, 1907b: 507, pl. 15, fig. 6. Type locality: Honolulu. Swezey, 1944a: 133–135. Synonymy by Sattler, 1967: 127.

*Ethmia meteoris* Meyrick, 1911b: 289. Clarke, 1965a: 422. Type locality: Seychelles.

*Ethmia systematica* Meyrick, 1922a: 552. Clarke, 1965a: 430. Type locality: Burma.

*Psecadia apicalis* Matsumura, 1931: 1084. Type locality: Okinawa.

*Ethmia nigroapicella* (Saalmüller) Sattler, 1967: 127, pl. 9, fig. 65; pl. 63, fig. 65–1, 65–2; pl. 104, fig. 65.

The *Cordia* defoliator or kou leaf worm.

Kauai, Oahu, Maui, Hawaii.

Immigrant. First recorded from Hawaii by Butler in 1883: 180 (then called *Azinis hilarella* Walker in error). Widely distributed from Madagascar to Hawaii including the Seychelles, India, Assam, Burma, Philippines, Taiwan, Ryukyu Islands, Kei Islands (near New Guinea), and Samoa and other islands.

Hostplants: *Cordia sebestena*, *Cordia subcordata* ("kou").

Parasites: *Apanteles marginiventris* (Cresson), *Ephialtes hawaiiensis* (Cameron), in the pupa.

Predator: *Pheidole megacephala* (Fabricius).

This is one of the most distinctively colored of all moths in Hawaii and is easily recognized. The forewings are pinkish grey with conspicuously distinct black maculae. The hindwings are yellow with black tips.

The larvae, protected by webs, feed upon the leaves. In earlier days when the *Cordia subcordata* trees were more common in Hawaii, the larvae kept the trees in such a nearly constant state of defoliation that few new trees were planted. The host trees are not common today in the islands, but the moth, although much reduced in numbers, persists. Mr. S. Au reported to me that on Kauai in April, 1963, he found *Cordia subcordata* had been heavily attacked but *Cordia sebestena* was only lightly attacked by the larvae.

Its food-plant is the 'Kou' (*Cordia subcordata*), a tree no doubt introduced by the natives themselves, who valued it highly. Since the introduction of the *Ethmia*, this tree has been robbed of all its beauty; many indeed have been entirely destroyed, while others are either continually defoliated or have the foliage so riddled by the attacks of the caterpillars as to be unworthy of preservation. The gaily-coloured caterpillars seem to be remarkably free from the attacks of any natural enemies, but sometimes the omnivorous ant *Pheidole megacephala* destroys numbers of them. The moth itself is comparatively rarely seen, though it may be found resting on tree-trunks and occasionally visits lights. (Perkins, 1913: clxiv.)

Hillebrand, in his classic *Flora*, 1888:321, said that the *Cordia* trees were found:

Along the sea shore here and there; formerly much planted by the natives round their houses, but now almost exterminated by the ravages of a small moth. The tree, although bearing an original native name "Kou" (Tahitian "Tou"), which occurs in old "meles" or songs, can hardly be considered indigenous. It ranges all the way from the Hawaiian Islands to Madagascar and Zanzibar, and would seem to have accompanied the Malayo-Maori race in their migrations, a reason for which may be found in the large shade afforded by its broad crown, particularly valuable in a littoral tree. The wood, rather soft but durable, is much prized for cabinet work, cups and dishes, exhibiting wavy ribbons of light and dark brown when polished.

Swezey said (1944a:133), "It was a favorite wood with the Hawaiians for making calabashes . . . and probably since Hillebrand's time, no trees have been able to grow large enough for this purpose. They are always kept stunted on account of the caterpillars . . . feeding on the young terminal foliage and checking the growth of the tree. In fact, the tree is so scarce that only an

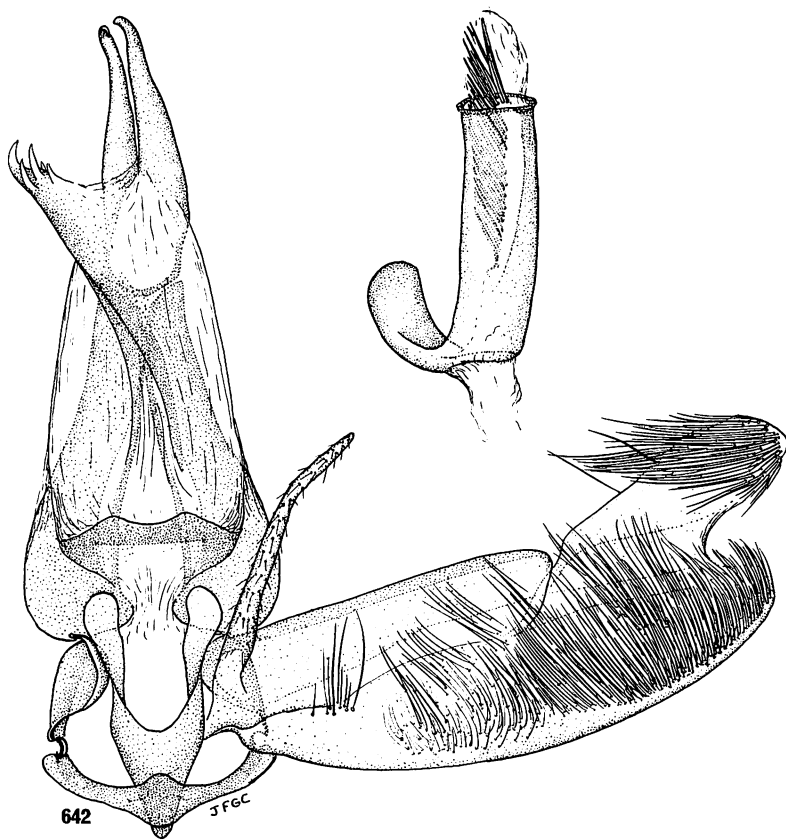


Figure 642—Male genitalia of *Ethmia nigroapicella* (Saalmüller).

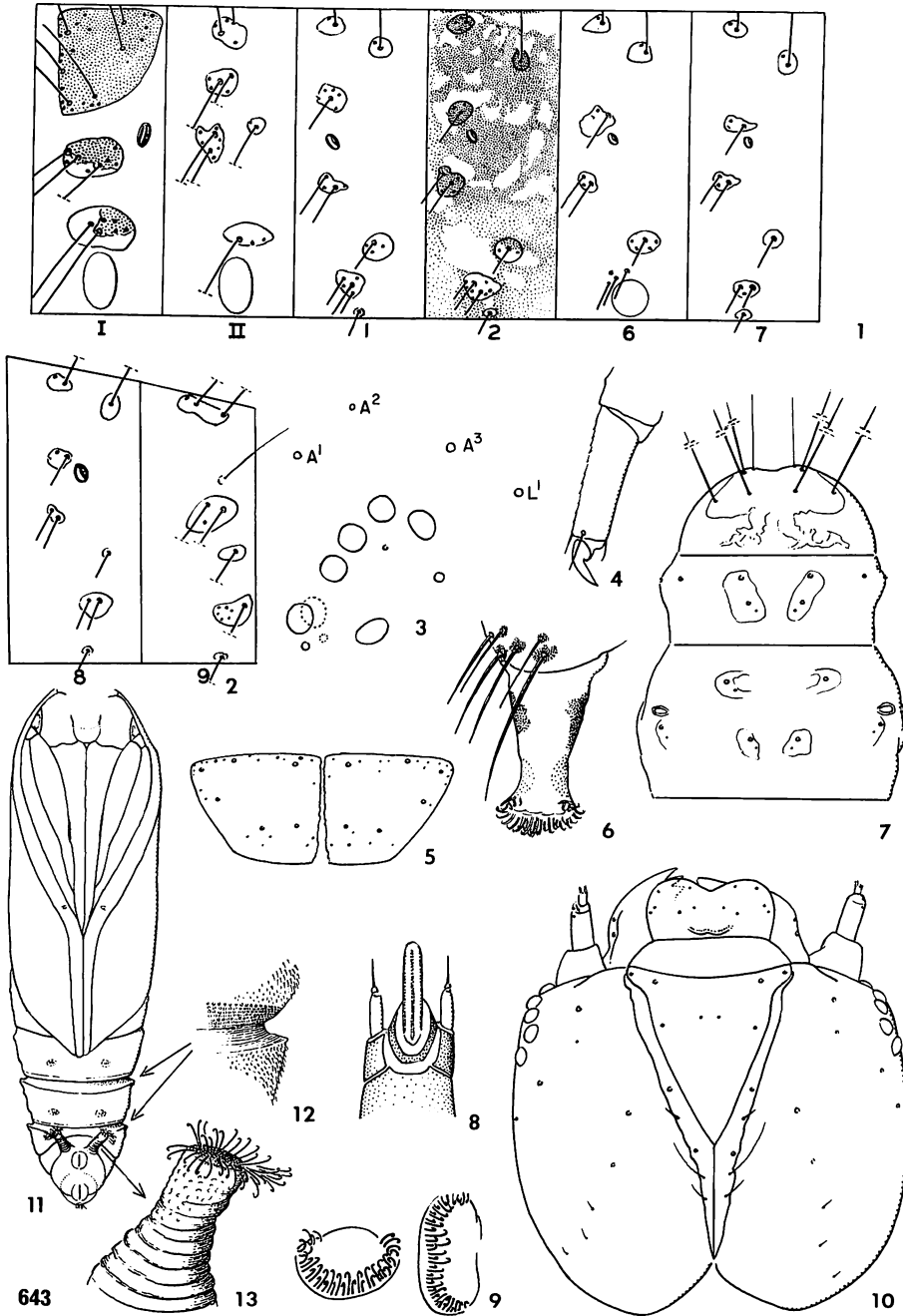


Figure 643—Details of the larva and pupa of *Ethmia nigroapicella* (Saalmüller), especially drawn for this text by Margaret MacKay. 1, setal map of pro- and mesothorax and abdominal segments 1, 2, 6, and 7 in lateral aspect; 2, setal map of abdominal segments 8 and 9, lateral aspect; 3, ocelli and associated setal sockets; 4, tarsus and claw of a thoracic leg, left side; 5, prothoracic shield; 6, a ventral proleg, lateral aspect; 7, dorsal aspect of abdominal segments 8 to 10; 8, spinneret and labial palpi, ventral aspect; 9, crochets of the prolegs of the sixth ventral and the anal prolegs on the left side; 10, frontal aspect of head; 11, ventral aspect of pupa; 12, 13, parts of pupa enlarged.

occasional stunted example is now seen." The trees once grew 30 to 50 feet high with trunks three feet in diameter (Rock, 1913:415).

The full-grown caterpillar is about 22 mm. long; black, with the dorsal and lateral surfaces speckled with numerous small irregular-shaped light yellow spots, a median dorsal pair of closely-parallel interrupted light yellow lines, laterally the spots are assembled in a distinct broken stripe just above the line of spiracles, which are small dark and nearly circular; cervical shield black with anterior margin widely light yellow and a median light yellow line; head black; head, cervical shield and dorsum with long slender black setae. Four pairs of slender abdominal prolegs.

The white cocoons are elongate oval, made rather flat on the surface of a leaf or other object. The pupa is 10 mm. long; uniformly reddish brown, surface smooth; wing and leg cases extend to the posterior margin of the fourth abdominal segment; cremaster has two stout [processes] situated ventrad a little forward from the apex of the abdomen and projected forward at a 45 degree angle, having numerous slender hooks to hold to the silk of the cocoon. This feature of the pupa distinguishes it from the pupa of any other moth in Hawaii. [But see *Agonoxena* which has rather similar processes but which became established in Hawaii after Dr. Swezey's paper was published.] The caterpillar, too, is distinct from any other occurring in Hawaii. (Swezey, 1944a:134.)

Subfamily **XYLORYCTINAE** (Meyrick), **new status.**

*Xyloryctidae* Meyrick, 1890a:23.

*Xylorictidae*: Dyar, 1903a(1902):518. Forbes, 1923:250. Brues and Melander, 1932, 1945:228.

*Cryptolechiidae* Meyrick, 1883b:124.

*Cryptolechidae*: Walsingham, 1891:100.

*Cryptophasidae* Kirby, 1897:303.

*Uzuchidae* Hampson, 1918:336.

Diakonoff, 1954b:89; key to New Guinea genera, p. 90.

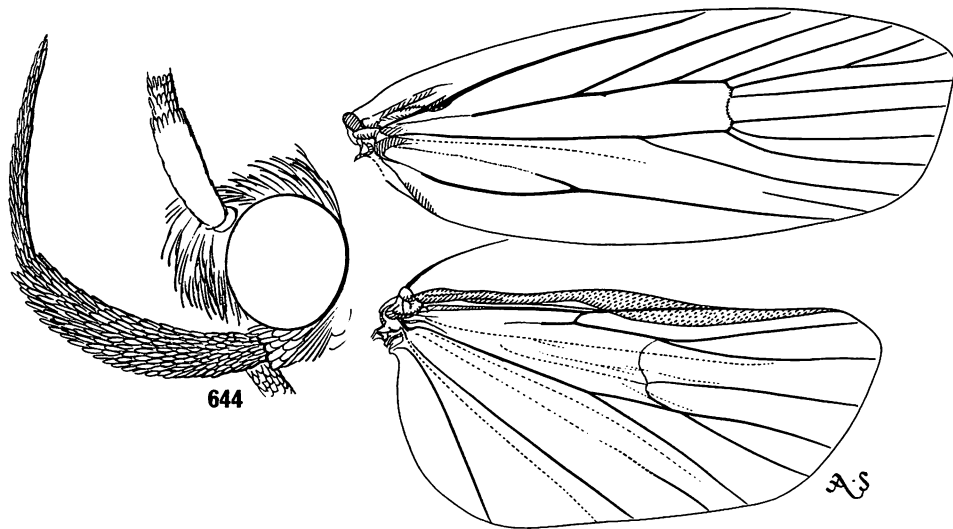


Figure 644—Head and wing venation of *Thyrocopa abusa* Walsingham, the type-species of *Thyrocopa*; from the male holotype (BM slide 4044); Oahu.

This group is usually given family rank by lepidopterists, but it can hardly be considered more than a subfamily of the Gelechiidae.

The name Cryptophasidae has been used by those who unfortunately believe that the family name should be based upon the oldest generic name within the family instead of on the oldest family-group name. It is based upon *Cryptophasa* Lewin, 1805. Hampson, 1918, proposed the synonymous name Uzuchidae for a similar reason. *Xylorycta* Meyrick, 1890a:57, is an Australian genus.

Walsingham, 1891:100, has explained how "Zeller's genus *Cryptolechia* falls into the family OEcophoridae of Meyrick, and annihilates Meyrick's family *Cryptolechidae*, which was not founded on the typical form. Mr. Meyrick, recognising this, has since recharacterised his family *Cryptolechidae* under the name *Xyloryctidae*. . . . The error, for which Mr. Meyrick cannot rightly be held responsible, has evidently arisen through confusion which Zeller created by his attempts to expand and amplify his original work." Additional details of importance will be found in Walsingham's discussion.

All the members of the Xyloryctinae in Hawaii are endemic. Walsingham divided them into five endemic "genera": *Thyrocopa*, *Catamempsis*, *Psychra*, *Ptychothrix*, and *Hodegia*. *Catamempsis*, *Psychra*, and *Ptychothrix* were separated from *Thyrocopa* largely on the basis of sexual characters of the male antennae. I cannot agree that such characters of one sex can be used to maintain genera. *Hodegia* was erected to receive a single female specimen with reduced wings. We now know that both sexes are flightless, but the species is otherwise a typical *Thyrocopa*. I have examined all of the Hawaiian species, including their wing venations and genitalia, and I can find nothing to indicate that more than one genus in the process of rapid specific radiation is involved. I am, therefore, reducing all of Walsingham's "generic" names to new synonyms of *Thyrocopa* Meyrick, 1883a.

Although my late friend August Busck had not examined the Hawaiian Xyloryctinae at the time, he had the following pertinent remarks to make in his 1908:137-138 review of Walsingham's *Fauna Hawaiiensis* monograph.

The writer regrets one single feature in this masterful work, namely, the erection of genera (*Ptychothrix*, *Catamempsis*) on secondary sexual characters alone, and this in spite of His Lordship's own statement in his remarks (page 738-9), that such characters are of very doubtful value, and especially so in the Hawaiian fauna, where the most embarrassing plasticity of such characters prevails. Undoubtedly, other sounder structural characters, common to both sexes, could have been found, or if not, the genera are, in the writer's judgment, not justified. To him it seems essential, for a sound appreciation of the natural grouping of the *Microlepidoptera*, that we get away altogether from these superficial characters, however tempting, and rely solely on the more . . . dependable . . . modifications. . . .

The greatest known development of the Xyloryctinae is in Australia where there are more than 400 species, but in nearby New Zealand the group is hardly represented. The subfamily is confined mostly to the Southern Hemisphere: Australia, South America, and southern Africa. There are none recorded from North America.

The abdominal tergites in this group have characteristic transverse bands of spines, as in figures 668 and 690. Except for *Endrosis*, *Oecia*, and *Blastobasis* no other group now known in Hawaii has *transverse* bands of spines, and the



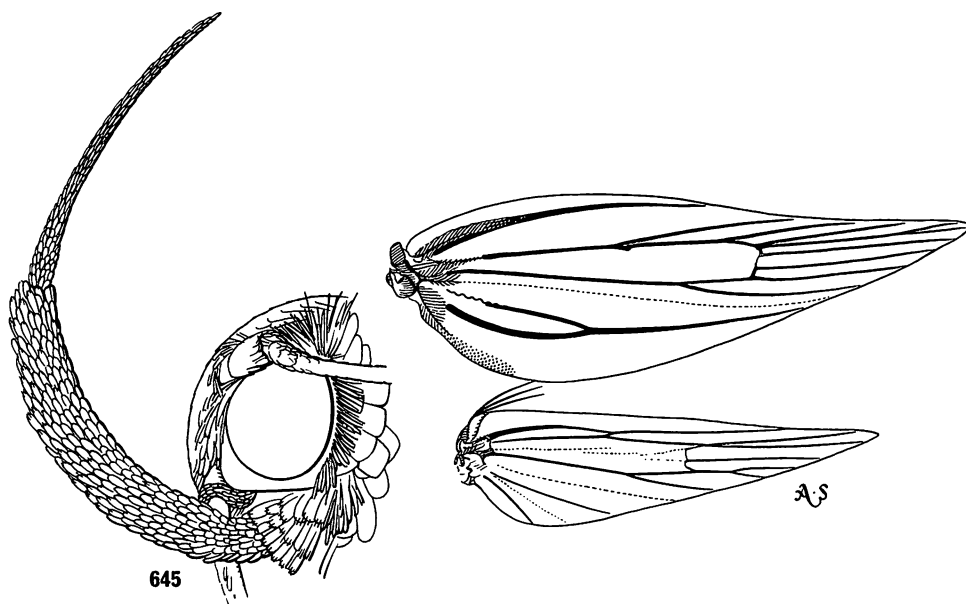


Figure 645—*Thyrocopa* ("Hodegia") *apatela* (Walsingham), head and wing venation of the female holotype (BM slide 3955). This is the type-species of *Hodegia* Walsingham. The labial palpus may appear unusually long on this species, but other species of *Thyrocopa* have similar palpi. There is much variation in their lengths and shapes.

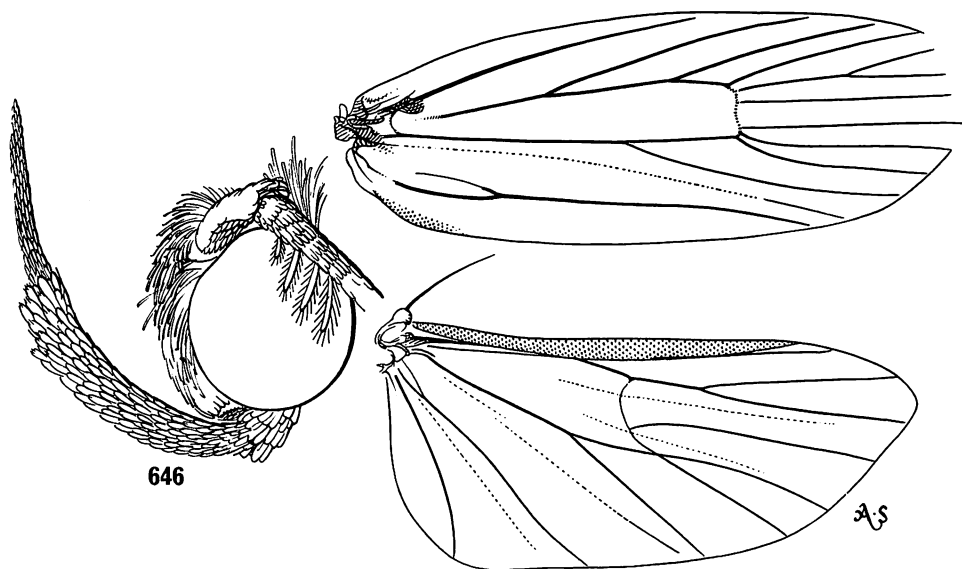


Figure 646—Head and wing venation of *Thyrocopa* ("Ptychothrix") *vagans* (Walsingham), the type-species of *Ptychothrix*, from the male holotype (BM slide 4176); Halemanu, 4,000 feet, Kauai.

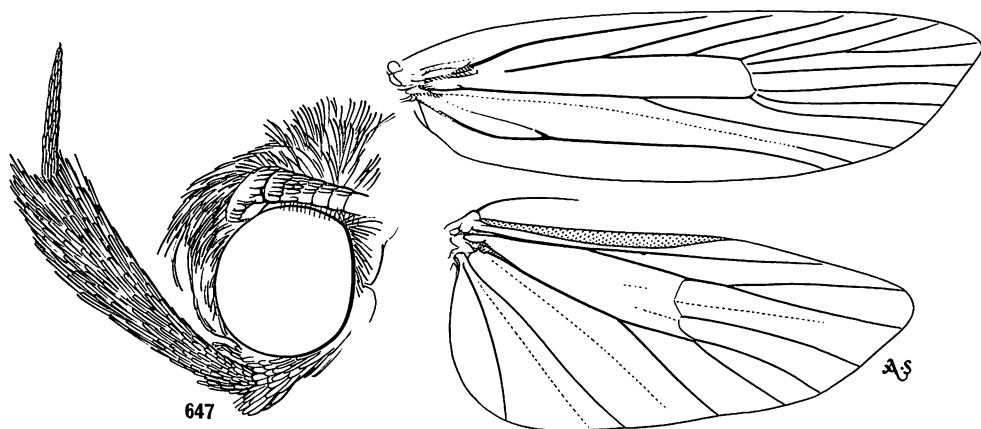


Figure 647—*Thyrocopa* ("Psychra") *phycidiformis* (Walsingham), the type-species of *Psychra*, from the male holotype (BM slide 4159); Kauai, 3,000 to 4,000 feet.

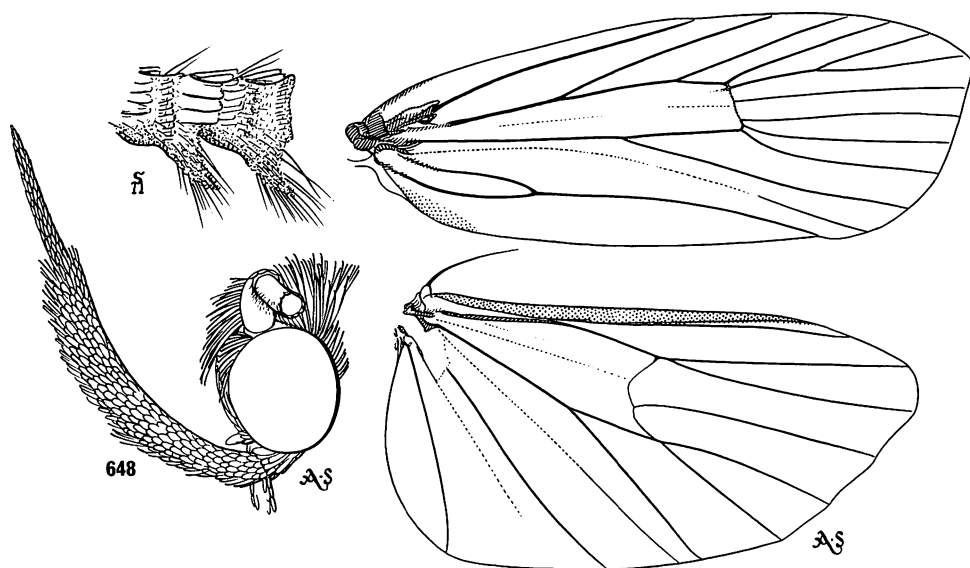


Figure 648—Head and wing venation of *Thyrocopa* ("Catamempsis") *decipiens* (Walsingham), the type-species of *Catamempsis*, from the male holotype (BM slide 4389); Olaa, 2,000 feet, Hawaii. An inset showing the structure of male antennal segments 17 and 18 is above the head.

character is almost diagnostic of the subfamily in Hawaii. Often the spines are easily seen on dried specimens where they may appear golden in color. *Batrachedra* also has spinose abdominal tergites, but its spines are placed in longitudinal rows. Vein 1c is preserved near the forewing margin in Hawaiian Xyloryctinae (except evidently in the highly modified flightless "*Hodegia*" *apatela*) as it is in the Hawaiian representatives of the Ethmiinae and Endrosia in the Oecophorinae.

In his detailed work on the Australian gelechiids Meyrick, 1904c:256, said: "Assuming that the *Xyloryctidae* are maintained as a distinct family (which still appears to me to be convenient, though I think ultimately it must be reduced to a group of the *Gelechiidae*), I rely for distinction mainly on the character of vein 2 of the forewings, which in that group rises widely remote from 3 (generally disproportionately so). . . ."

#### Genus **THYROCOPA** Meyrick

*Thyrocopa* Meyrick, 1883a:32. Type-species: *Thyrocopa abusa* Walsingham (= *Thyrocopa usitata* of Meyrick, 1883:33, not *Depressaria usitata* Butler, 1881:396). Clarke, 1969b:480.

*Synomotis* Meyrick, 1883a:33. Type-species: *Synomotis epicapna* Meyrick. Synonymy by Walsingham, 1907b:492.

*Hodegia* Walsingham, 1907b:488. Type-species: *Hodegia apatela* Walsingham.

#### **New synonym.**

*Ptychothrix* Walsingham, 1907b:489. Type-species: *Ptychothrix vagans* Walsingham. **New synonym.**

*Psychra* Walsingham, 1907b:489. Type-species: *Psychra phycidiformis* Walsingham. **New synonym.**

*Catamempsis* Walsingham, 1907b:491. Type-species: *Catamempsis decipiens* Walsingham. **New synonym.**

*Thyrocopa* is an endemic genus. I have been unable to discover whence it has come or to what genus it may be allied. It is evidently of Austral origin, and its immediate allies may have developed on archipelagos now worn away or submerged and marked by atolls. The group is in an active stage of evolutionary flowering in Hawaii, and there are many closely allied and confusing forms. The species have a remarkable range in size from about 14mm. to nearly 50mm. They form a dominant group in Hawaii.

The genitalia, which have not been studied heretofore, are remarkably similar throughout the genus. Most unfortunately, I have not found the shapes of the male genital valvae to be of use in separating the species. There are, however, certain differences in the processes of the sacculus (this structure may also have been referred to as the clasper or harpe of the valva) which are useful in the separation of the species. Some of the females have good characters in the signa of the bursa copulatrix. Some signa are small and round, and, in the opposite extreme, others are long and tapelike. There is a considerable range of specific development in the labial palpi. It would appear that there may be some confusion in the association of the sexes of various species in literature and in collections. The number of spines and the number of rows of

spines along the caudal parts of the abdominal tergites of the adults differ between the species. Further study may demonstrate that the nature of the spinulation of the abdominal tergites may be useful in the identification of the species.

A large amount of work remains to be done on *Thyrocopa*. It is a poorly understood genus, and many species probably await discovery and description. Unfortunately, I have not been allowed time and opportunity to enable an adequate study of the genus so that I must leave the group in an unsatisfactory taxonomic condition. I regret especially not being able to complete my key to the species.

The larvae of some species feed beneath silken webs on the bark of various plants, some bore in dead twigs or have been found in beetle borings, some feed on living tissue, and some feed upon leaves. Much remains to be learned of their habits. Perkins said (1913:clxiv):

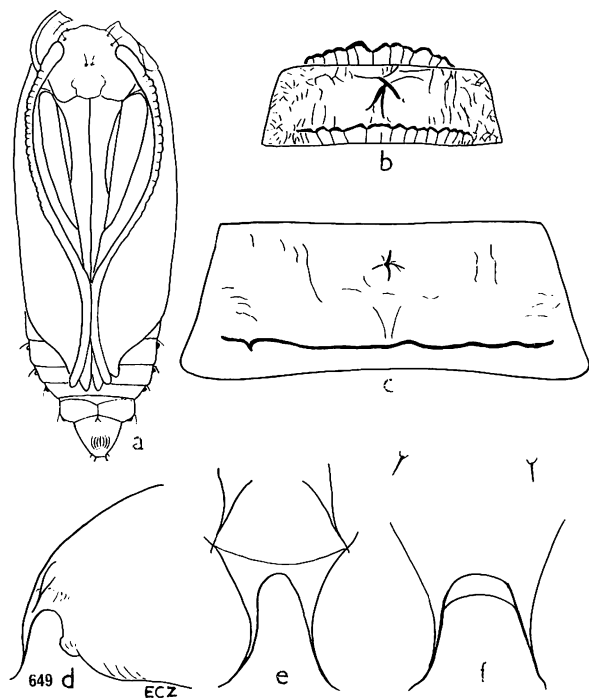


Figure 649—Details from cast pupal skins of *Thyrocopa*. *a*, ventral aspect of *sapindiella* Swezey, holotype female; Niu, Oahu; the dense, coarse reticulation of the derm is not shown. *b*, the same, first abdominal tergite and the caudal ridge of the metathorax. *c*, first abdominal tergite of *peleana* Swezey, holotype female, Waipio Ridge, Oahu. *d*, right lateral, and *e*, dorso-caudal aspects of the cremaster of *sapindiella*. *f*, dorso-caudal aspect of the hooks of the cremaster of *peleana*. Each of these species has four spines in the cremaster (note the great difference in the anterior pair in these species), but some species of *Thyrocopa* have only one caudal spine.

The numerous species of [*Thyrocopa*] are mostly feeders on dead wood, some occurring in the driest localities, living in the stems of both native and introduced plants, and one of them is common around Honolulu, feeding on the dried droppings of cattle. The moths are, many of them, very readily attracted to lights, and are very numerous in individuals. The caterpillars of some species, however, feed on living shoots, and some live in decaying logs so wet and rotten that the water can be squeezed from the wood. Some of the species are very variable, and in some there is a striking sexual dimorphism. The caterpillars in some localities (especially on the lowlands) are a favourite prey of the wasps of the genus *Odynerus* and *Pseudopterocheilus*, and in mountain districts they are eagerly sought for on the dead branches of trees by various Drepanid birds, e.g. *Hemignathus* and *Heterorhynchus*. We have also found them in the stomach of the little flycatchers of the genus *Chasiempis*, which may be seen investigating fallen decayed tree-trunks in search of this food.

*Thyrocopa* was originally assigned to the Gelechiidae by Meyrick.

*Hodegia* was erected for a single female specimen with reduced wings. I consider it to be only a *Thyrocopa* with reduced wings and not worthy of generic status. The genitalia are typical of *Thyrocopa*.

*Ptychothrix* was founded on a unique male which has conspicuously bipectinate antennae, but its genitalia are typical of *Thyrocopa*. It represents the extreme in the tendency of *Thyrocopa* toward the development of antennal pectinations which is demonstrated by the species Walsingham separated into the genera *Psychra* and *Catamempsis*. The antennae of the male of the type-species are distinctive, but this sexual character alone is not sufficient reason for separating the type-species into a genus separate from *Thyrocopa*.

*Psychra* was established for two species, *brevipalpis* and *phycidiformis*. The terminal segment of each labial palpus on these species is much reduced. Although the palpal segments in *Thyrocopa* are subject to considerable variation, the short palpi of these two species give them a distinctive appearance. The genitalia are typical of *Thyrocopa*. I cannot agree with Walsingham's description of the male antennae. They are not biciliate beneath; they are multiciliate, essentially as in other *Thyrocopa*, and the ciliation is somewhat more prominent than in most species. Walsingham also said that the male antennae are "serrate toward the apex". This statement refers to the scales on the dorsum being more erect there and not to the antennae being serrate beneath. This is only an emphasized male antennal character of *Thyrocopa*. The male antennae of *phycidiformis* are essentially similar to those of *Thyrocopa subahenea*, but Walsingham did not mention the antennal features of *subahenea*. *Thyrocopa pulverulenta*, *tessellatella* and *indecora* are intermediate. I consider the name *Psychra* to be only a synonym of *Thyrocopa*.

*Catamempsis* is based upon one of the very large species, *decipiens*, whose male has serrate antennae. This character of the male gives the antenna quite a distinctive appearance from the usual *Thyrocopa*, but the character is only sexual. The genitalia are typical of *Thyrocopa*, and the female is a normal *Thyrocopa*. I have thus merged *Catamempsis* with *Thyrocopa*.

It should be noted that when Walsingham knew only the female sex that he usually questioned the "generic" assignment of his species. This demonstrates that he could not determine his so-called genera in the absence of males.

See color plate 4, figures 7-8; 5, figures 1-3.

**DISTRIBUTION OF THYROCOPA**

Our knowledge of the geographical distribution of the *Thyrocopa* species is poor and probably in part misleading. We have only begun to study *Thyrocopa*. A tentative listing by island follows. Where the type locality is on an island other than that of the main listing, the type locality island is indicated by the word "type".

**Nihoa (1 species)**

new species near *abusa* Walsingham

**Kauai (15 species)**

*acetosa* Meyrick  
*albonubila* Walsingham  
*brevipalpis* (Walsingham)  
*cinerella* Walsingham  
*depressariella* Walsingham  
*epicapna* (Meyrick) + Hawaii  
*gigas* (Butler) + Oahu, Molokai, Maui (type)  
*immutata* Walsingham  
*librodes* Meyrick  
*pallida* Walsingham + Oahu, Molokai  
*phycidiformis* (Walsingham)  
*seminatella* Walsingham  
*usitata* (Butler) + Oahu (type), Hawaii  
*vagans* (Walsingham)  
*viduella* Walsingham

**Oahu (12 species)**

*abusa* Walsingham  
*argentea* (Butler) + Hawaii  
*criminosa* Meyrick  
*decipiens* (Walsingham) + Molokai, Hawaii (type)  
*gigas* (Butler) + Kauai, Molokai, Maui (type)  
*ingeminata* Meyrick  
*pallida* Walsingham + Kauai (type), Molokai  
*peleana* Swezey  
*sapindiella* Swezey  
*spilobathra* Meyrick  
*sucosa* Meyrick  
*usitata* (Butler) + Kauai, Hawaii

**Molokai (6 species)**

*decipiens* (Walsingham) + Oahu, Hawaii (type)  
*geminipuncta* Walsingham  
*gigas* (Butler) + Kauai, Oahu, Maui (type)  
*minor* Walsingham  
*pallida* Walsingham + Kauai (type), Oahu  
*subahenea* Walsingham

## Maui (7 species)

*alterna* Walsingham  
*apatela* (Walsingham)  
*fraudentella* Walsingham, + Hawaii (type)  
*gigas* (Butler) + Kauai, Oahu, Molokai  
*indecora* (Butler) + Hawaii  
*mediamaculata* Walsingham + Hawaii?  
*megas* Walsingham

## Lanai (1 species)

*leonina* Walsingham

## Hawaii (12 species)

*adumbrata* Walsingham  
*argentea* (Butler) + Oahu (type)  
*decipiens* (Walsingham) + Oahu, Molokai  
*epicapna* (Meyrick) + Kauai  
*fraudentella* Walsingham, + Maui  
*indecora* (Butler) + Maui (type)  
*inermis* Walsingham  
*mediamaculata* Walsingham? + Maui (type)  
*nubifer* Walsingham  
*pulverulenta* Walsingham  
*tessellatella* Walsingham  
*usitata* (Butler) + Kauai, Oahu (type)

**Thyrocopa abusa** Walsingham (figs. 644, head, wing venation; 652, 666, moth; 667, 670, male genitalia).

*Thyrocopa abusa* Walsingham, 1907*b*:504, 733, pl. 15, fig. 1.

*Thyrocopa usitata*, by error of identification by Meyrick, 1883*a*:33, not *Depressaria usitata* Butler, 1881:396.

Endemic. Oahu (type locality on Oahu not exactly known).

Hostplants: *Acacia koa*, *Cyrtandra*, *Freycinetia*, guava, *Ipomoea*, *Lantana*, *Pipturus*, *Ricinus*.

The brownish larvae, protected by a silken web or tunnel, bore in the dead twigs of many plants. They also feed on the bark and may feed to some extent upon the living tissues. See Swezey, 1910*e*:139 and 1912*c*:154, for details.

**Thyrocopa** new species near *abusa* (figs. 668, 669, male, female genitalia and abdomen).

Endemic. Nihoa Island.

Specimens of this species were collected by J. W. Beardsley in September, 1964. Some were collected at light, and one specimen was reared from a larva found in litter beneath shrubs. The reared specimen made a cocoon of thin white silk into which it incorporated an astonishing and varied amount of debris. Included are numerous pellets of lepidopterous frass, several kinds of

plant parts and fragments, parts of dead insects, cast larval skins of insects, the larval cases of two species of *Hyposmocoma*, and representatives of terrestrial Mollusca of the families Tornatellinidae and Endodontidae!

Externally this moth is quite similar to *Thyrocopa abusa* Walsingham, but its genitalia appear to differ significantly from that species.

***Thyrocopa acetosa*** Meyrick (figs. 652, moth; 682, female genitalia).

*Thyrocopa acetosa* Meyrick, 1915a:371.

Endemic. Kauai (type locality not further determined).

Hostplant: unknown.

***Thyrocopa adumbrata*** Walsingham (figs. 652, moth; 681, female genitalia).

*Thyrocopa adumbrata* Walsingham, 1907b:503, pl. 14, fig. 26.

Endemic. Hawaii (type locality: Kona, 3,000 feet).

Hostplant: unknown.

Described from one female.

***Thyrocopa albonubila*** Walsingham (figs. 653, moth; 671, male genitalia).

*Thyrocopa albonubila* Walsingham, 1907b:495, pl. 14, fig. 11.

Endemic. Kauai (type locality: mountains, 3,000 to 4,000 feet).

Hostplant: unknown.

The Swezey references to this species (1910e:138 and 1931b:502) belong to *argentea*.

***Thyrocopa alterna*** Walsingham (figs. 653, moth; 670, male genitalia).

*Thyrocopa alterna* Walsingham, 1907b:501, pl. 14, fig. 22.

Endemic. Maui (type locality: Olinda forest area), Hawaii.

Hostplant: unknown.

I have not seen a female.

***Thyrocopa apatela*** (Walsingham), **new combination** (figs. 645, head and wing venation; 650, moth, female genitalia; 650-A, male genitalia).

*Hodegia apatela* Walsingham, 1907b:488, pl. 14, fig. 2. Type-species of *Hodegia*.

Endemic. Maui (type locality: Haleakala, above 9,000 feet).

Hostplant: bunchgrass? The originally unique female holotype was shaken from a tuft of grass by Dr. Perkins.

As my illustrations demonstrate, the wings of this moth are so reduced that the insect cannot fly. Thus it represents one of the most unusual insects of Hawaii. The genitalia are typical of other *Thyrocopa*, and those of the female are quite similar to those of *cinerella*. The type has the same kind of long, tapelike signum as does *cinerella*. The male genitalia (only recently seen by me) are closely similar to other species of *Thyrocopa*. I do not know how many species of *Thyrocopa* inhabit Haleakala, and I cannot suggest which species may have given rise to this unusual flightless moth. Its immediate ancestor could have come from some other island.



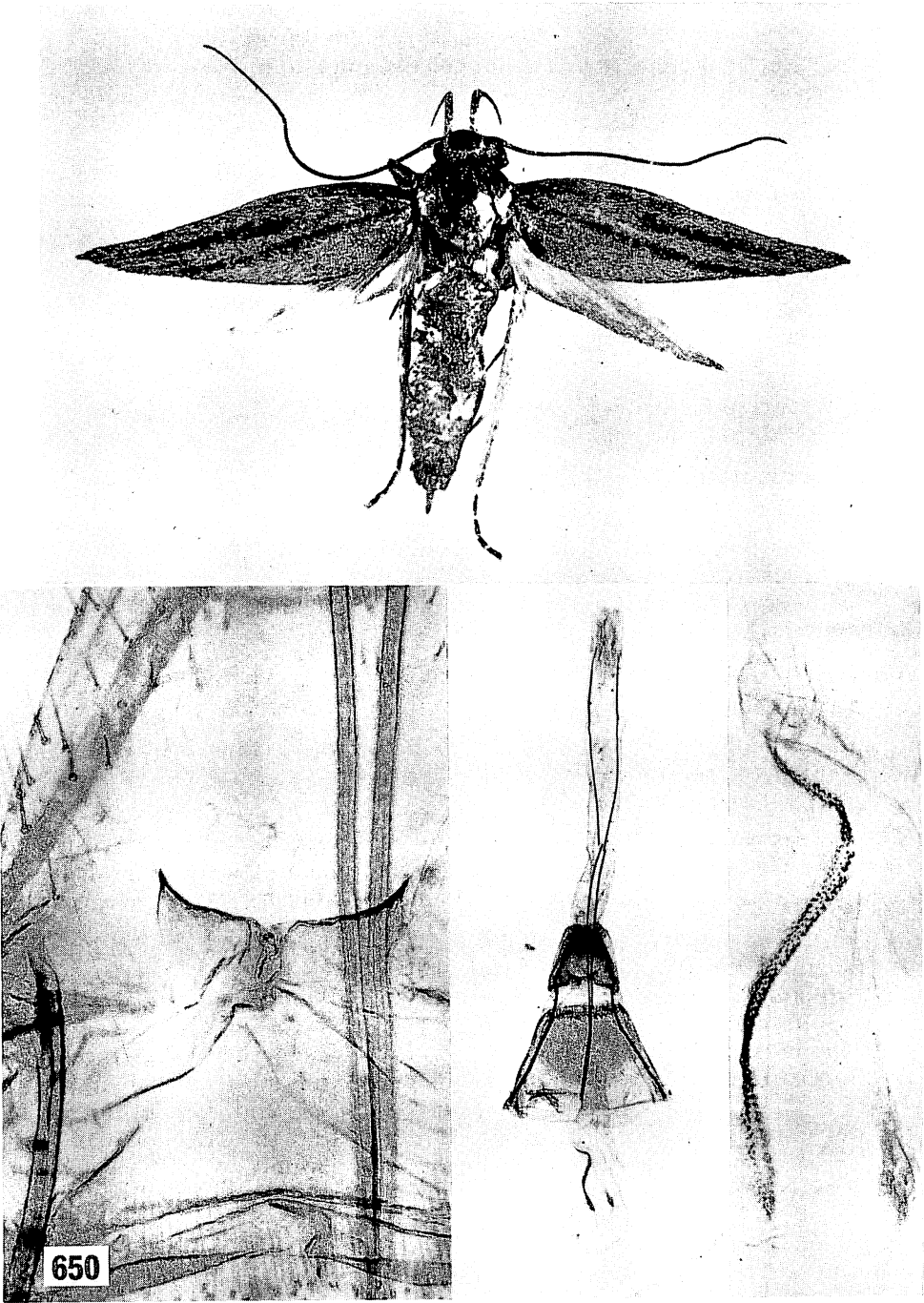


Figure 650—*Thyrocopa* ("Hodegia") *apatela* (Walsingham), the unique female holotype and its genitalia (BM slide 3955); Haleakala, 9,500 feet, Maui. This is the type-species of *Hodegia*.

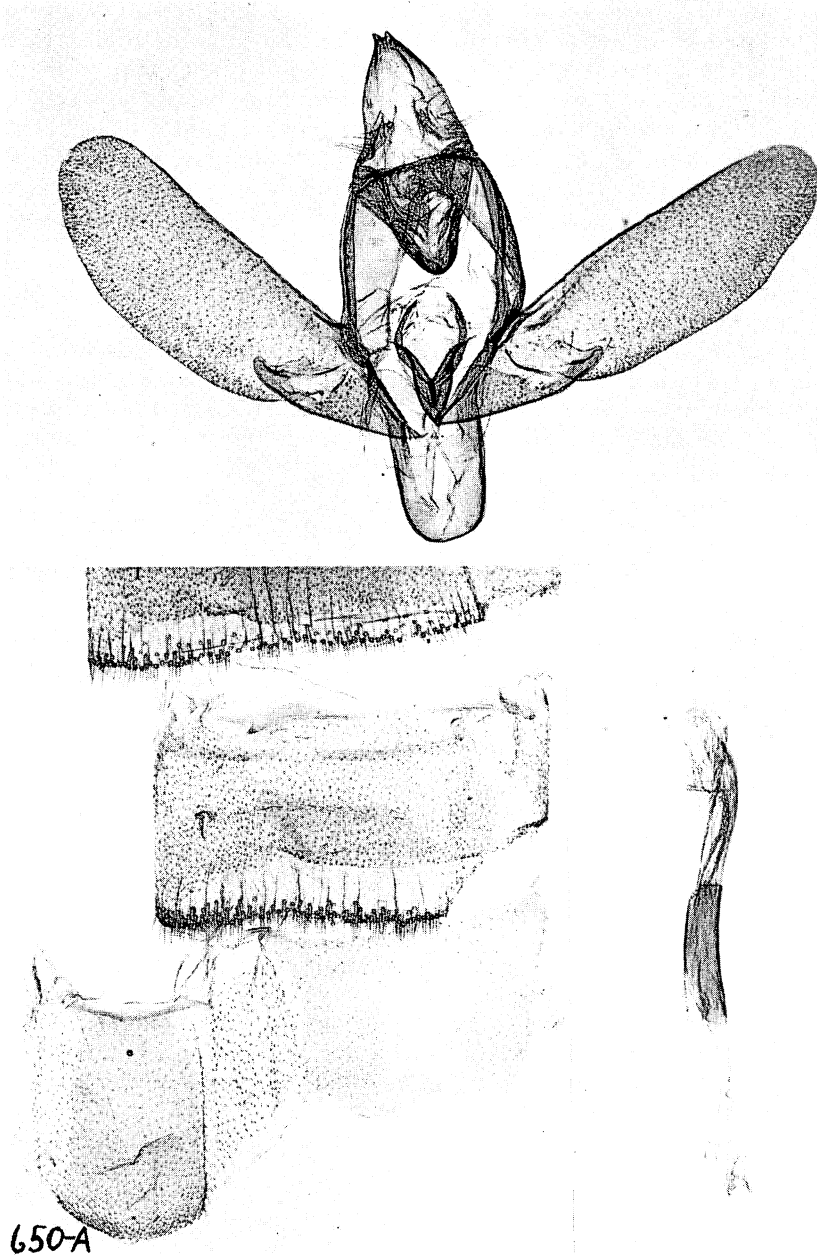


Figure 650-A—*Thyrocopa* ("Hodegia") *apatela* (Walsingham). Male genitalia, with aedeagus (in lateral aspect) at bottom right and caudal abdominal segments at bottom left (terminal segment split open to show sclerotization of sternite and tergite); Haleakala, Maui, 10,000 feet, May 17, 1965, J. W. Beardsley. Dissection prepared by K. Sattler (Sattler 700) in the British Museum (Nat. Hist.).

Dr. Perkins (1913:clxiv) said: "*Hodegia apatela*, a flightless jumping insect with abbreviated wings, is only known in the female sex, the male probably being fully winged. It was found in the wind-swept open country near the summit of Haleakala, and one or two similar forms have been seen on the open lower slopes of Molokai, below the forest region, a locality also constantly swept by strong winds." It is strange that Perkins did not collect the specimens he saw on Molokai, or, if he did collect specimens, why no specimens were preserved in the collections he sent back to England for the *Fauna Hawaiiensis* studies.

Until about two and one-half years after the manuscript for this book was submitted to the Press for publication, I knew only the then unique female holotype of *apatela*. It was with great surprise and delight, therefore, that, long after my text on the Xyloryctinae was completed, I learned by chance that the species had been rediscovered by J. W. Beardsley. Dr. Beardsley kindly sent me a pair of specimens for study, and I have rewritten my text. The female was collected at about 9,000 feet on Haleakala on June 15, 1963, and the male was found at about 10,000 feet on May 17, 1965. The wings of both sexes are similarly reduced as they are on the holotype female. The suggestion by Perkins and others that the male was probably fully winged is, therefore, proved incorrect. This species is truly a totally flightless insect. There is considerable variation in the color pattern of the forewings.

Dr. Beardsley wrote to me that his "five specimens were collected at several different times and at different places on Haleakala, between 6,000 and 10,000 feet, during the time when I was working on *Nysius* aggregations (1964-67). The moths attracted my attention because of their unusual habit of skittering along the ground when disturbed. [Compare Perkins' statement quoted above regarding the species as a "jumping" insect.] I think most of those which I saw were hiding in clumps of bunchgrass when disturbed. I saw many more specimens than I collected as, unfortunately, I assumed they were probably something fairly common. Also, unfortunately, I did not make any notes on their behavior and so am relying on my memory of their habitat."

Dr. Beardsley's collections and observations of this species are among the most exciting of recent events of Hawaiian entomology. Until now it was not known whether the female holotype of *apatela* represented an abnormal individual, the normal flightless female of a species with winged males (as Perkins originally incorrectly assumed) or a species in which both sexes have peculiarly reduced wings and the species is totally flightless as Dr. Beardsley's valued discovery has proved is the true condition.

Credence is now given to Dr. Perkins' report (quoted above) that he found similar flightless moths on Molokai, and detailed searches should be made on Molokai and elsewhere in an attempt to discover other flightless species. Unhappily, however, such flightless moths that once occupied areas now invaded by the voracious introduced *Pheidole megacephala* ant have probably been exterminated.

[While this proof was being read, Klaus and Edith Sattler found fully-winged males of this species on Maui and the flightless females of another species on Mauna Kea, Hawaii.]

Text continued on page 953.

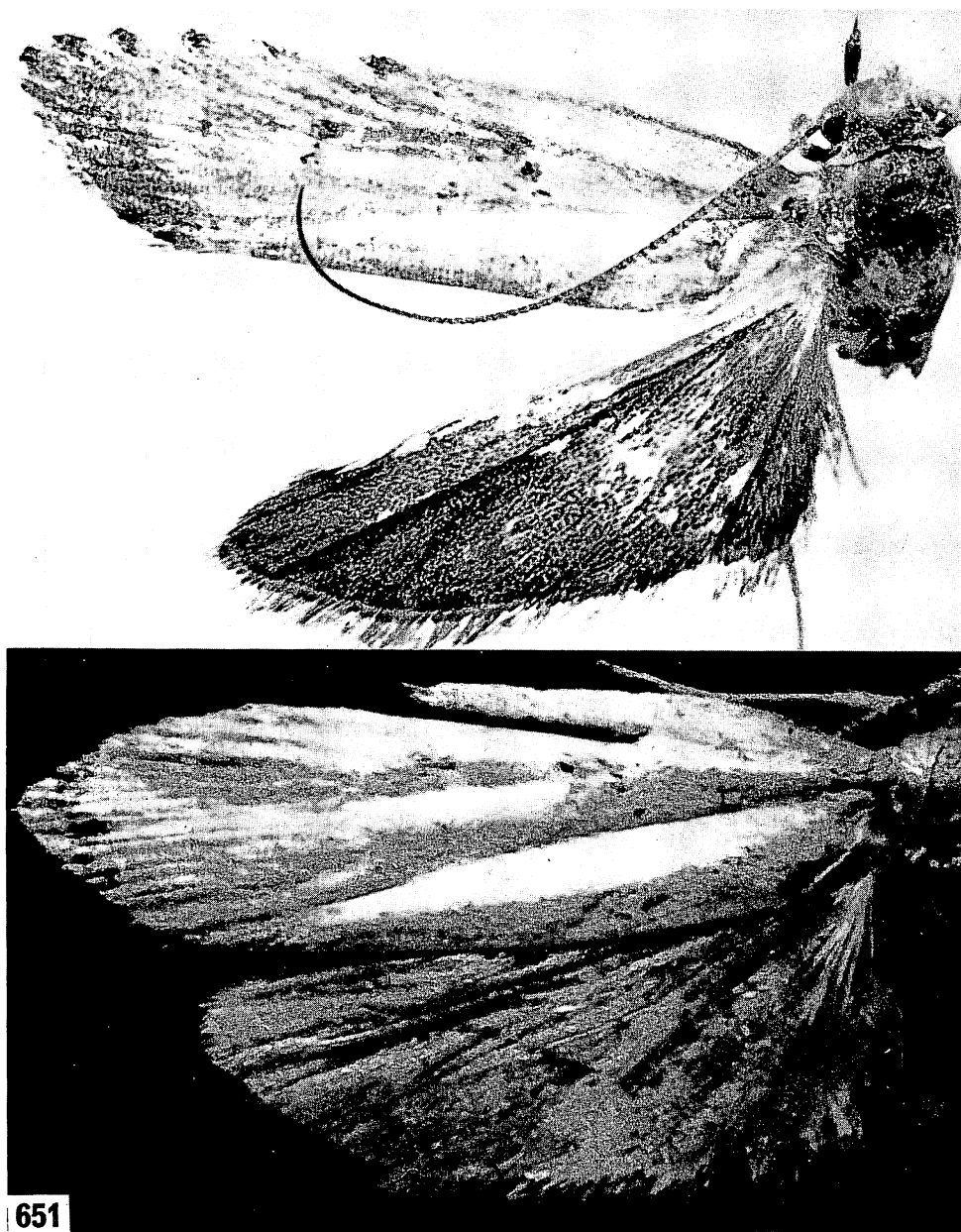


Figure 651—*Thyrocopa* species. Top, (*"Psychra"*) *brevipalpis* (Walsingham), holotype male (BM slide 4158); Kaholuamano, 4,000 feet, Kauai; forewing=11 mm. The hindwings are dark fuscous. Bottom, (*"Ptychothrix"*) *vagans* (Walsingham), male holotype (BM slide 4176); Halemanu, 4,000 feet, Kauai; forewing=10.5 mm.

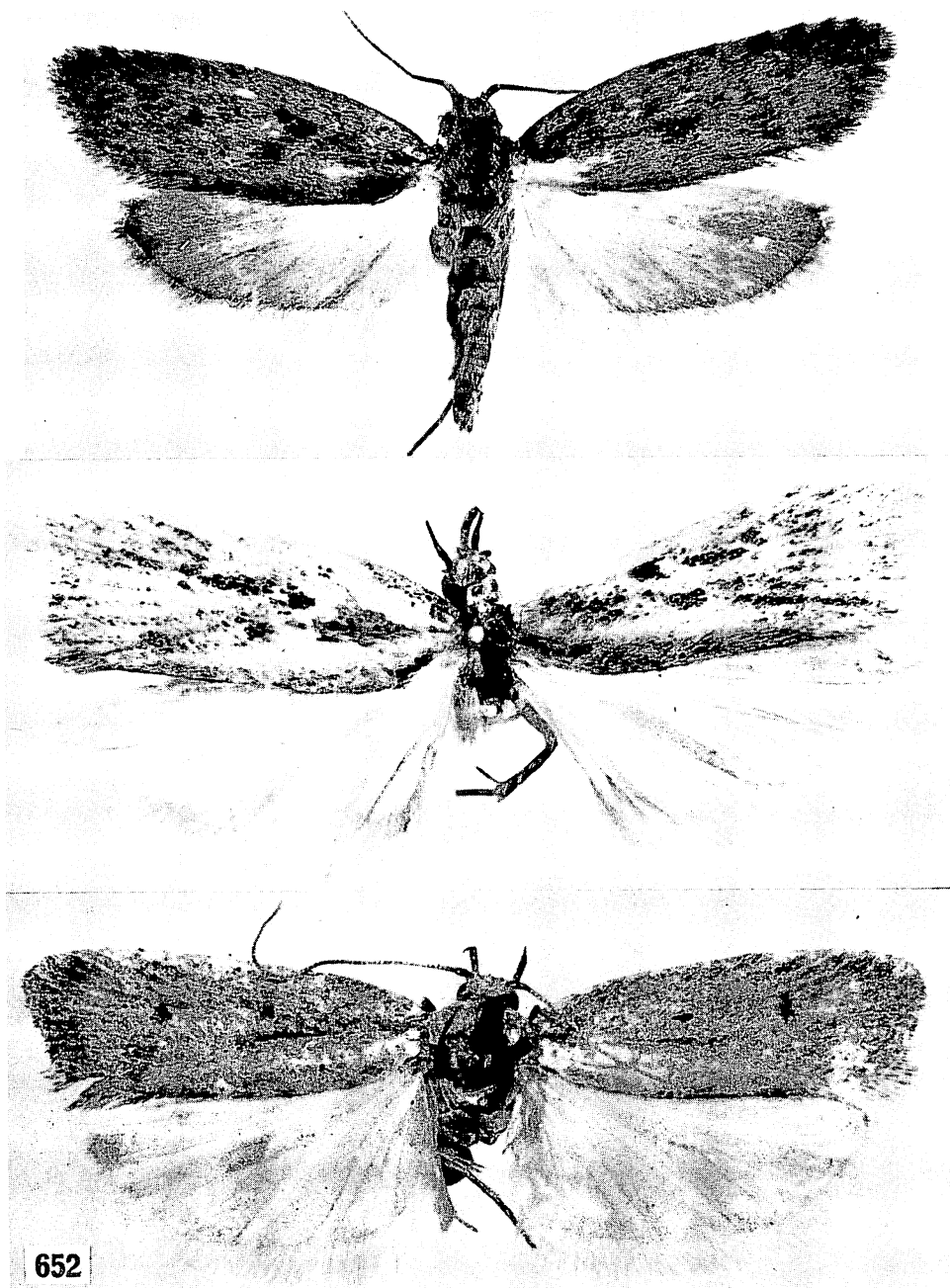
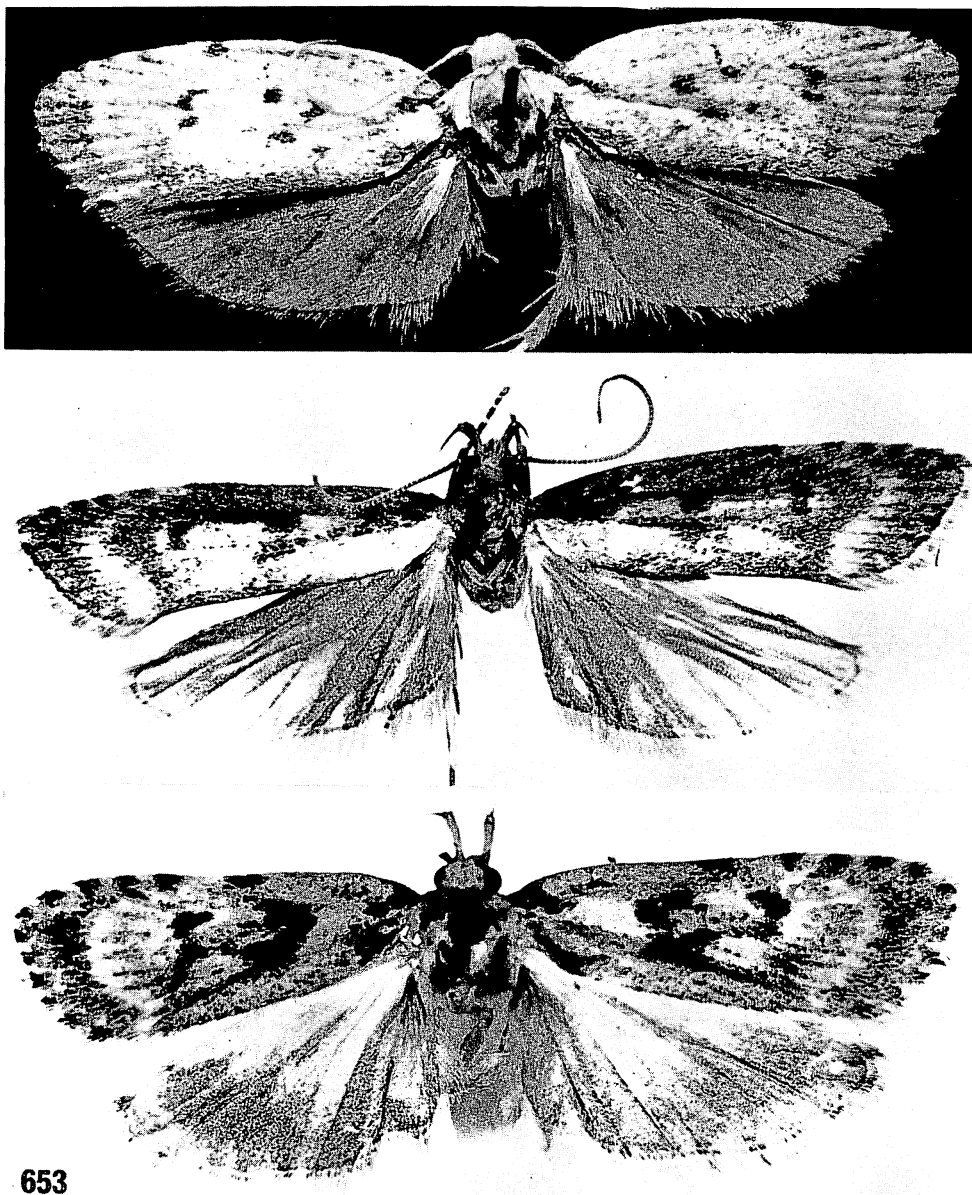


Figure 652—*Thyrocopa*. Top, a male of *abusa* Walsingham from the coast at Honolulu; expanse 18 mm.; see also figure 666. Middle, *acetosa* Meyrick, holotype female (BM slide 9554 Clarke); Kauai; expanse 21 mm. Bottom, *adumbrata* Walsingham, holotype female (BM slide 3942); Kona, 3,000 feet, Hawaii; expanse 22 mm.



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Figure 653—*Thyrocopa*. Top, *albonubila* Walsingham, holotype male (BM slide 4049); Kauai, 3,000 to 4,000 feet; expanse 24 mm. Middle, *alterna* Walsingham, male holotype (BM slide 4046); Haleakala, 5,000 feet, Maui; expanse 24 mm. Bottom, *indecora* (Butler) from the holotype female of the synonymous *lactea* Butler (BM slide 3895); labeled "Hawaiian Islands 81.7/129"; expanse 30mm.

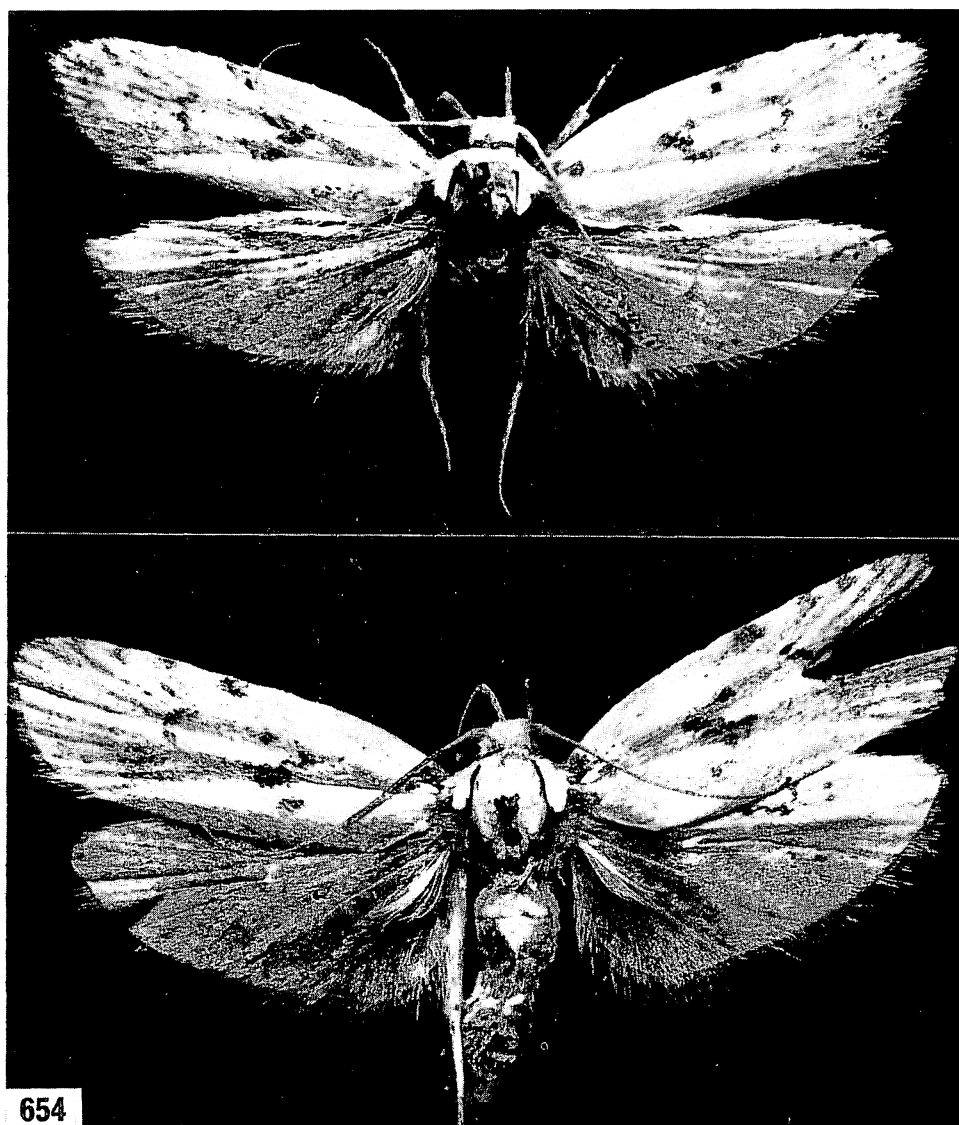
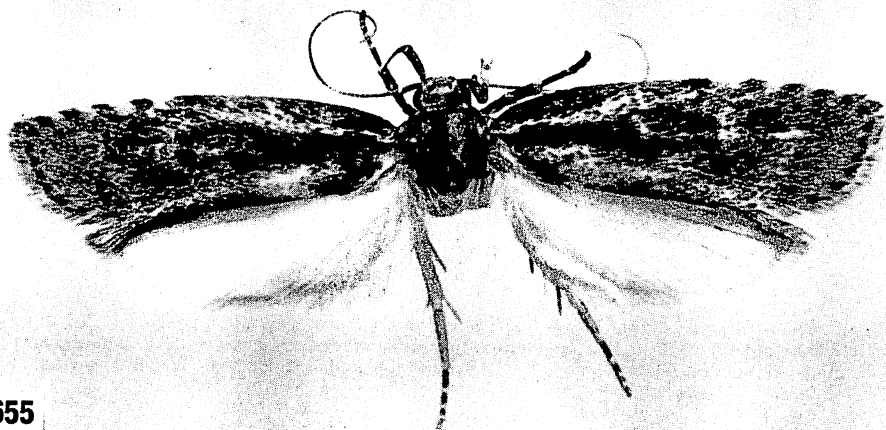
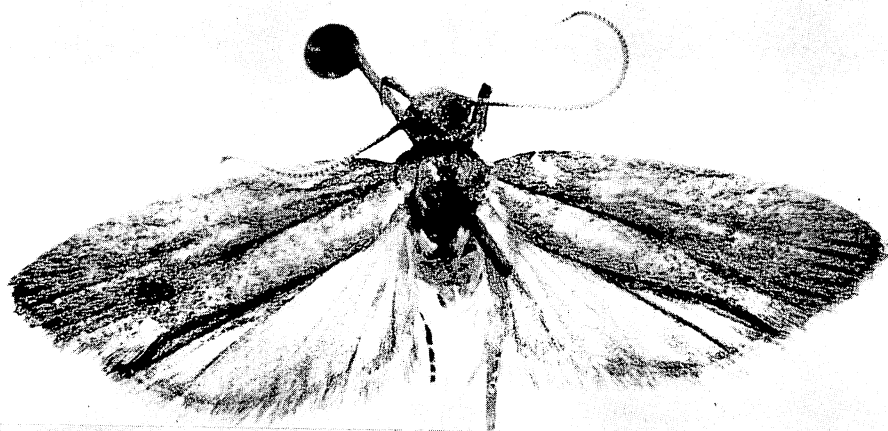
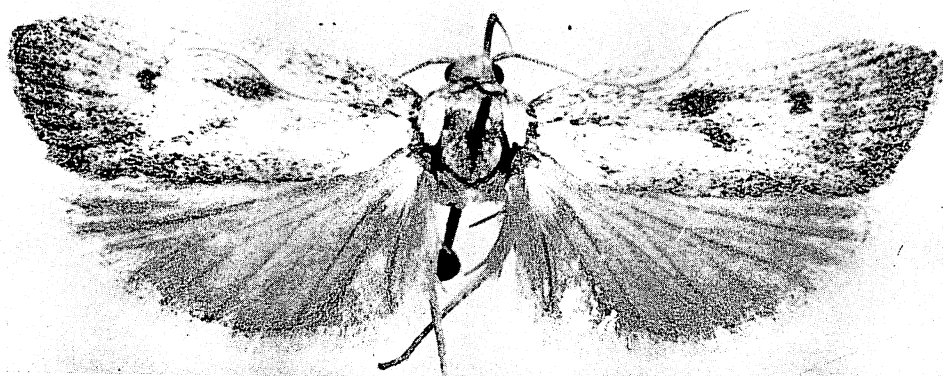


Figure 654—*Thyrocopa argentea* (Butler). Top, holotype female (originally thought to be a male) (BM slide 4045); expanse 14 mm. Bottom, the original allotype female; expanse 21.5 mm. Both specimens bear the Blackburn labels "Hawaiian Islands 81.7/100"; the locality code means taken in the mountains near Honolulu.



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Figure 655—*Thyrocopa*. Top, *cinerella* Walsingham, holotype female (BM slide 3943); Kauai, 3,000 to 4,000 feet; expanse 39 mm. Middle, *criminosa* Meyrick, lectotype male (BM slide 9552 Clarke); Honolulu; expanse 19 mm. Bottom, *depressariella* Walsingham, holotype male (BM slide 4052); Kauai, 3,000 to 4,000 feet; expanse 23 mm.



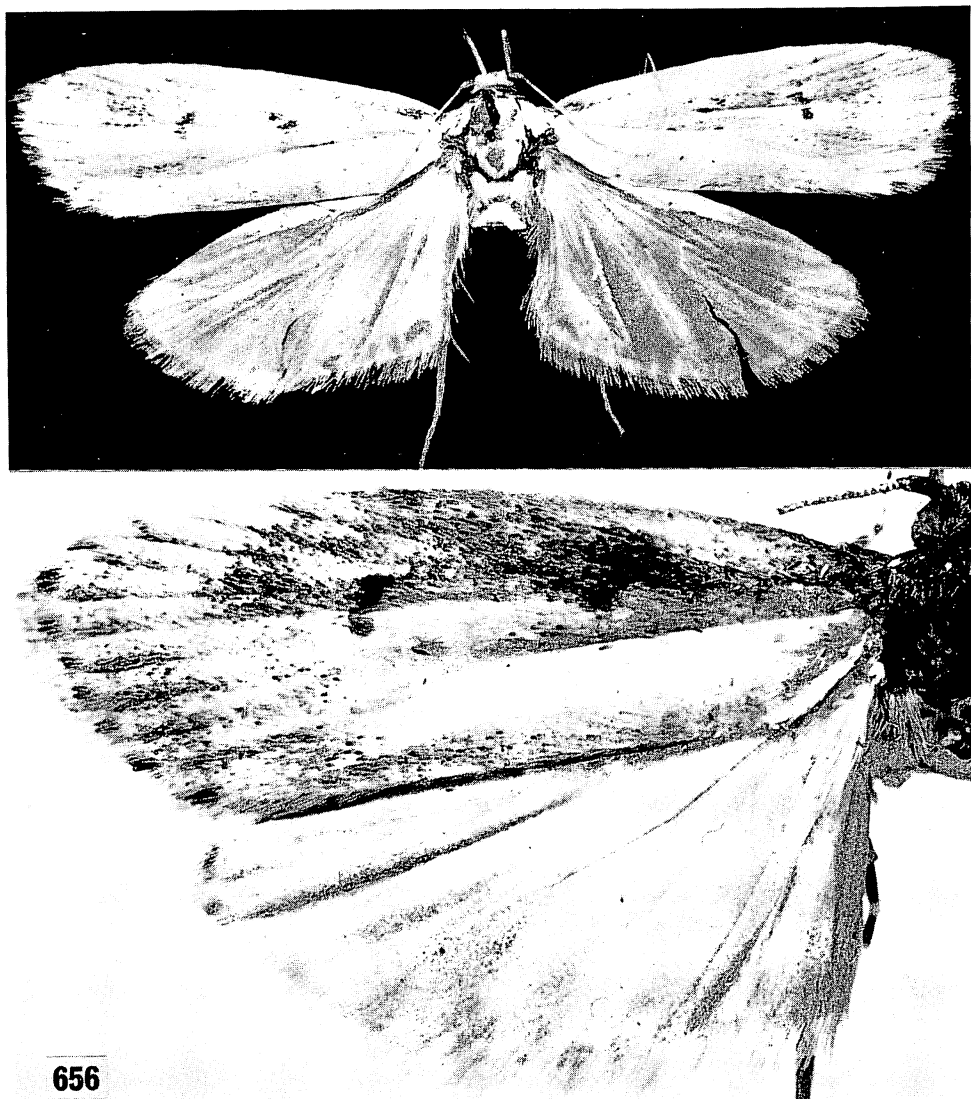


Figure 656—*Thyrocopa* ("Catamempsis") *decipiens* (Walsingham), Top, allotype female (BM slide 3944); Olaa, Hawaii; expanse 49 mm. This photograph makes the moth appear too white; it should appear more like the male in tone. Bottom, holotype male (BM slide 4389); Olaa, 2,000 feet, Hawaii; forewing=18 mm.

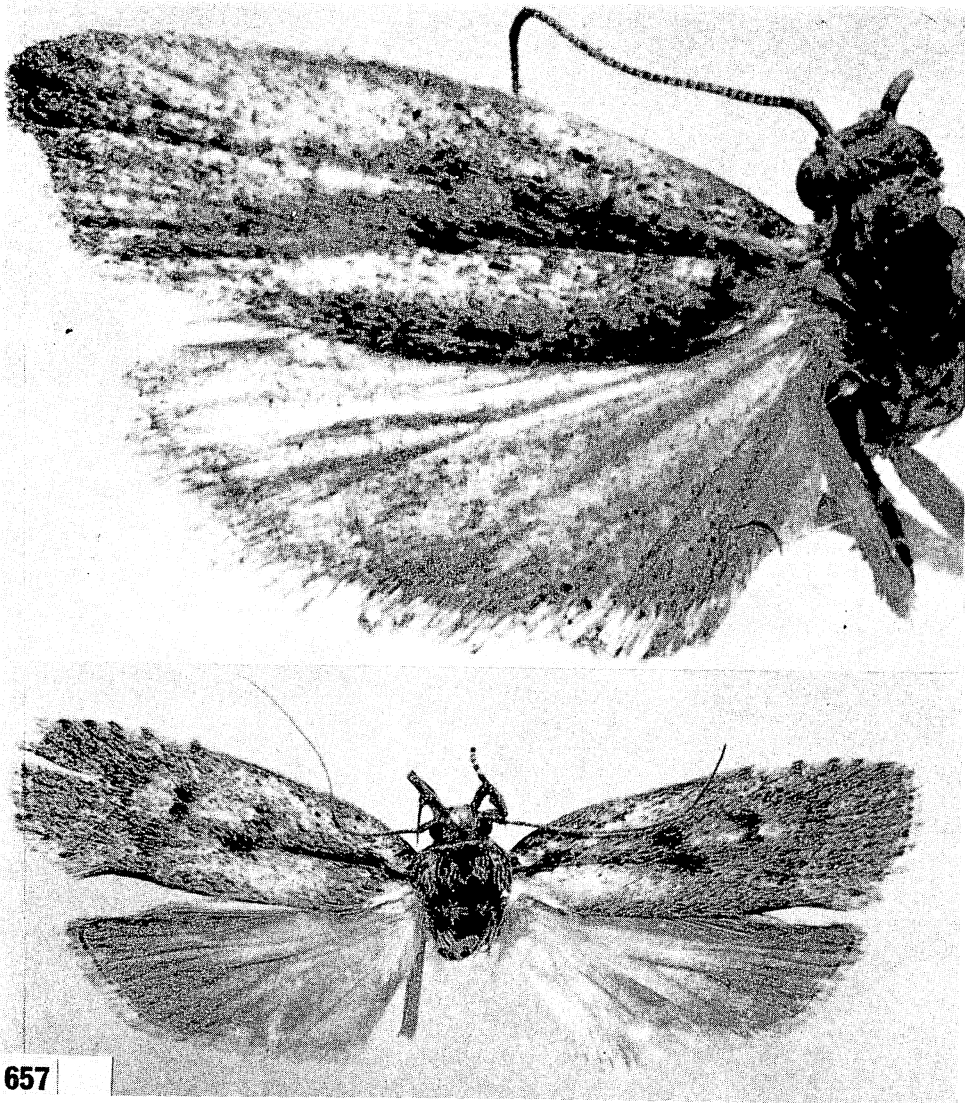


Figure 657—*Thyrocopa*. Top, *epicapna* (Meyrick), holotype male; forewing=9 mm.; locality unknown; abdomen lost (a female abdomen of another family was glued on the type; BM slide 4075). Bottom, *fraudentella* Walsingham, holotype male (BM slide 4076); Kilauea, Hawaii; expanse 25 mm.

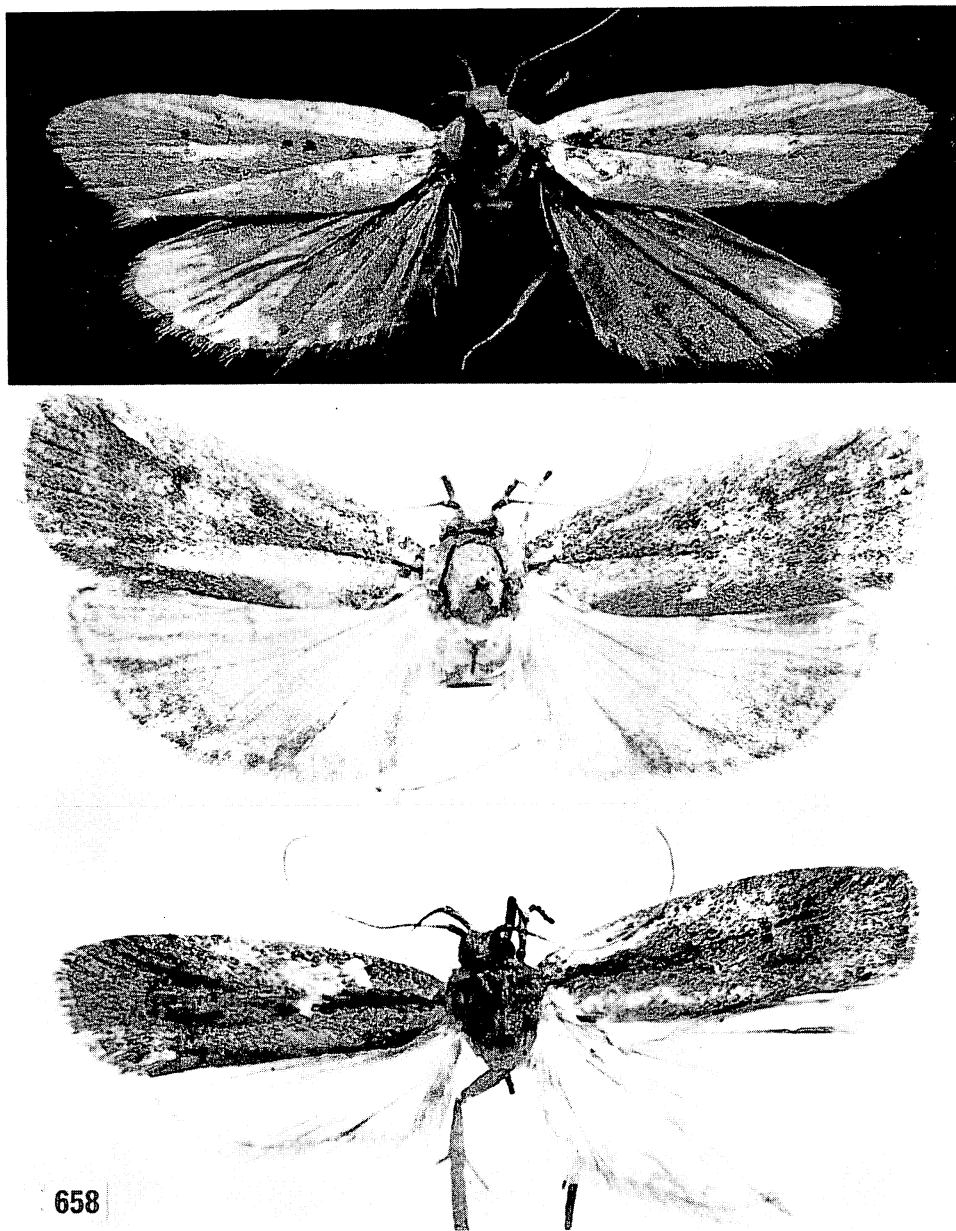
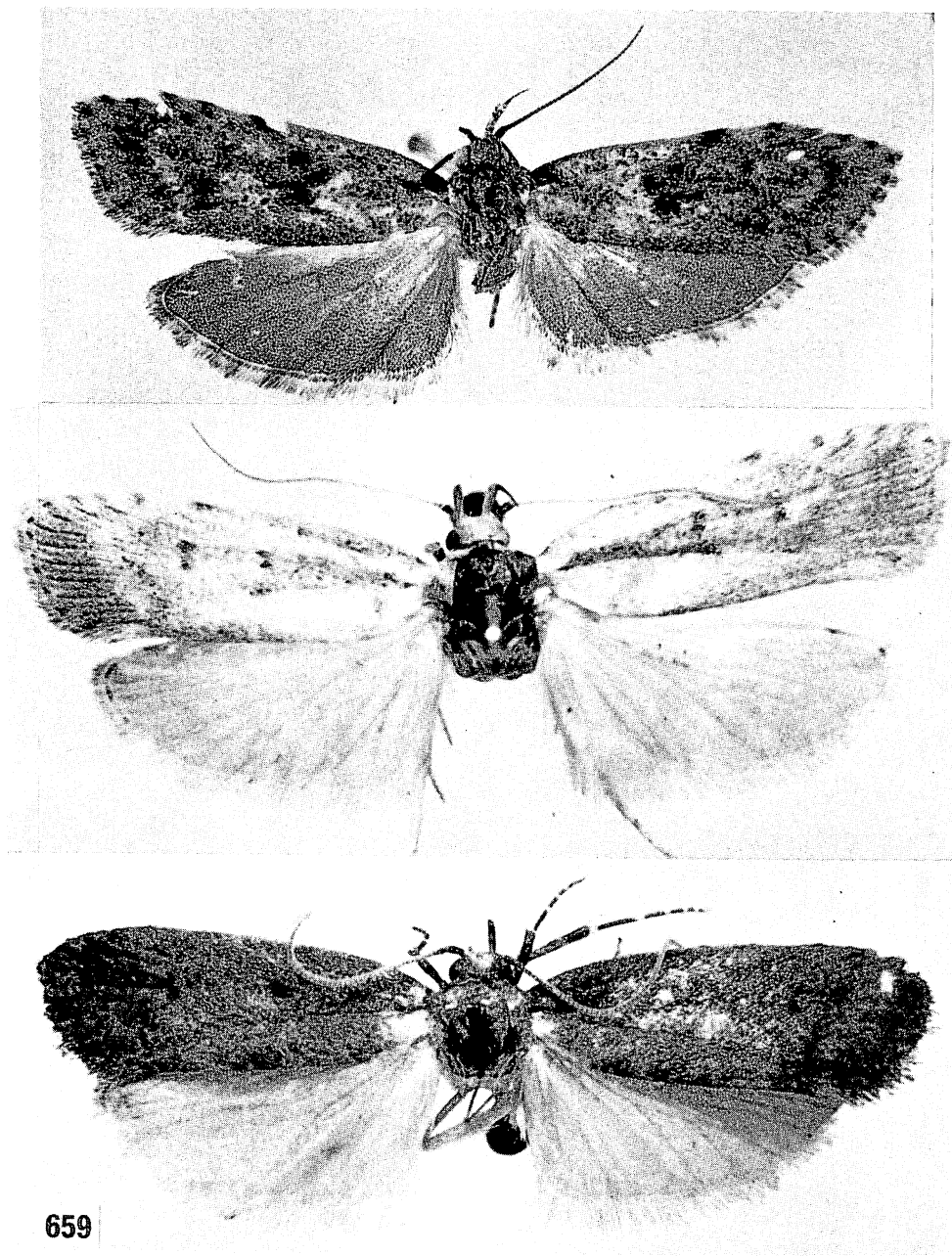


Figure 658—*Thyrocopa*. Top, *geminipuncta* Walsingham, holotype female (BM slide 3898); Molokai, 4,500 feet; expanse 21 mm; this is a straw-colored species. Middle, *gigas* (Butler), holotype male (BM slide 4048); Haleakala, 4,000 feet, Maui (the original Blackburn label reads "Hawaiian Islands 81.7/119"); expanse 45 mm. It is a brown species; the photograph makes it appear too pale. Bottom, *immutata* Walsingham, holotype male (BM slide 4155); Kaholuamano, 4,000 feet, Kauai; expanse 24.5 mm.



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Figure 659—*Thyrocopa*. Top, *indecora* (Butler), holotype male (BM slide 4050); Haleakala, 4,000 feet, Maui (Blackburn's number 81.7); expanse 27 mm. Middle, *ingeminata* Meyrick, lectotype female (BM slide 9551 Clarke); Honolulu; expanse 23 mm. Bottom, *inermis* Walsingham, holotype male (BM slide 4077); Kona, 3,000 feet, Hawaii; expanse 24 mm.

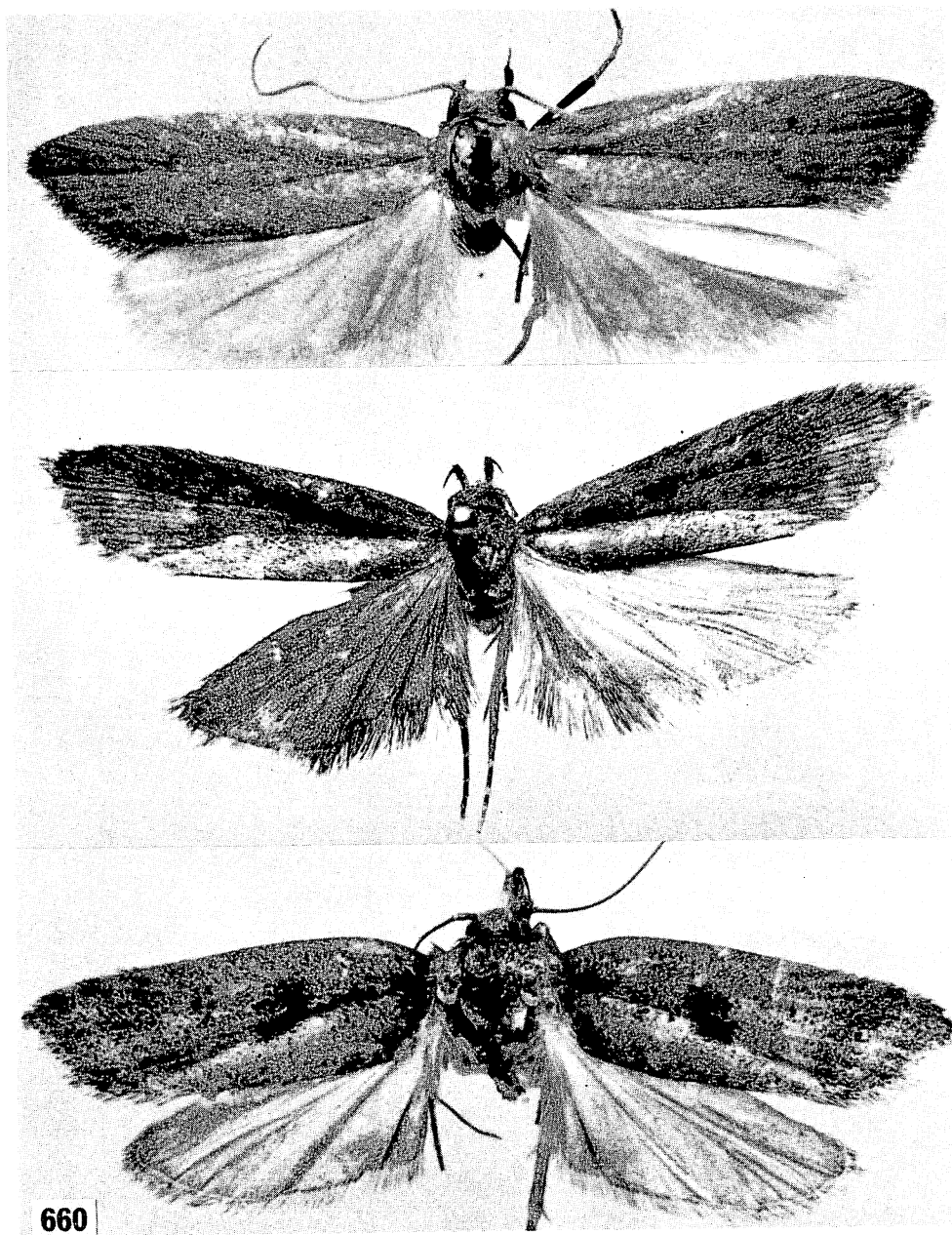


Figure 660—*Thyrocopa*. Top, *leonina* Walsingham, holotype male (BM slide 4078); Lanai, 2,000 feet; expanse 20.5 mm. Middle, *librodes* Meyrick, holotype female (BM slide 9555 Clarke); "Kauai, Palmer .00"; expanse 25 mm. Bottom, *mediomaculata* Walsingham, holotype female (BM slide 3899); Haleakala Crater, Maui; expanse 25 mm.

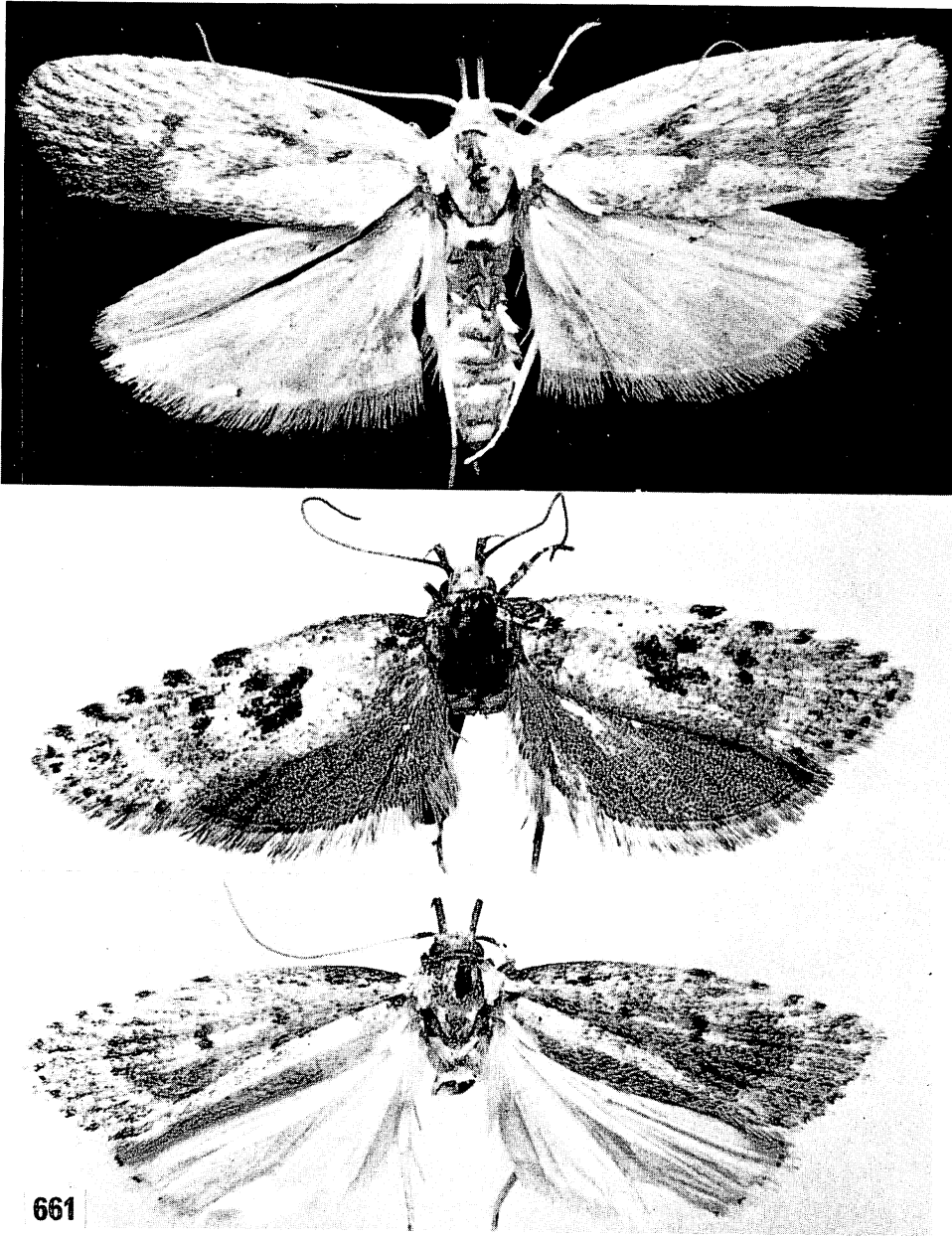


Figure 661—*Thyrocopa*. Top, *megas* Walsingham, holotype female; Haleakala, 5,000 feet, Maui; expanse 39 mm.; the forewings are too pale in the photograph. Middle, *minor* Walsingham, holotype female (BM slide 3946); Molokai, above 3,000 feet; expanse 18 mm. Bottom, *nubifer* Walsingham, holotype male (BM slide 4151); Kona, 4,000 feet, Hawaii; expanse 28 mm.



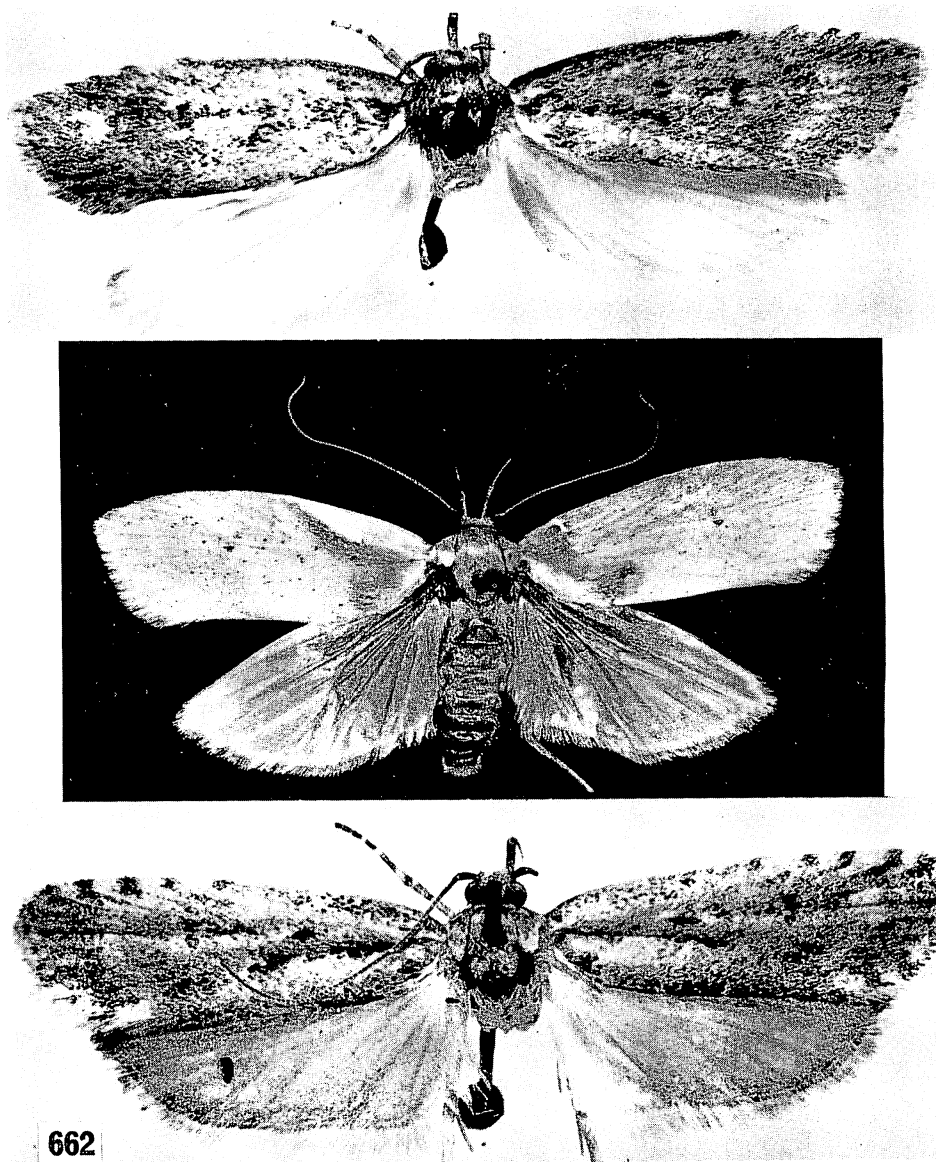


Figure 662—*Thyrocopa*. Top, *pallida* Walsingham, holotype male (BM slide 4152); Kaholuamano, 4,000 feet, Kauai; expanse 24.5 mm. Middle, *peleana* Swezey, holotype; Waipio Ridge, Oahu; ex *Pelea*; forewing=19 mm. Bottom, *pulverulenta* Walsingham, holotype male (BM slide 4153); Kona, 4,000 feet, Hawaii; expanse 25.5 mm.

It is remarkable that *apatela* remained an enigma for so long a time. The area it occupies has been collected over by almost all entomological collectors who have worked in the popular summit area of Haleakala. Dr. Swezey visited the area several times, and I collected extensively in the area on various occasions, but neither of us saw this moth. I must admit, however, that I did not make any special searches for ground-dwelling insects (excepting to search for Carabidae beneath objects lying on the ground), and, although I swept over them, I never searched bunchgrass clumps carefully in that locality. Much specialized collecting remains to be done in Hawaii.

Text continued on page 977.

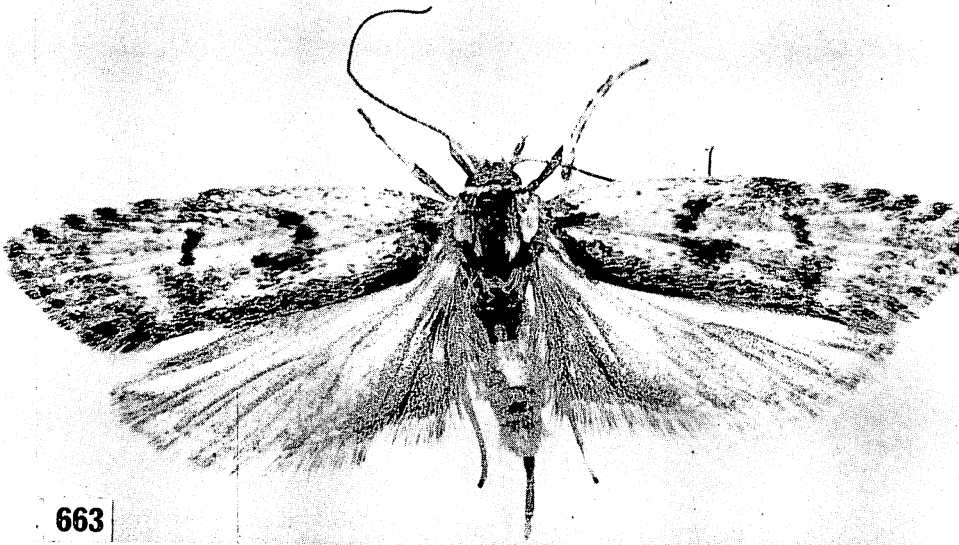


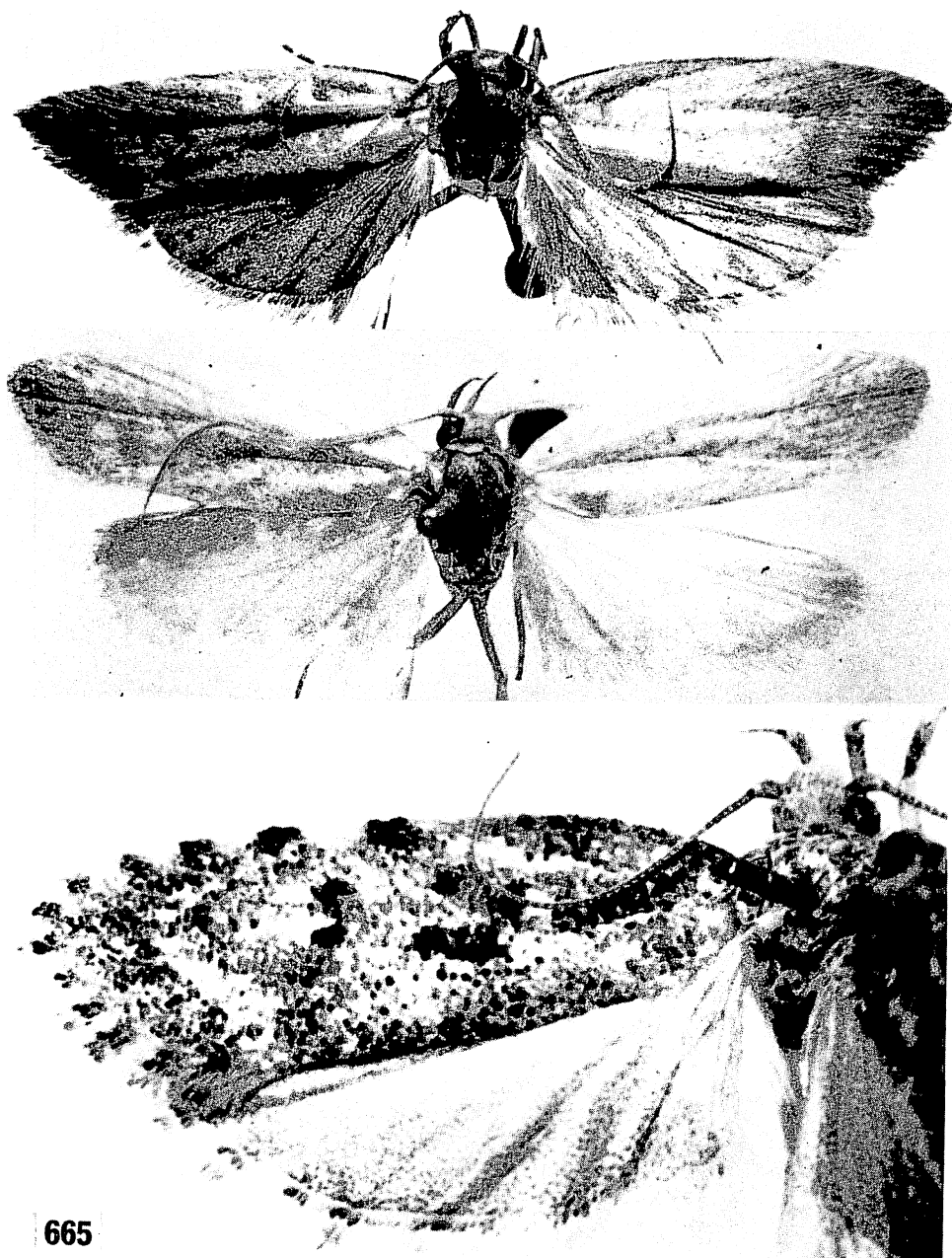
Figure 663—*Thyrocopa* ("Psychra") *phycidiformis* (Walsingham). Top, holotype male (BM slide 4159); Kauai, 3,000 to 4,000 feet; expanse 23 mm. Bottom, allotype female from the same locality; expanse 27 mm.





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Figure 664—*Thyrocopa*. Top, *seminatella* Walsingham, holotype male (BM slide 4156); Haleakala, 4,000 feet, Maui, expanse 25.5 mm.; the photograph makes the wings appear too pale. Middle, *sapindiella* Swezey, holotype female; Niu, Oahu; forewing=10 mm. Bottom, *spilobathra* Meyrick, lectotype (BM slide 9547 Clarke); Honolulu, Oahu; expanse 18 mm.



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Figure 665—*Thyrocopa*. Top, *subahenea* Walsingham, holotype male (BM slide 4157); Molokai, 3,000 feet; expanse 21 mm. Middle, *sucosa* Meyrick, holotype male (BM slide 9553 Clarke); Koolau Mts., Oahu; expanse 18 mm. Bottom, *tessellatella* Walsingham, holotype male (BM slide 4051); Kona, 4,000 feet, Hawaii.

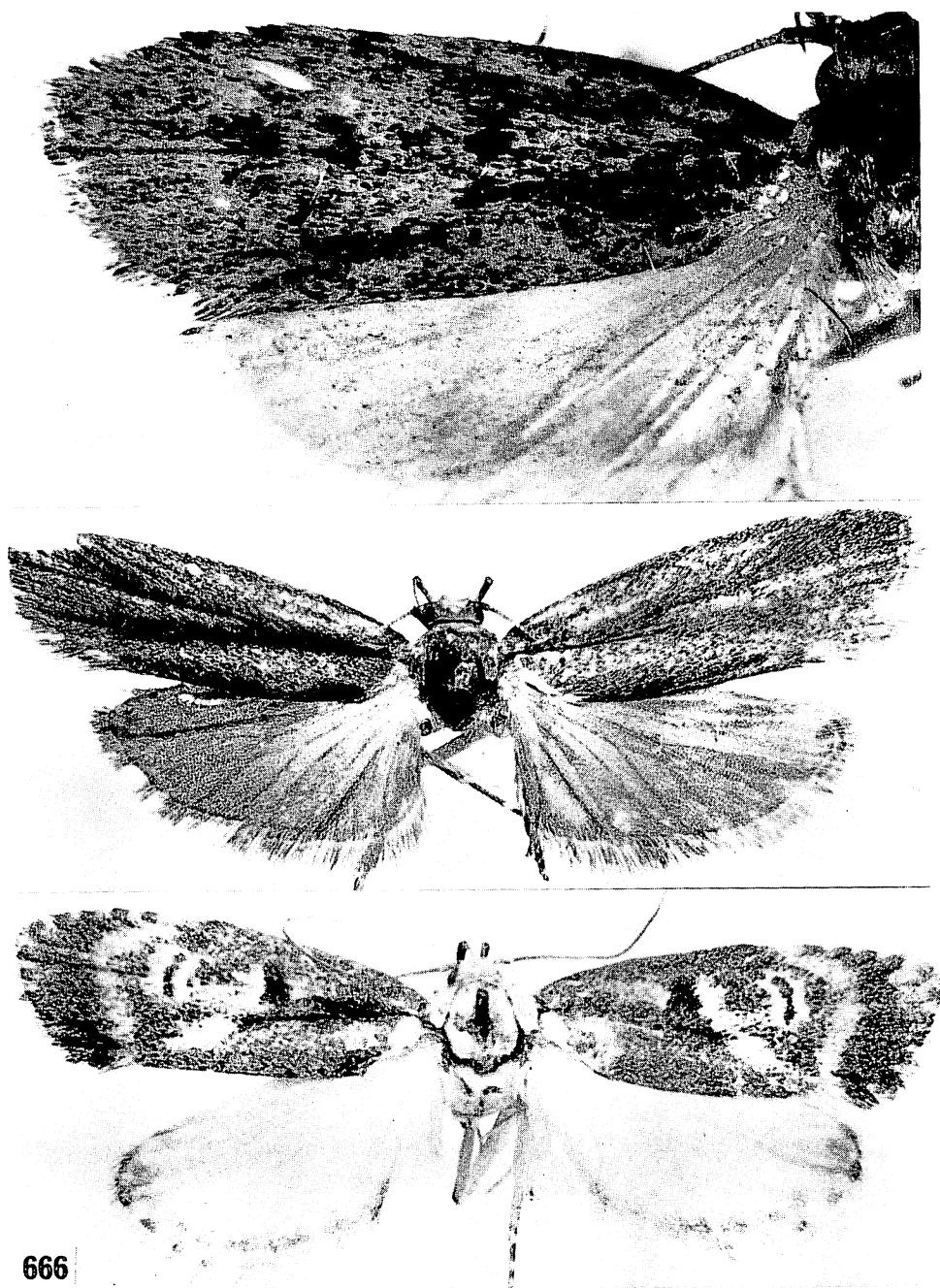


Figure 666—*Thyrocopa*. Top, *abusa* Walsingham, holotype male (BM slide 4044); Oahu; forewing= 8 mm.; the wings appear too dark on the photograph. Middle, *usitata* (Butler), holotype female (BM slide 3900); Oahu (probably near Honolulu; the Blackburn code is 81.7/69); expanse 24.5 mm. Bottom, *viduella* Walsingham, holotype female (BM slide 3945); Kauai, 3,000 to 4,000 feet; expanse with wings drooping as mounted, 33 mm.

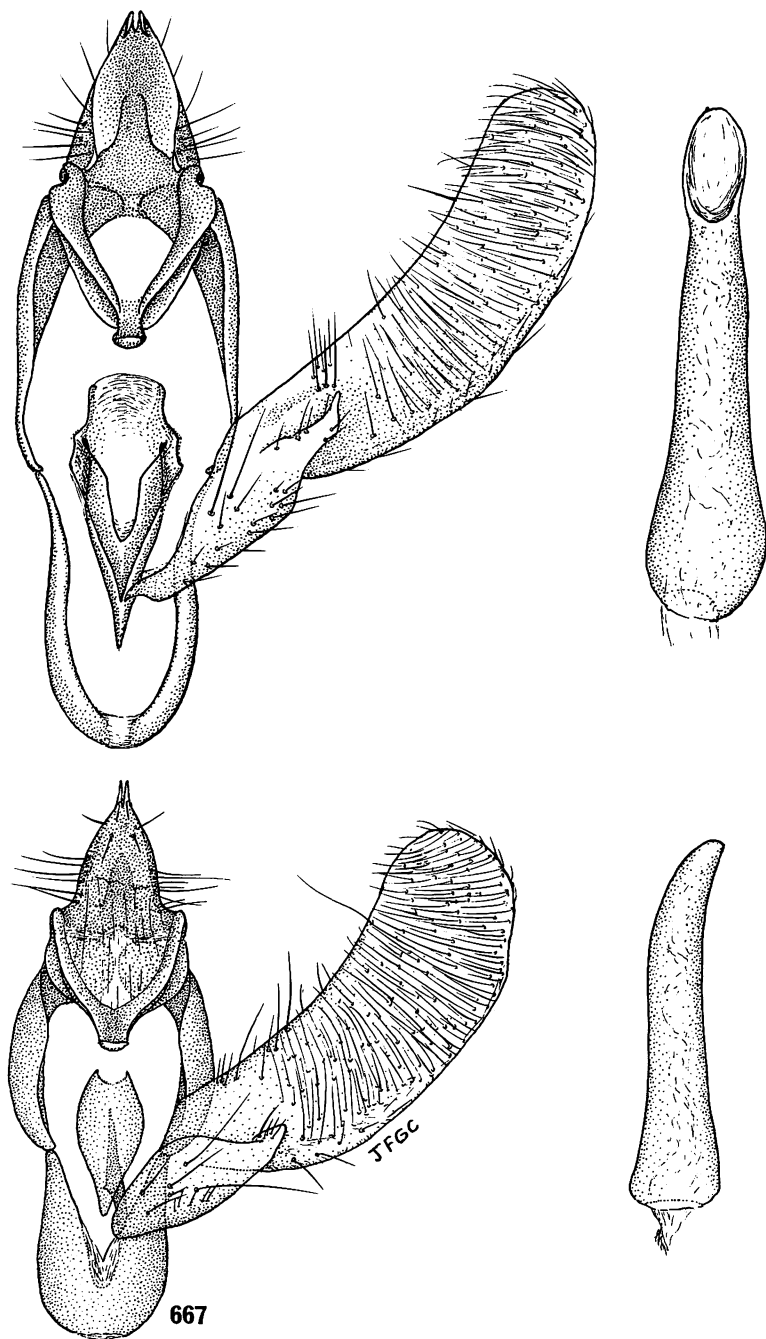


Figure 667—Male genitalia of *Thyrocopa*. Top, (*“Psychra”*) *phycidiformis* (Walsingham). Bottom, *abusa* Walsingham? (an error in identification may be involved here; the drawing appears not to be the same as the holotype in figure 670).

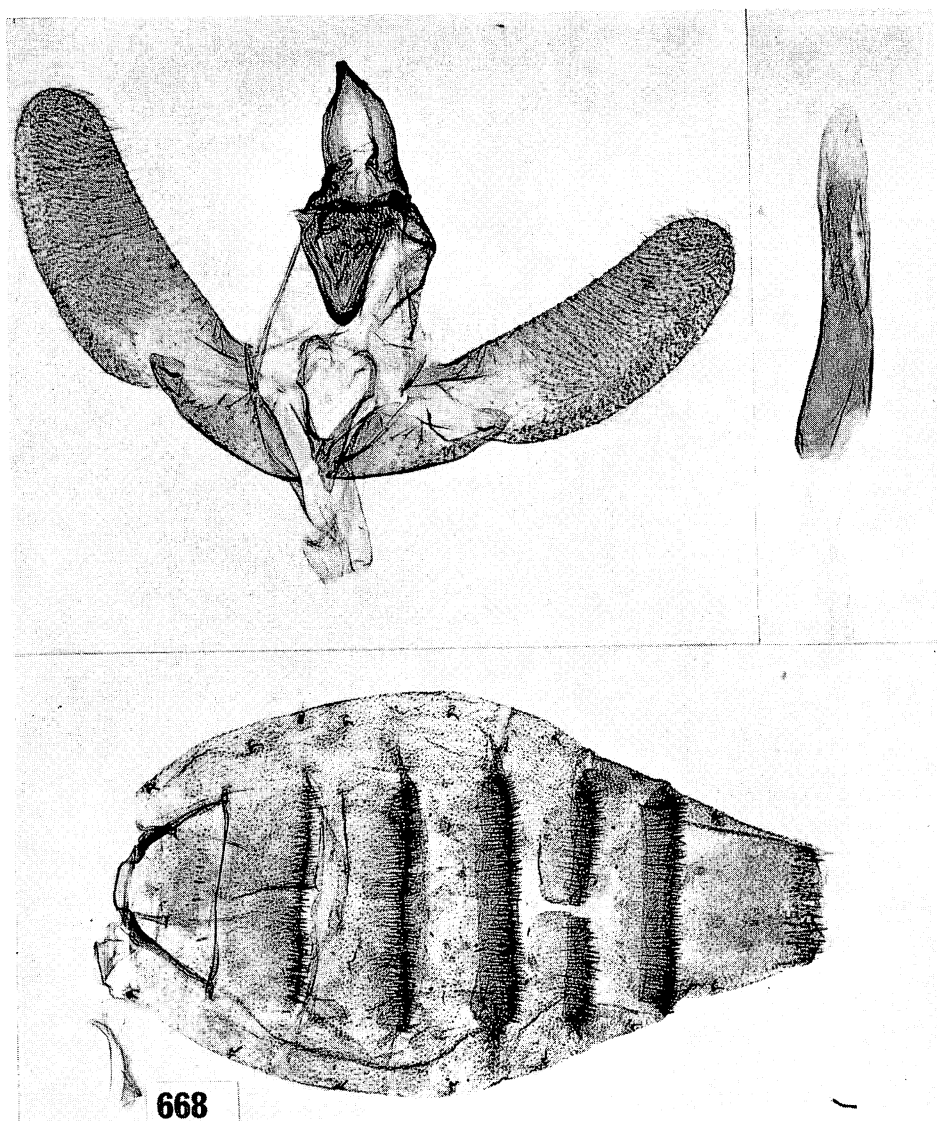


Figure 668—*Thyrocopa* species; Nihoa Island. Top, male genitalia (slide Z-II-28-65). Bottom, the abdominal skin of the female (slide Z-II-28-65-B). See also figure 669. Collected by J. W. Beardsley.

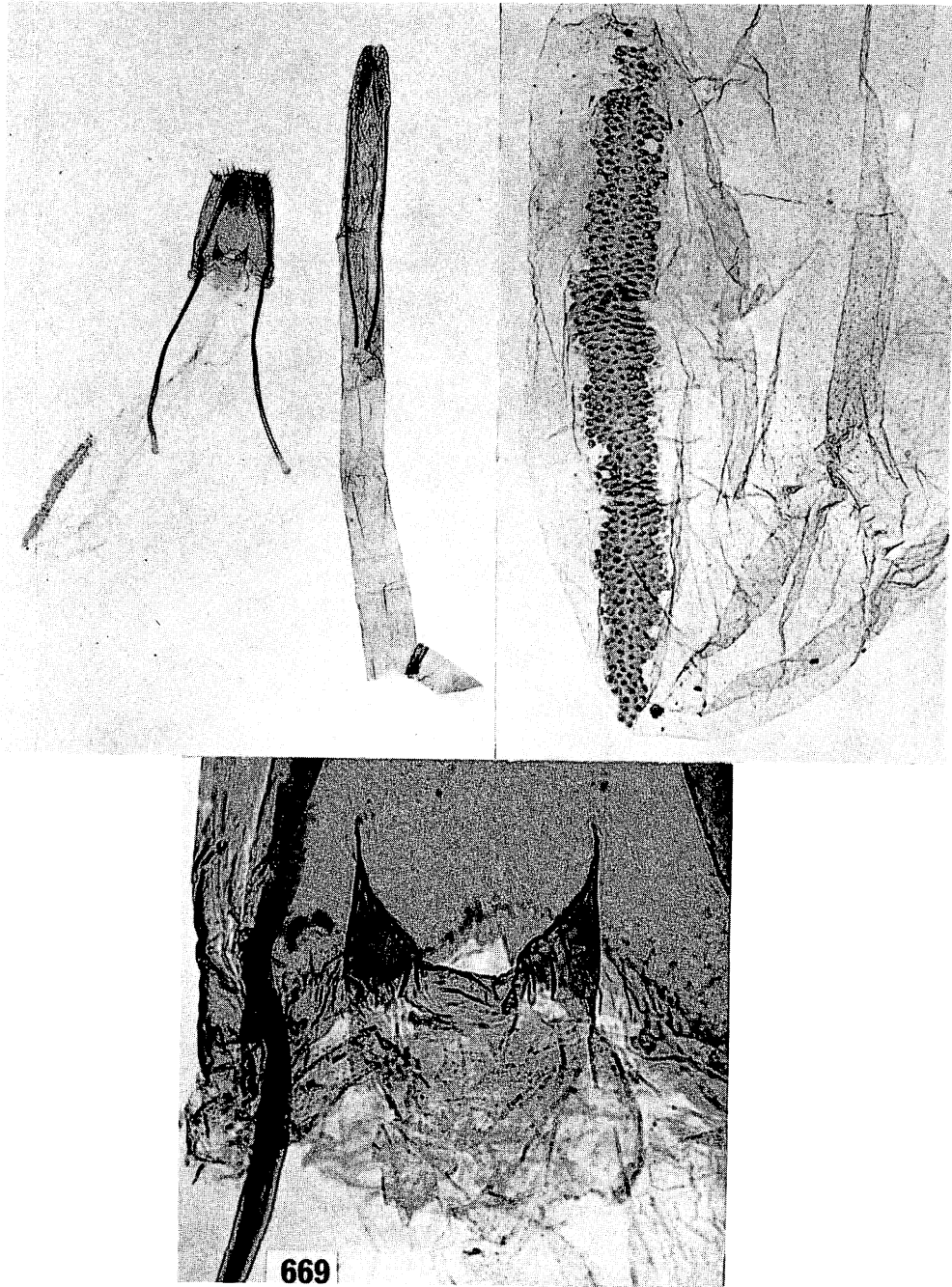


Figure 669—*Thyrocopa* species; Nihoa Island (slide Z-II-28-65-B). The posterior apophyses are broken. See figure 668 for the abdominal skin and for the male genitalia. Collected by J. W. Beardsley.

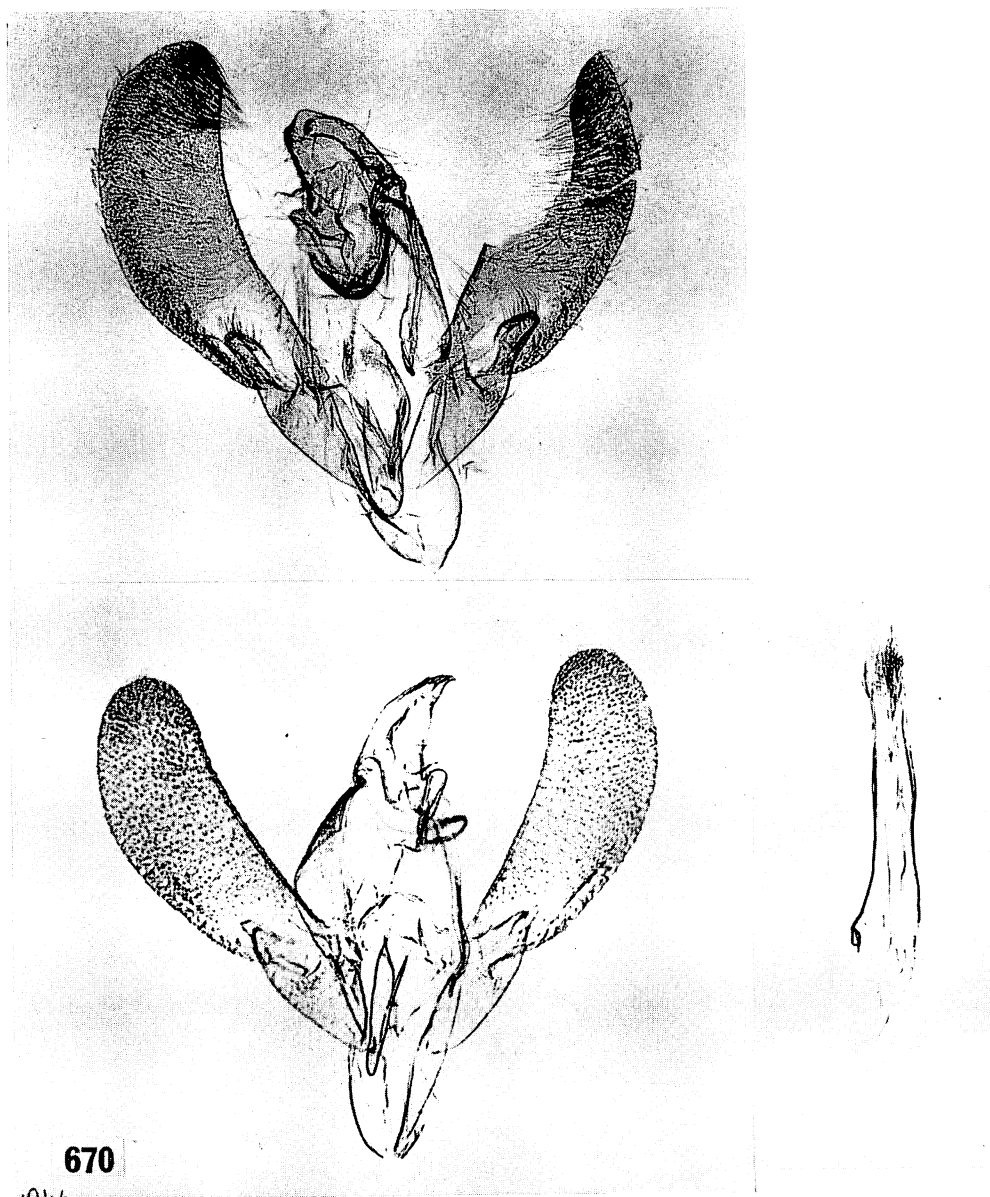


Figure 670—Male genitalia of *Thyrocopa*. Top, *abusa* Walsingham, holotype (BM slide 4044); Oahu; aedeagus lost. Bottom, *alterna* Walsingham, holotype (BM slide 4046); Haleakala, 5,000 feet. Compare the shapes of the ends of the sacculus on these and other species.

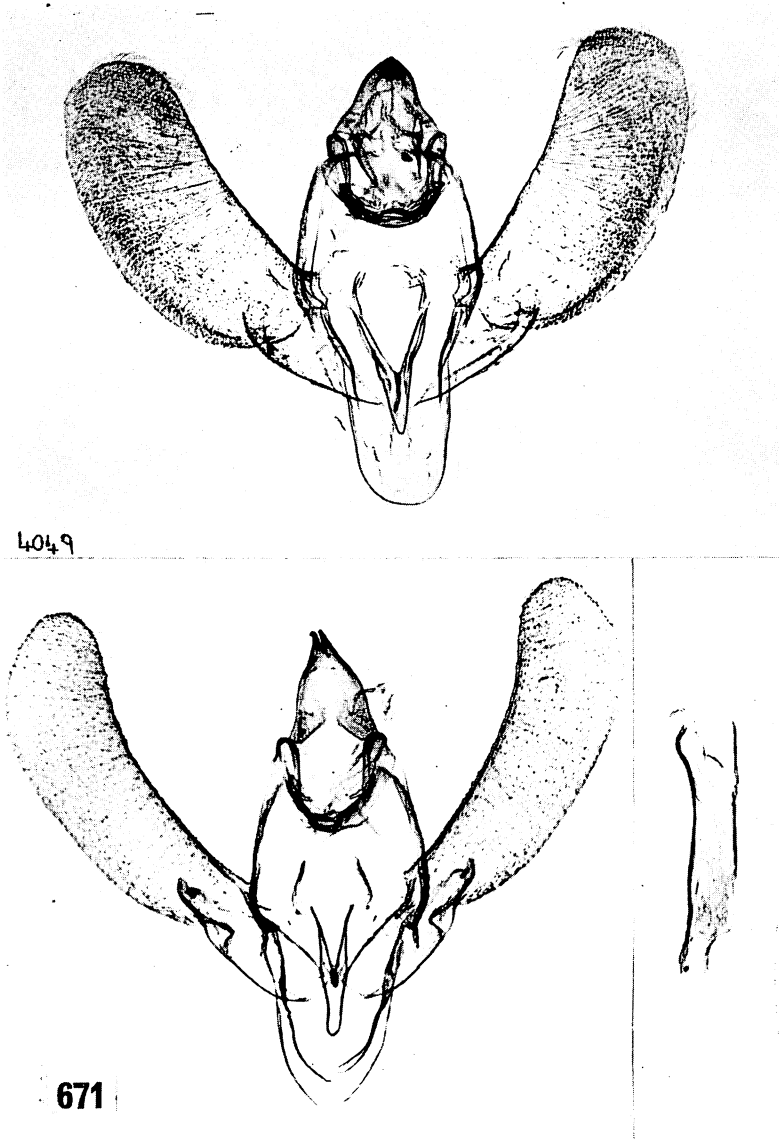


Figure 671—Male genitalia of *Thyrocopa*. Top, *albonubila* Walsingham, holotype (BM slide 4049); aedeagus lost; Kauai, 3,000 to 4,000 feet; Bottom, *criminosa* Meyrick, lectotype (BM slide 9552 Clarke); Honolulu.



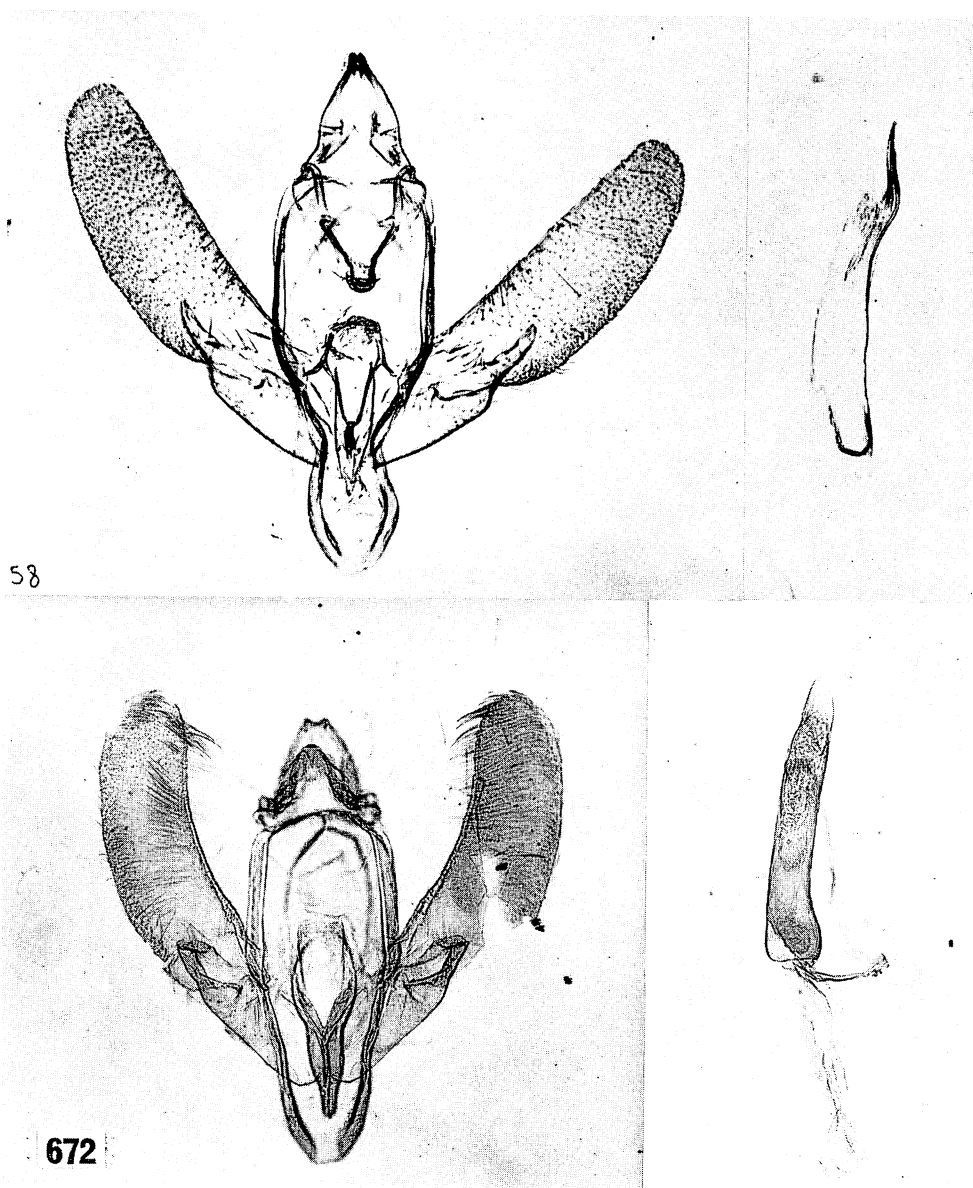


Figure 672—Male genitalia of *Thyrocopa*. Top, (*"Psychra"*) *brevipalpis* (Walsingham), holotype (BM slide 4158); Kaholuamano, Kauai; the aedeagus is shown in lateral aspect. Bottom, *depressariella* Walsingham, holotype (BM slide 4052); Kauai, 3,000 to 4,000 feet.

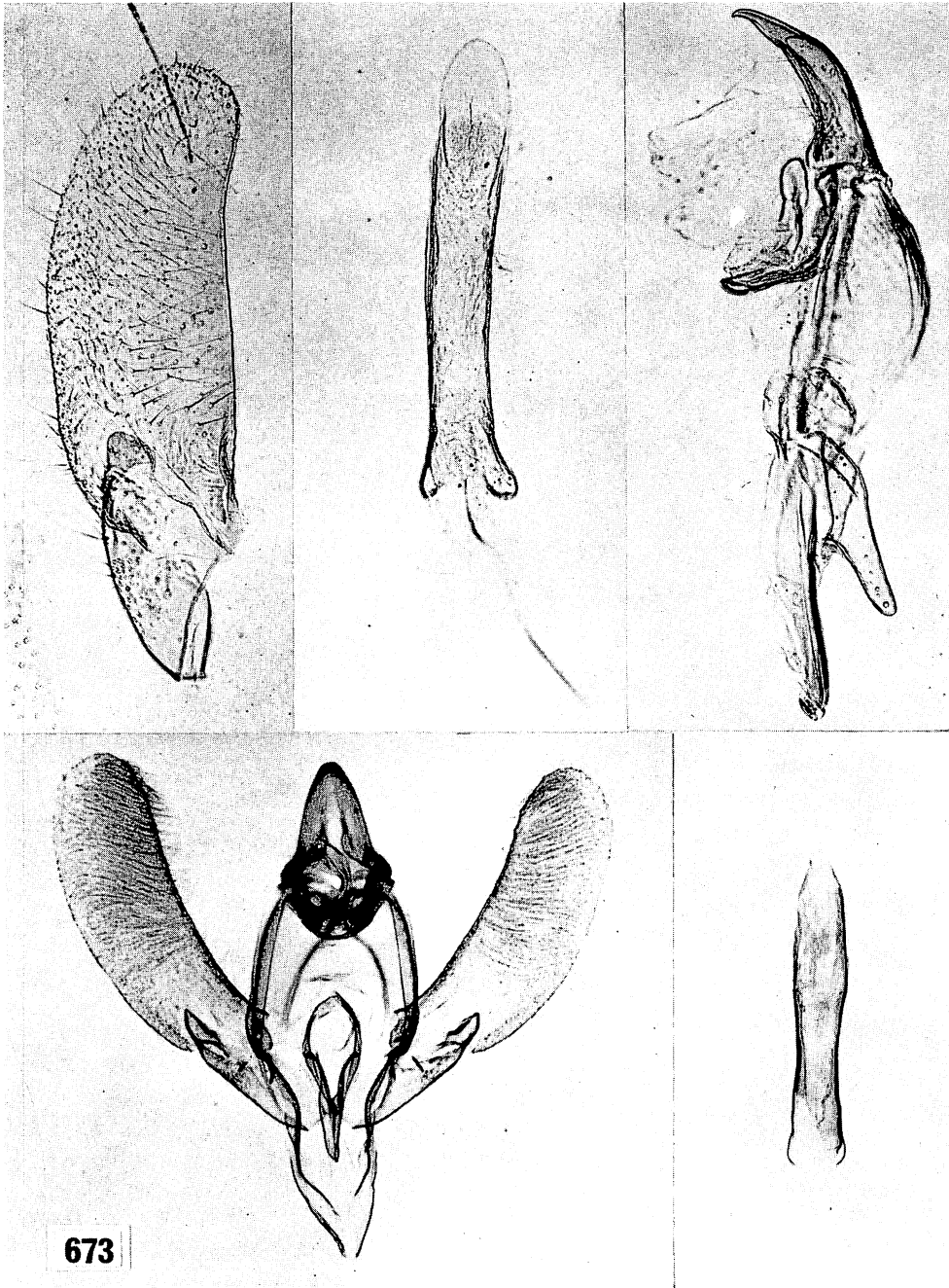


Figure 673—Male genitalia of *Thyrocopa*. Top, *sucosa* Meyrick, holotype (BM slide 9553, Clarke); Koolau Mts., Oahu. Bottom, *epicapna* (Meyrick) (BM slide 9602 Clarke); Kona, 4,000 feet, Hawaii.

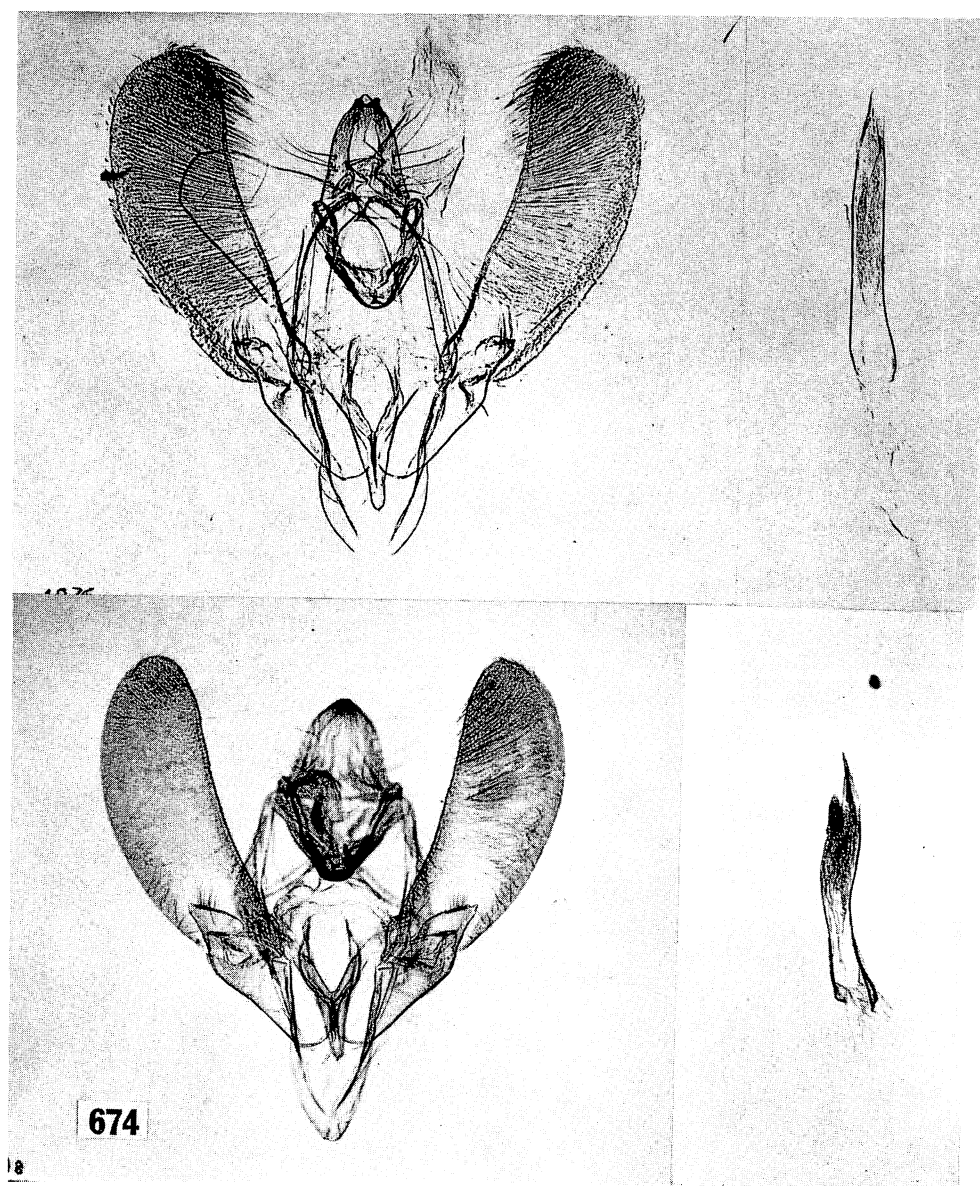


Figure 674—Male genitalia of *Thyrocopa*. Top, *fraudentella* Walsingham, holotype (BM slide 4076); Kilauea, Hawaii. Bottom, *gigas* Walsingham, holotype (BM slide 4048); Haleakala, 4,000 feet, Maui.

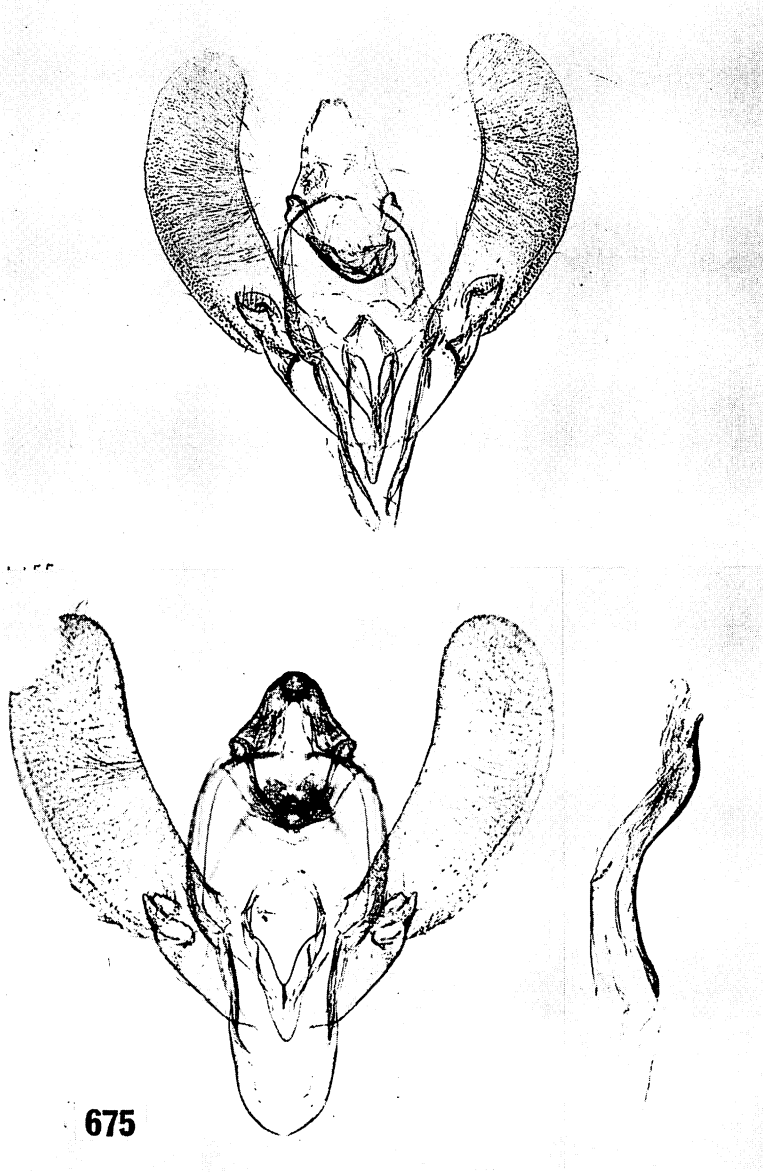


Figure 675—Male genitalia of *Thyrocopa*. Top, *immutata* Walsingham, holotype (BM slide 4155); aedeagus not photographed; Kaholuamano, 4,000 feet, Kauai. Bottom, *indecora* (Butler), holotype (BM slide 4050); Haleakala, 4,000 feet, Maui.

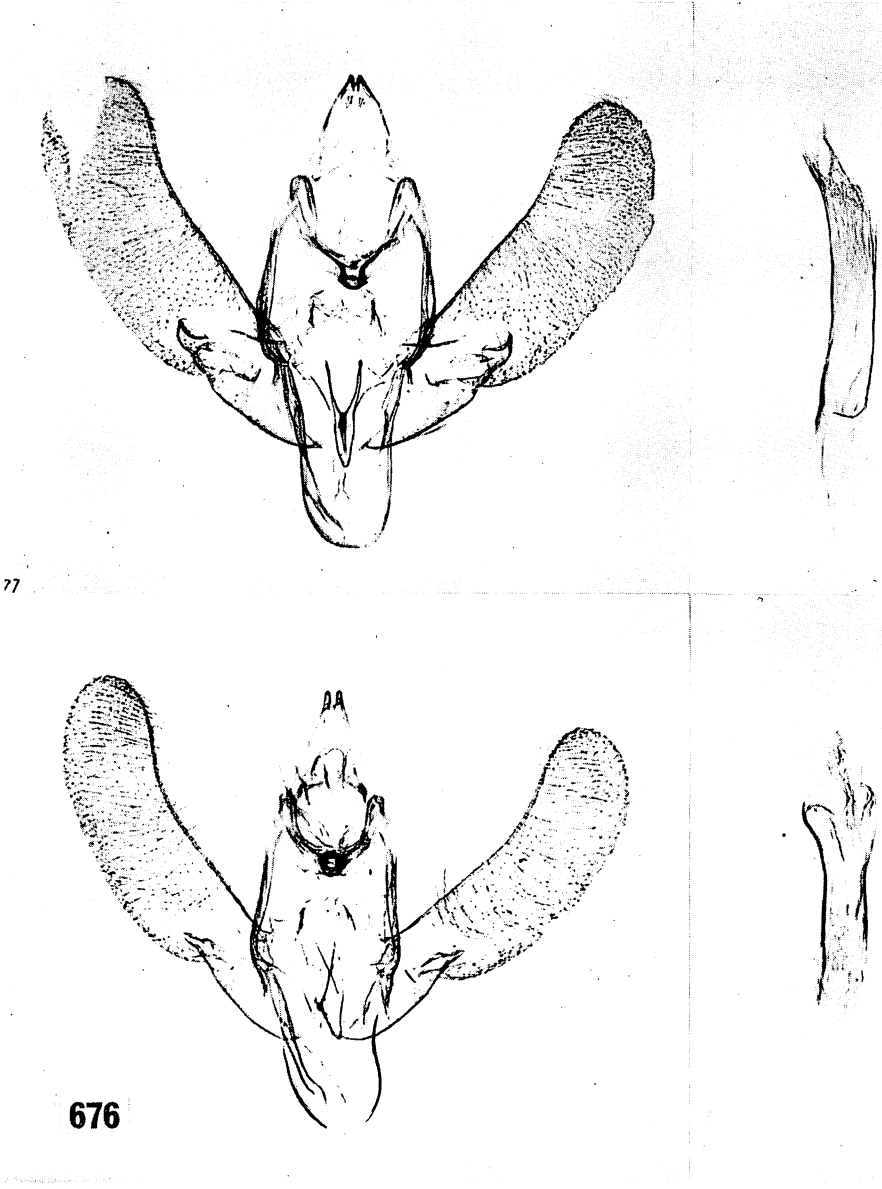


Figure 676—Male genitalia of *Thyrocopa*. Top, *inermis* Walsingham, holotype (BM slide 4077); Kona, 3,000 feet, Hawaii. Bottom, *leonina* Walsingham, holotype (BM slide 4078); Lanai, 2,000 feet.

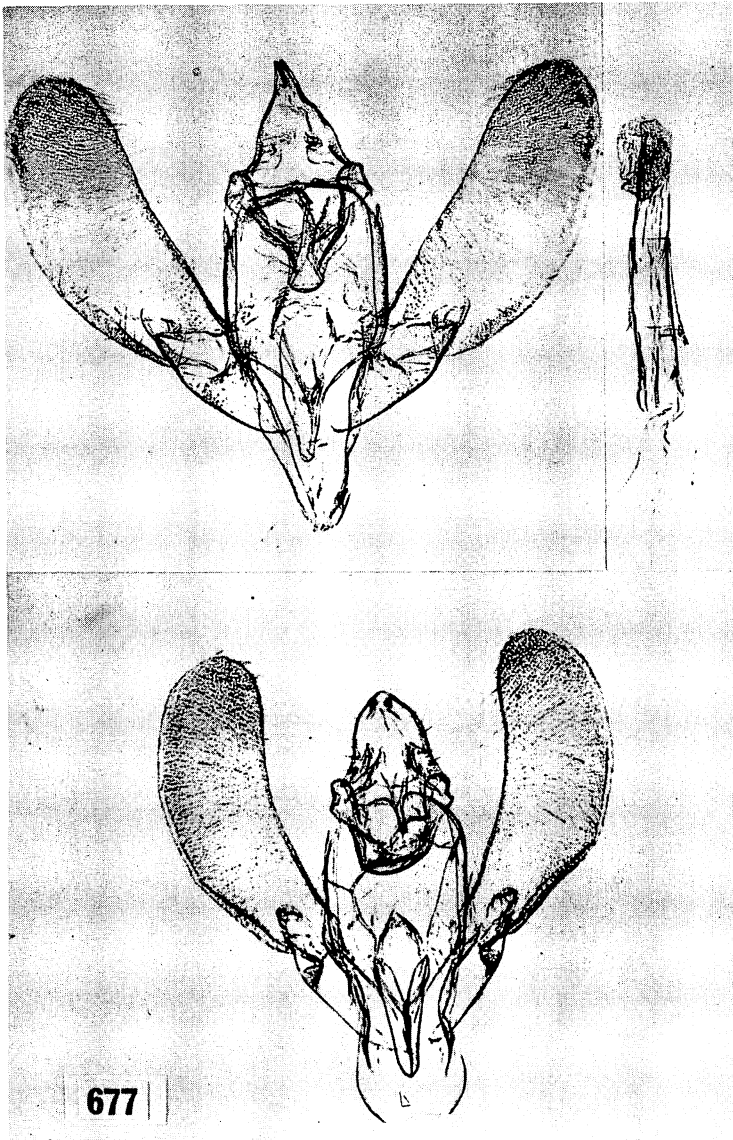


Figure 677—Male genitalia of *Thyrocopa*. Top, *megas* Walsingham, holotype (BM slide 4047); Haleakala, 5,000 feet Maui. Bottom, *nubifer* Walsingham, holotype (BM slide 4151); Kona, 4,000 feet, Hawaii; aedeagus not photographed.

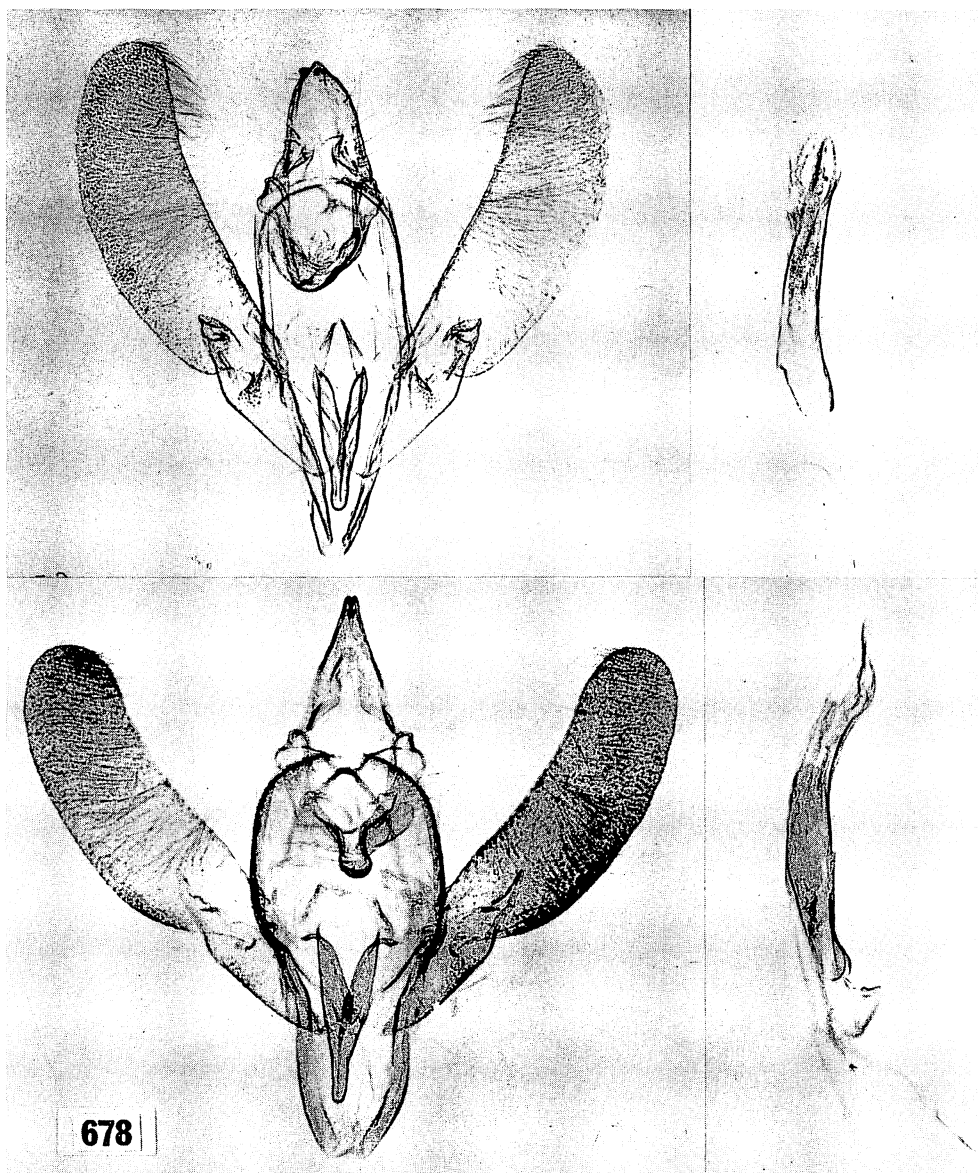


Figure 678—Male genitalia of *Thyrocopa*. Top, *pallida* Walsingham, holotype (BM slide 4152); Kaholua-mano, 4,000 feet, Kauai. Bottom, (*"Psychra"*) *phycidiformis* (Walsingham), holotype (BM slide 4159); Kauai, 3,000 to 4,000 feet.

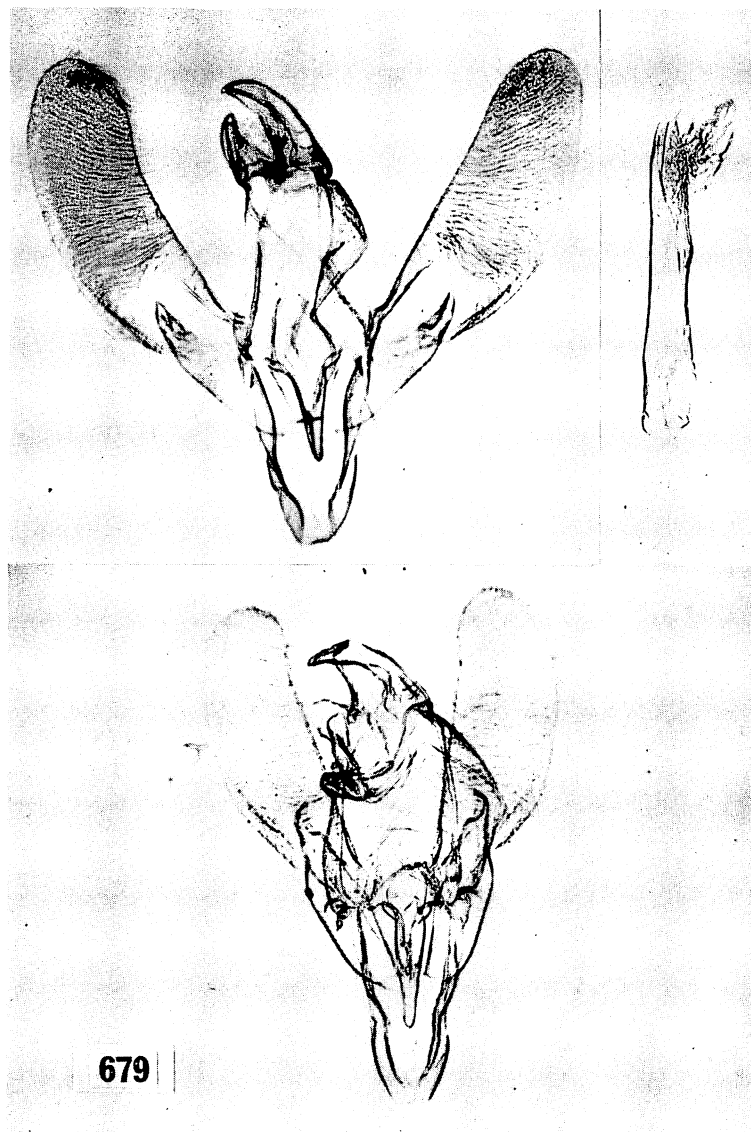


Figure 679—Male genitalia of *Thyrocopa*. Top, *pulverulenta* Walsingham, holotype (BM slide 4153). Bottom, *seminatella* Walsingham, holotype (BM slide 4156); Haleakala, 4,000 feet, Maui; aedeagus not photographed.



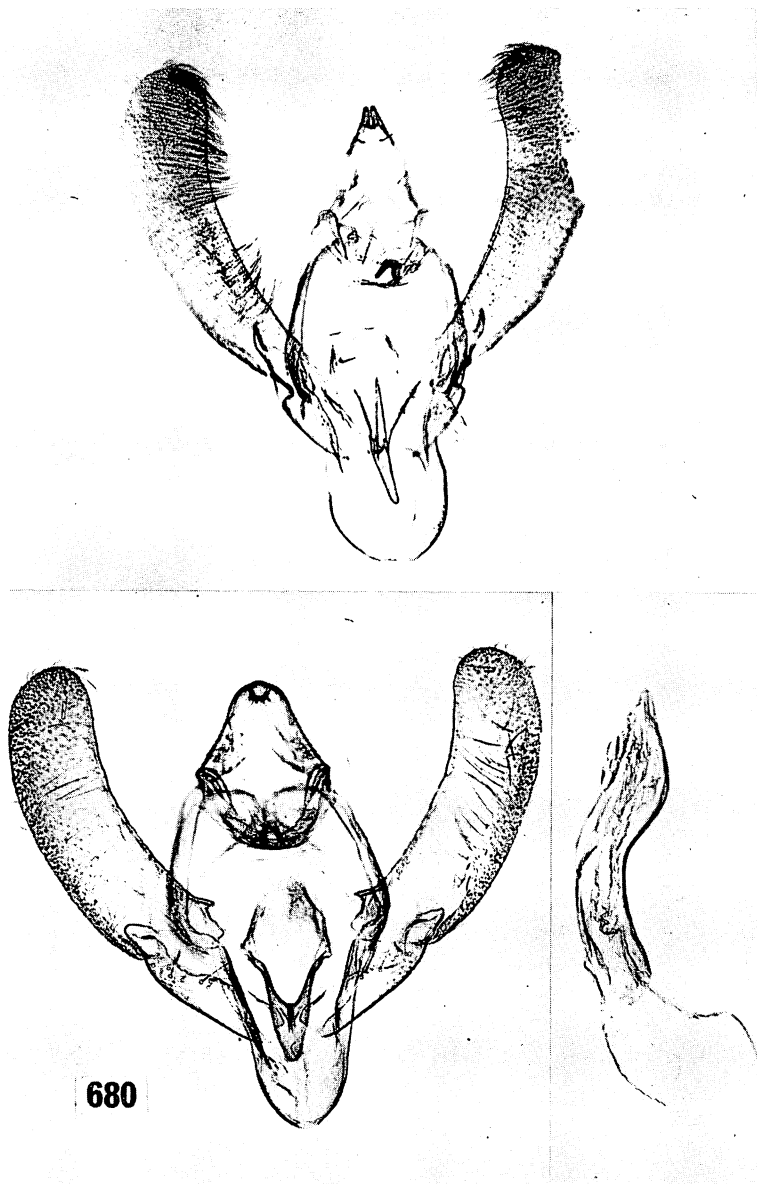
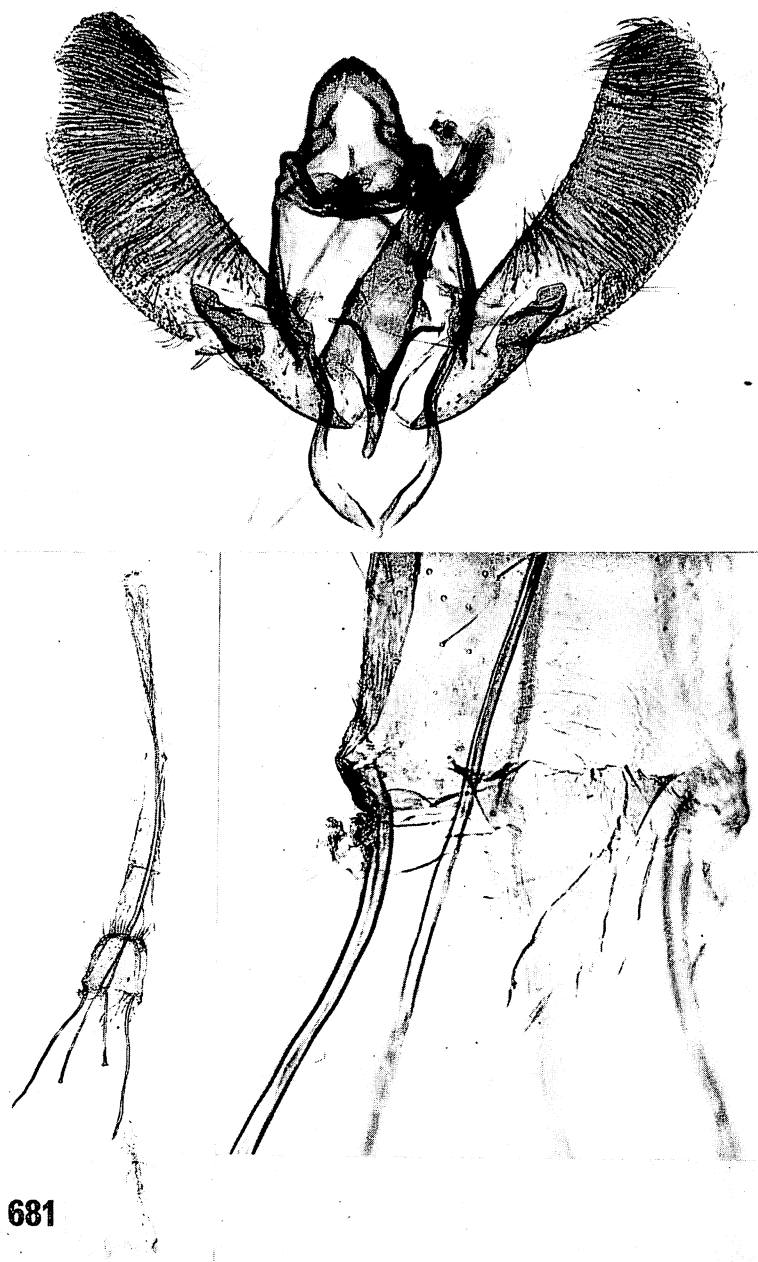


Figure 680—Male genitalia of *Thyrocopa*. Top, *subahenea* Walsingham, holotype (BM slide 4157); Molokai, 3,000 feet; aedeagus not photographed. Bottom, *tessellatella* Walsingham, holotype (BM slide 4051); Kona, 4,000 feet, Hawaii.



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Figure 681—Genitalia of *Thyrocopa*. Top, (*"Ptychothrix"*) *vagans* (Walsingham), holotype (BM slide 4176); aedeagus in situ; Halemanu, 4,000 feet, Kauai. Bottom, *adumbrata* Walsingham, holotype (BM slide 3942); Kona, 3,000 feet, Hawaii; the signum is long and tapelike.

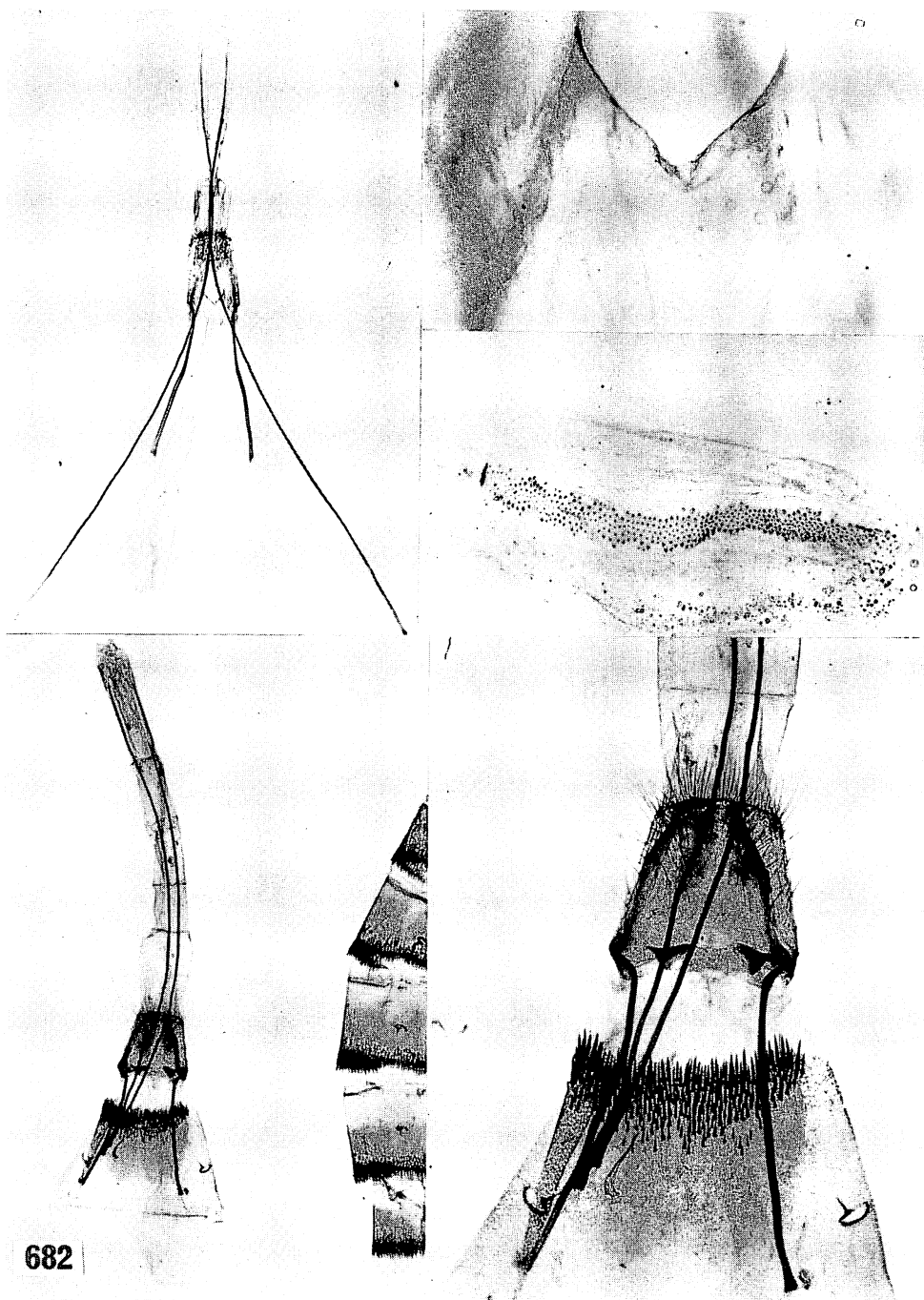


Figure 682—Female genitalia of *Thyrocopa*. Top, *acetosa* Meyrick, holotype (BM slide 9554 Clarke); Kauai ("Palmer .05"). Bottom ("Calamemopsis") *decipiens* (Walsingham), allotype (BM slide 3944); Oloa, Hawaii; the signum is long and tapelike. See also figure 685. Both photographic prints of *decipiens* have been reversed.

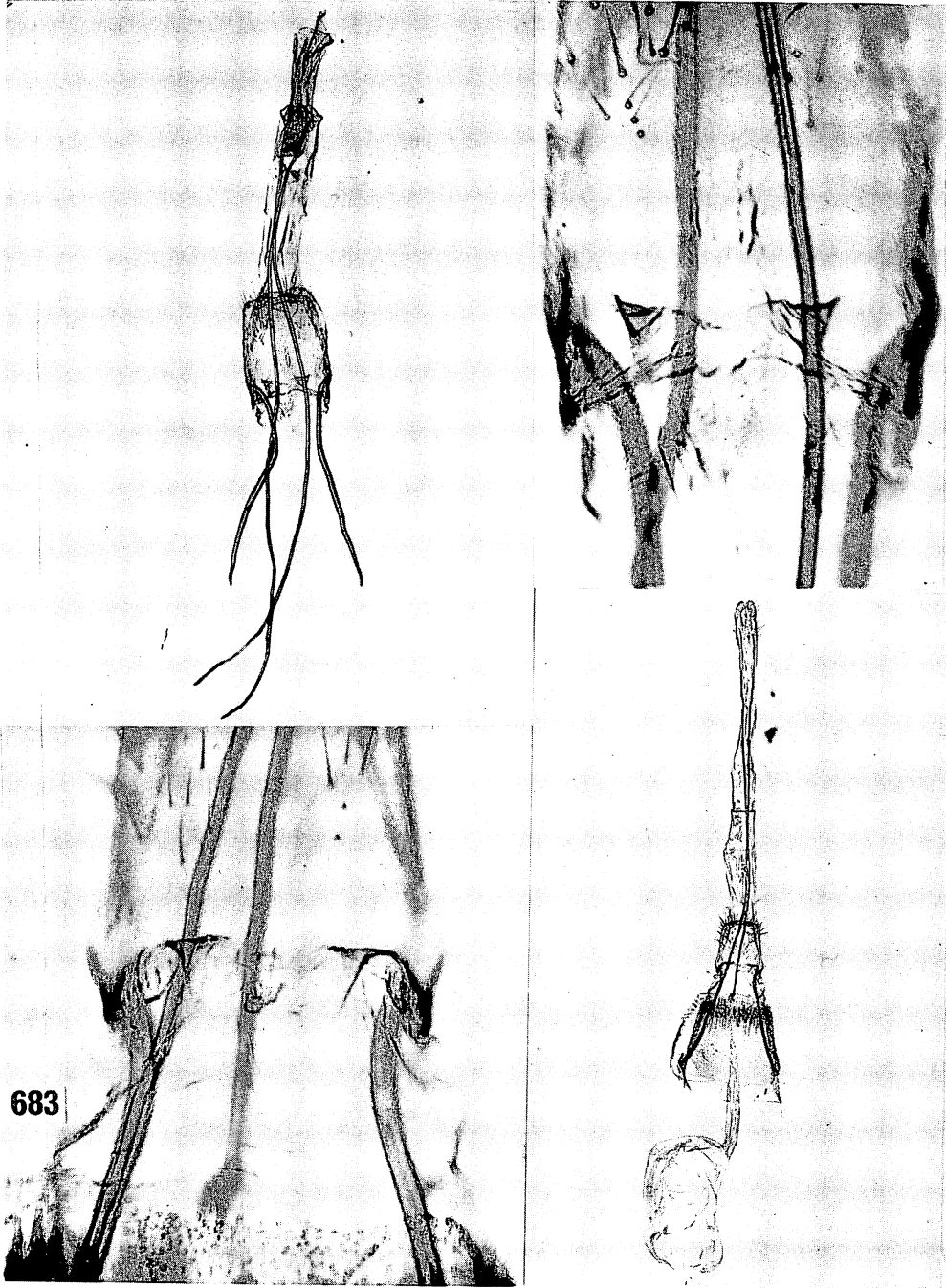


Figure 683—Female genitalia of *Thyrocopa*. Top, *argentea* (Butler), holotype (BM slide 4045); mountains near Honolulu. This specimen was erroneously labeled as being a male. The bursa is lost. Bottom, *geminipuncta* Walsingham, holotype (BM slide 3898); Molokai, 4,500 feet; the signum is long and tapelike.

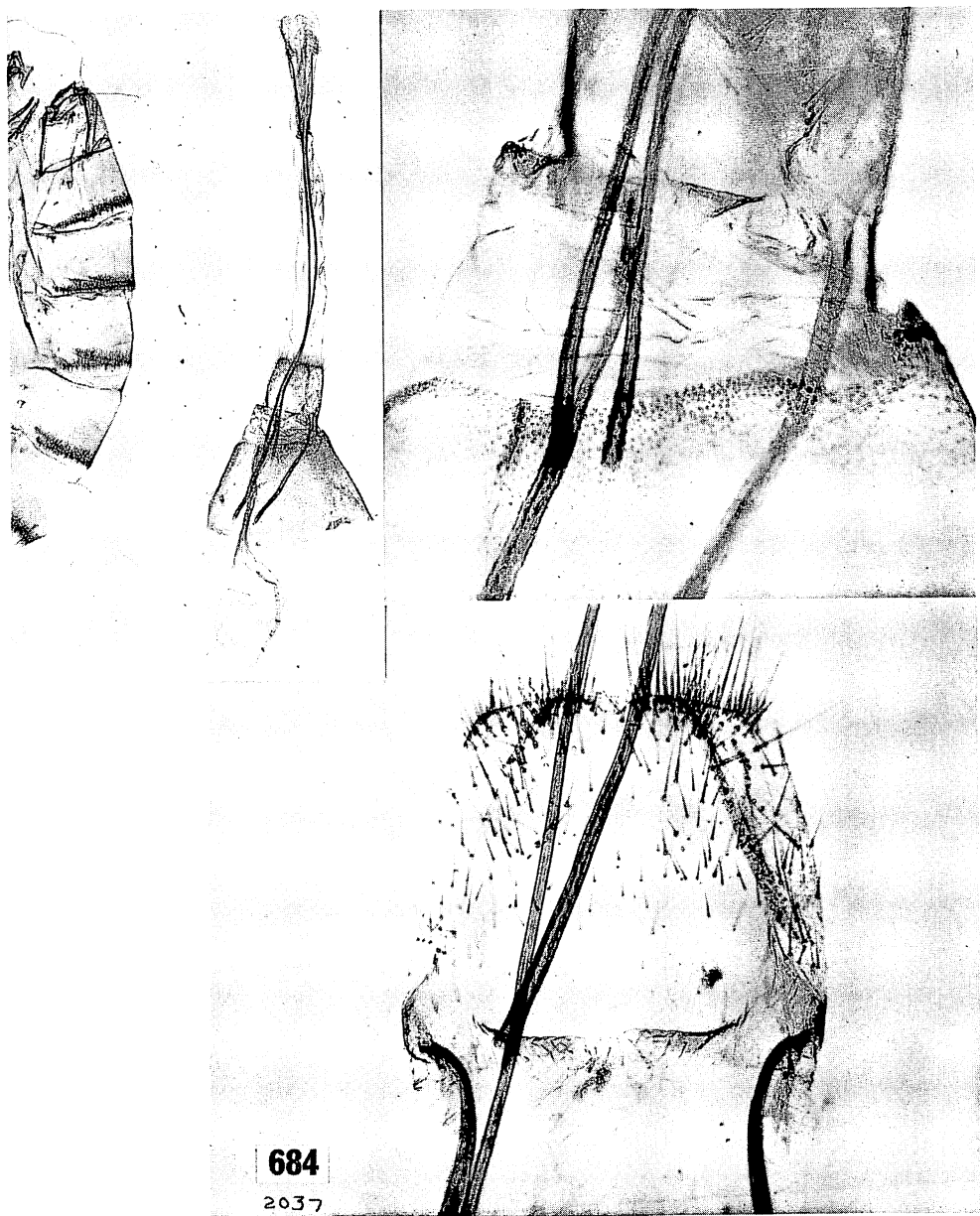


Figure 684—Female genitalia of *Thyrocopa cinerella* Walsingham. Top, holotype (BM slide 3943); Kauai, 3,000 to 4,000 feet; the ostium and surrounding area are partly folded. Bottom, a view of the ostium of another specimen (BM slide 2037); the signum is long and tapelike.

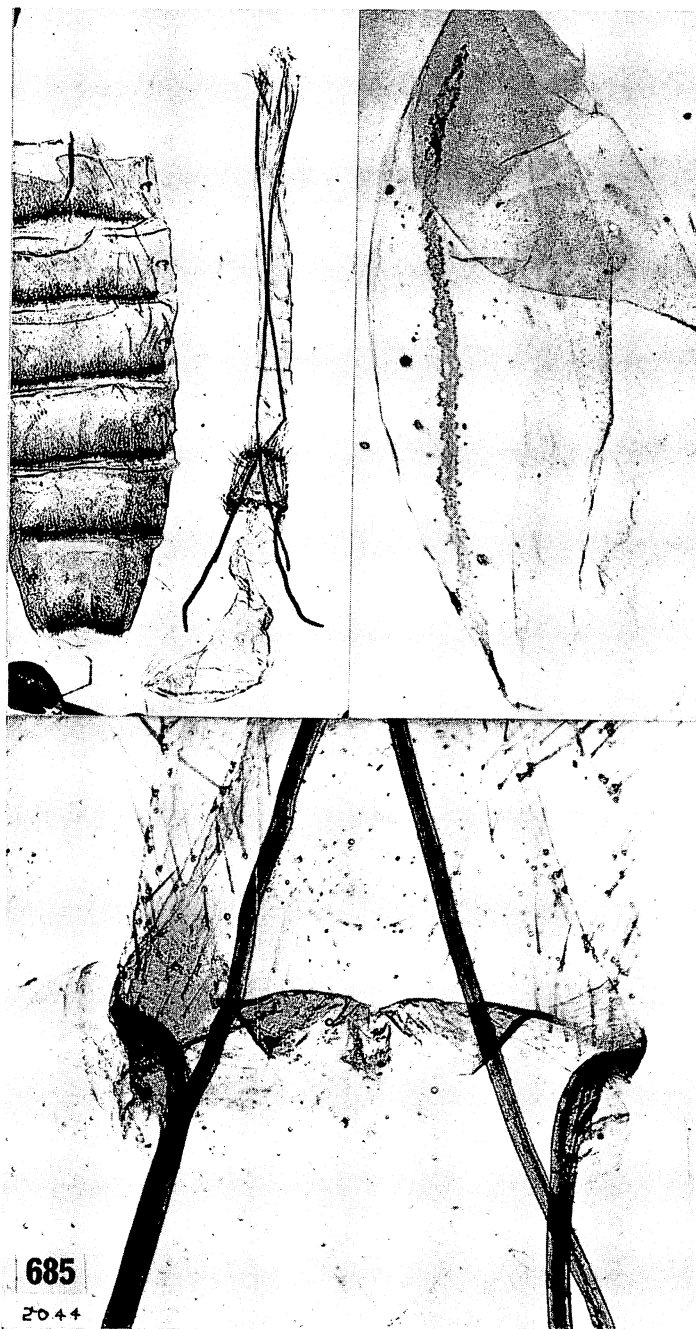
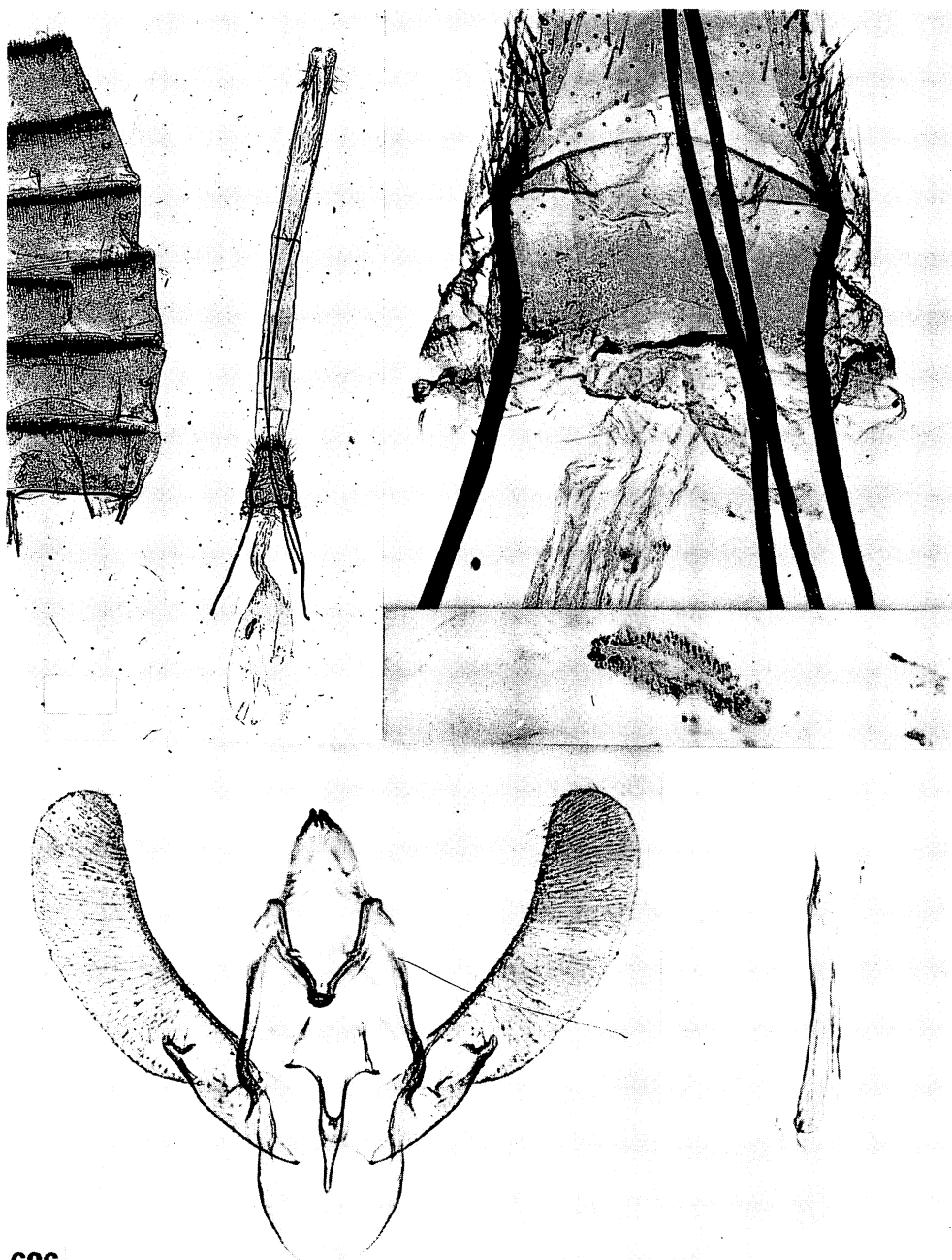


Figure 685—Female genitalia of *Thyrocopa* ("Catamempsis") *decipiens* (Walsingham), paratype (BM slide 2044); near head of Kaiwailoa Gulch, Oahu. Also see figure 682.



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Figure 686—Top three figures, female genitalia of *Thyrocopa gigas* (Butler); Waianae Mts., 2,500 to 3,000 feet, Oahu (BM slide 2036). Bottom, male genitalia of *Thyrocopa spilobathra* Meyrick, lectotype; Koolau Mts., Oahu (BM slide Clarke 9547).

**Thyrocopa argentea** (Butler) (figs. 654, moth; 683, female genitalia).

*Depressaria argentea* Butler, 1881:399.

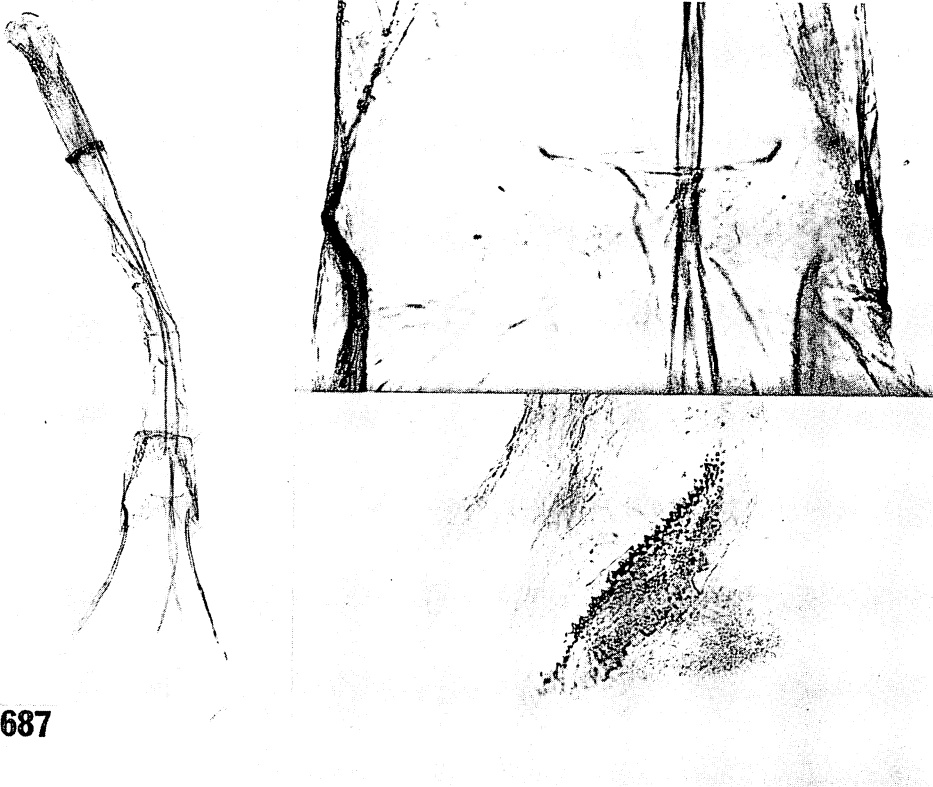
*Thyrocopa argentea* (Butler) Walsingham, 1907*b*:496, 733, pl. 14, fig. 12.

Endemic. Oahu (type locality: mountains near Honolulu), Hawaii.

Hostplants: *Acacia koa* (larvae often abundant in dead bark, twigs, and branches), *Rubus hawaiiensis*.

Walsingham said that the males expand "20-24"mm., but the female holotype (originally cited as a male) has an expanse of only about 14mm. Swezey (1910*e*:138, 1931*b*:502) misidentified this species as *albonubila*.

Text continued on page 984.



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Figure 687—Female genitalia of *Thyrocopa indecora* (Butler) from the holotype of the synonymous *lactea* (BM slide 3895); Haleakala, 4,000 feet, Maui.



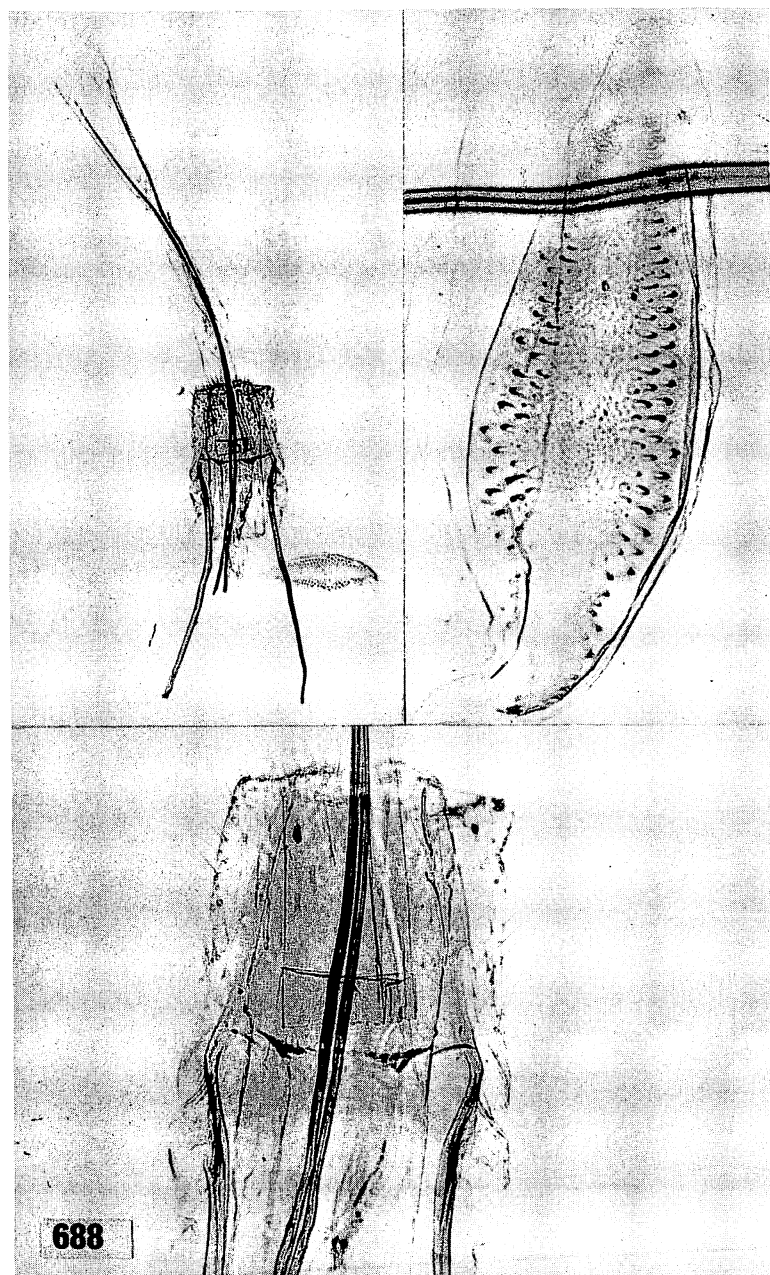


Figure 688—Female genitalia of *Thyrocopa ingeminata* Meyrick, lectotype (BM slide 9551, Clarke); Honolulu.

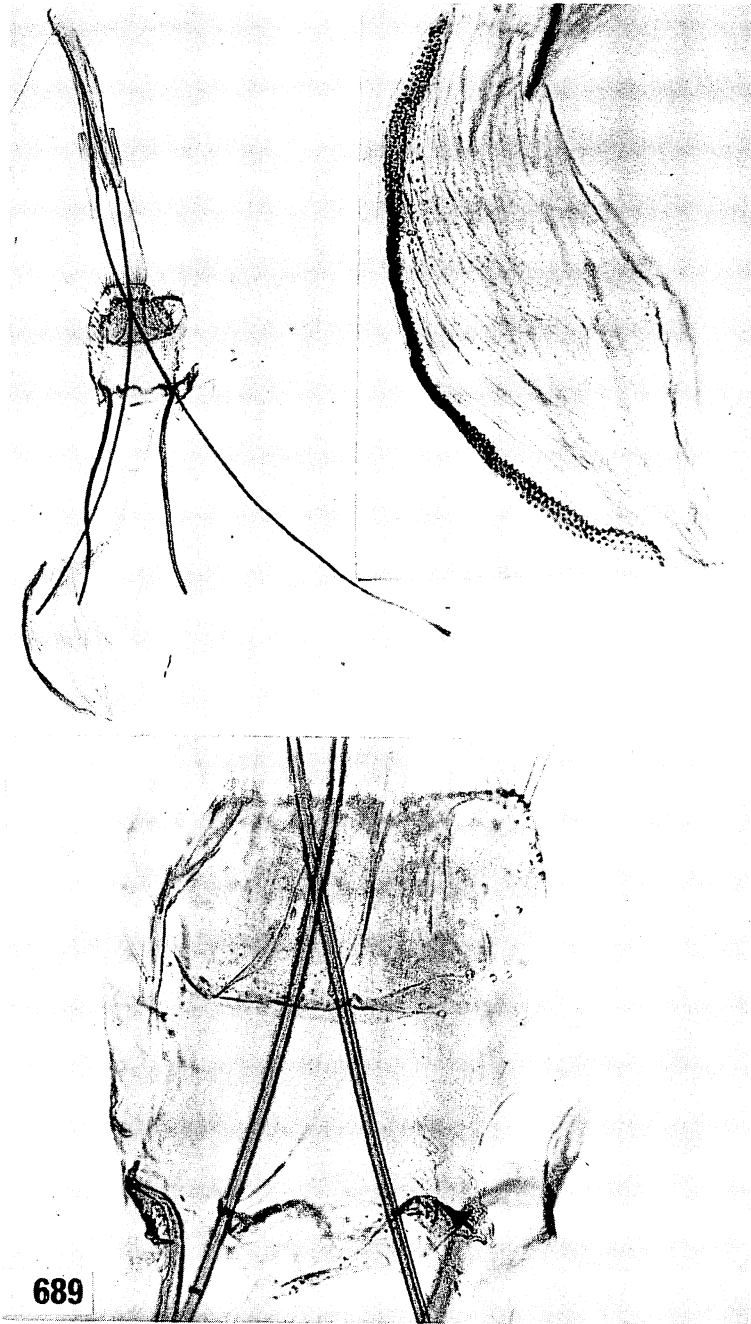
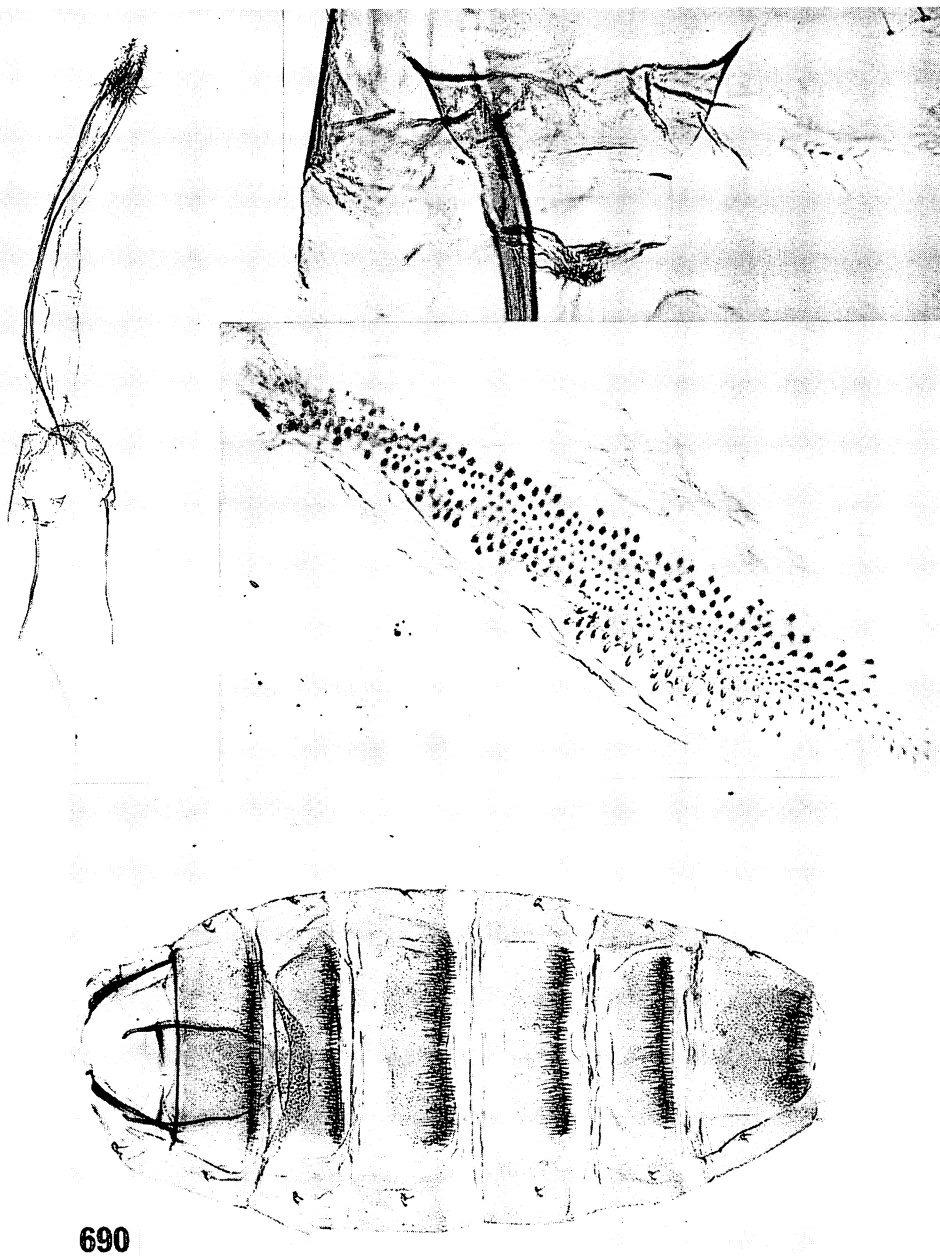


Figure 689—Female genitalia of *Thyrocopa librodes* Meyrick, holotype (BM slide 9555, Clarke); Kauai.



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Figure 690—Top three figures, female genitalia of *Thyrocopa mediomaculata* Walsingham, holotype (BM slide 3899); Haleakala Crater, Maui. Bottom, the abdominal pelt of the holotype of *sapindiella* Swezey; Niu, Oahu (slide Z-70-11).



Figure 691—Female genitalia of *Thyrocopa minor* Walsingham, holotype (BM slide 3946); Molokai, above 3,000 feet.

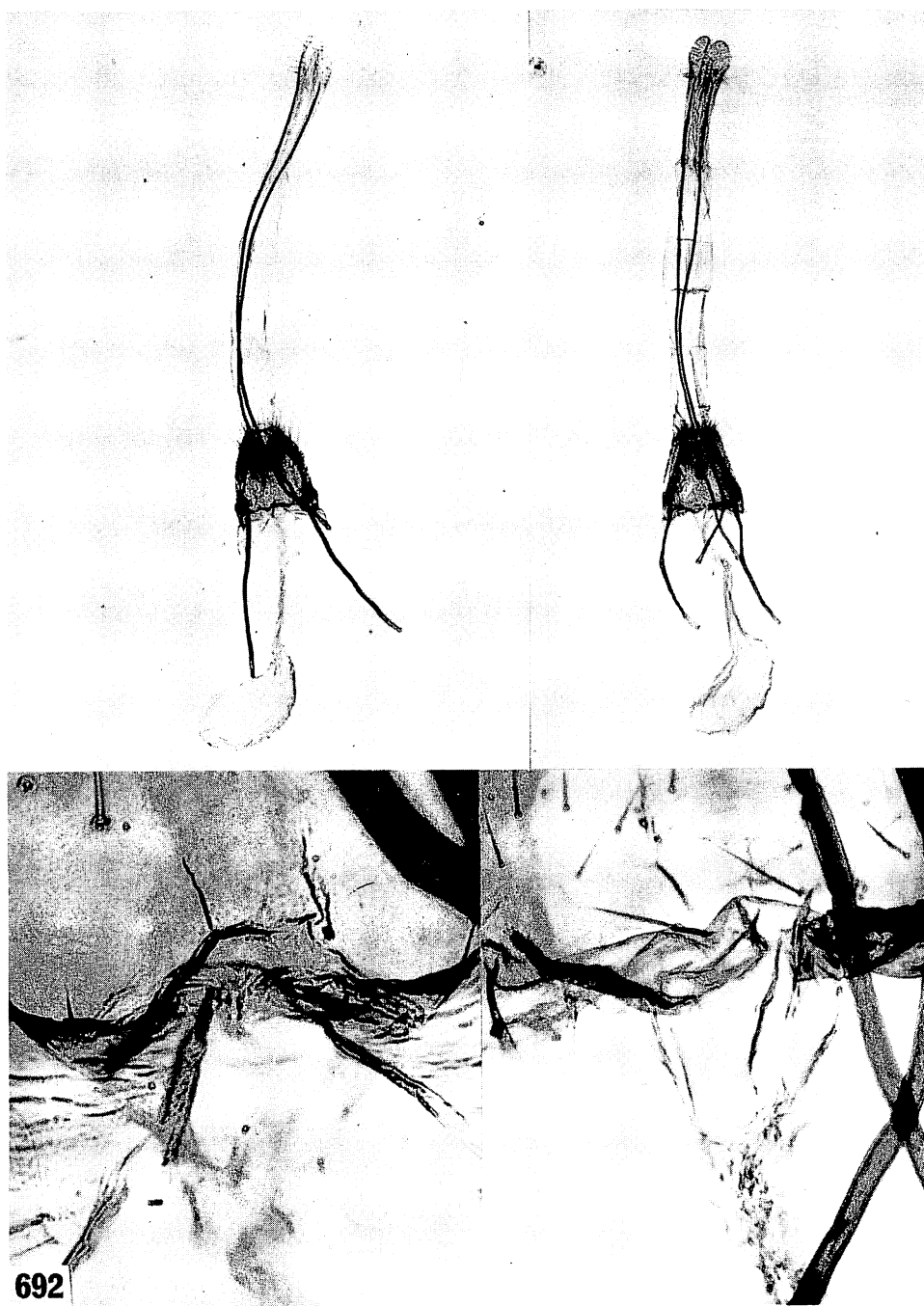


Figure 692—Female genitalia of two species of *Thyrocopa*. Left, top and bottom, *sapindiella* Swezey, holotype; Niu, Oahu (slide Z-70-11); see figure 690 for the abdominal pelt of this specimen. Right, top and bottom, *peleana* Swezey, holotype, Waipio, Oahu (slide Z-70-12). The ostia are enlarged in the bottom figures.



Figure 693—Female genitalia of *Thyrocopa* ("Psychra") *phycidiiformis* (Walsingham), paratype (BM slide 2046); Kauai, 3,000 to 4,000 feet. The enlargements of the ostium and the signum have been reversed.

**Thyrocopa brevipalpis** (Walsingham), **new combination** (figs. 651, moth; 672, male genitalia; col. pl. 4:7).

*Psychra brevipalpis* Walsingham, 1907*b*:490, pl. 14, fig. 5.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This species is known only from the male holotype. The terminal segment of the labial palpus is unusually short. It is the shortest of all species of the family now known in Hawaii.

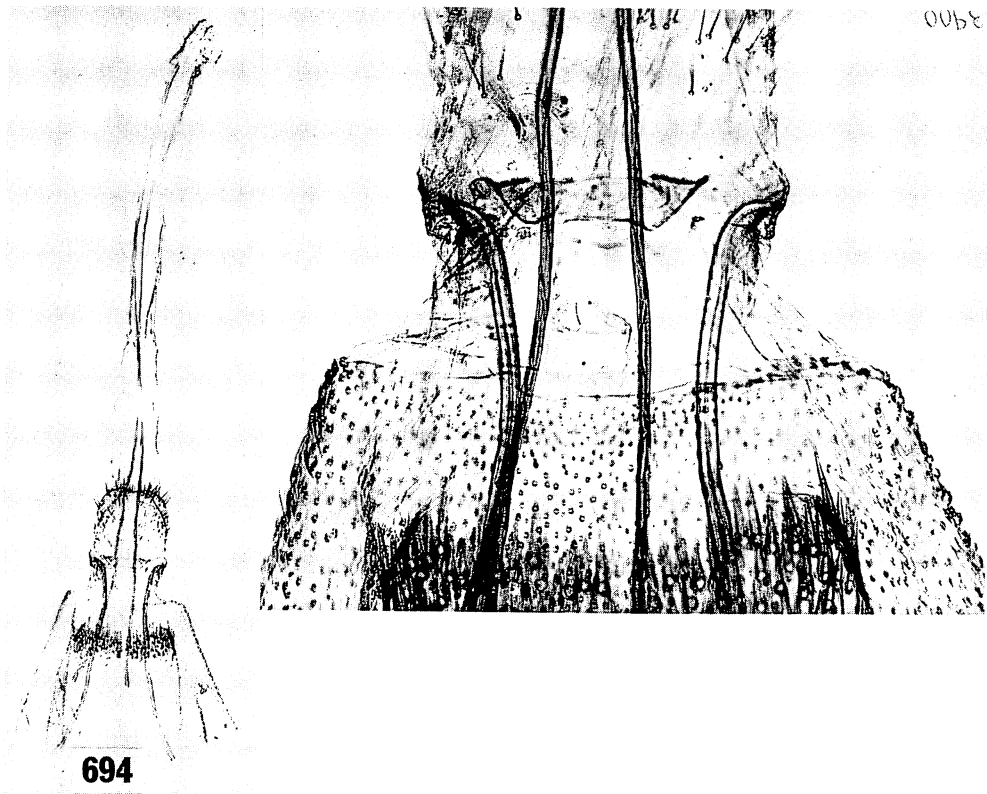


Figure 694—Female genitalia of *Thyrocopa usitata* (Butler), holotype (BM slide 3900); Oahu (probably near Honolulu); bursa copulatrix lost.

**Thyrocopa cinerella** Walsingham (figs. 655, moth; 684, female genitalia).

*Thyrocopa cinerella* Walsingham, 1907b:494, pl. 14, fig. 9.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The female holotype in the British Museum is very similar to *megas*, but the hindwings are darker. The left labial palpus is missing. The second segment of the right palpus (measuring along the chords of the segments) is 65 units long and the third segment 50 units as compared with 21 for the height of the eye.

**Thyrocopa criminosa** Meyrick (figs. 655, moth; 671, male genitalia).

*Thyrocopa criminosa* Meyrick, 1915a:372.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

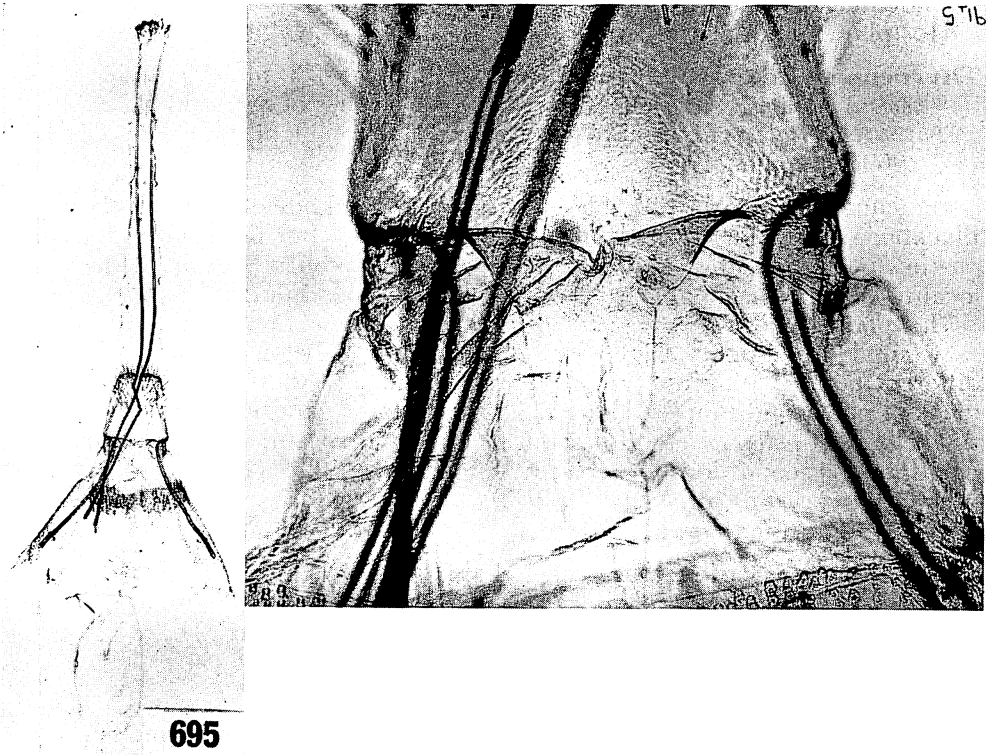


Figure 695—Female genitalia of *Thyrocopa viduella* Walsingham, holotype (BM slide 3945); Kauai, 3,000 to 4,000 feet; the signum is long and tapelike.



**Thyrocopa decipiens** (Walsingham), **new combination** (figs. 648, head, antenna, wing venation; 656, moth; 682, 685, female genitalia).

*Catamempsis decipiens* Walsingham, 1907*b*:491, pl. 14, fig. 6. Type-species of *Catamempsis*.

Endemic. Oahu, Molokai, Hawaii (type locality: Oloa, 2,000 feet).

Hostplant: *Freyinetia arborea*.

The caterpillars of this gelechiid moth feed in the tips of branches, eating the leaves of the unexpanded spindle. There may be a dozen or more feeding somewhat gregariously, and they produce a filthy condition in which such scavenger insects as nitidulid beetles may be found. They do not eat the terminal bud, however, so the growth of the branch continues, but is unsightly from the ragged appearance of the leaves when they have expanded after the caterpillars have finished their eating. The fullgrown caterpillar is about 25 mm., and the moth has a spread of about 40 mm. It is pale brown with a few black markings on forewing. It is seldom seen, but the caterpillars are often found, and the evidence of their work is commonly seen when one has become acquainted with the appearance of the injured leaves. It is known on Oahu, Molokai, and Hawaii. It probably occurs on the other islands as well. (Swezey, 1936*a*:191-192.)

**Thyrocopa depressariella** Walsingham (figs. 655, moth; 672, male genitalia).

*Thyrocopa depressariella* Walsingham, 1907*b*:498, pl. 14, fig. 17.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Thyrocopa epicapna** (Meyrick) (figs. 657, moth; 673, male genitalia).

*Synomotis epicapna* Meyrick, 1883*a*:33. Type-species of *Synomotis*.

*Thyrocopa epicapna* (Meyrick) Walsingham, 1907*b*:500, pl. 14, fig. 21. Clarke, 1969*b*:480, pl. 240.

Endemic. Kauai, Hawaii. The type locality is unknown. Meyrick had two Blackburn examples when he described the species, but no locality data are on the specimens other than "Hawaii, 1899, Blackburn". Perhaps the type locality is on neither Kauai nor Hawaii; it might be Oahu.

Hostplant: unknown.

A female abdomen was glued to the type, but it belongs to a species of a different family! Walsingham (1907*b*:501) said that there were "four specimens in poor condition" in the Blackburn material, and he said, "Perhaps a small form of *pulverulenta* Wlsm., but the original specimens are not in sufficiently good condition for critical comparison. The Kauai and Hawaii specimens vary but appear to be *epicapna* Meyr.; more material is however required to decide this with certainty."

**Thyrocopa fraudulentella** Walsingham (figs. 657, moth; 674, male genitalia).

*Thyrocopa fraudulentella* Walsingham, 1907*b*:502, pl. 14, fig. 24.

Endemic. Maui, Hawaii (type locality: Kilauea).

Hostplant: unknown.

Swezey (1910*e*:138) reported finding the larvae in silken tunnels in and beneath dried cow dung, but in later years he questioned his determination.

**Thyrocopa geminipuncta** Walsingham (figs. 658, moth; 683, female genitalia).

*Thyrocopa* (?) *geminipuncta* Walsingham, 1907*b*:506, pl. 15, fig. 4.

Endemic. Molokai (type locality: 4,500 feet).

Hostplant: unknown.

Walsingham felt uncertain as to which of his "genera" to assign this species because he described it from a unique female.

**Thyrocopa gigas** (Butler) (figs. 658, moth; 674, male genitalia; 686, female genitalia).

*Depressaria gigas* Butler, 1881:397. Meyrick, 1883*a*:32.

*Thyrocopa gigas* (Butler) Walsingham, 1907*b*:493, pl. 14, fig. 7.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: "Three specimens taken; one was at sugar, the other two at light; all at about 4000 feet up Haleakala, Maui." Blackburn).

Hostplant: unknown.

The Blackburn reference to this species having been taken at sugar bait is one of the very few such references in Hawaiian entomology.

**Thyrocopa immutata** Walsingham (figs. 658, moth; 675, male genitalia).

*Thyrocopa immutata* Walsingham, 1907*b*:501, pl. 14, fig. 23.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

I have not seen the female.

**Thyrocopa indecora** (Butler) (figs. 653, 659, moth; 675, male genitalia; 687, female genitalia; col. pl. 5:1).

*Depressaria indecora* Butler, 1881:397.

*Depressaria lactea* Butler, 1881:398. Synonymy by Meyrick, 1883*a*:32, who noted that *lactea* was the female and *indecora* the male of the same species.

The same field data apply to both names.

*Thyrocopa indecora* (Butler) Walsingham, 1907*b*:497, pl. 14, fig. 14.

Endemic. Maui (type locality: Haleakala, 4,000 feet, bred from rotten wood), Hawaii.

Hostplants: *Acacia koa* (in rotten bark), *Sophora*.

**Thyrocopa inermis** Walsingham (figs. 659, moth; 676, male genitalia).

*Thyrocopa inermis* Walsingham, 1907*b*:503, pl. 14, fig. 27.

Endemic. Hawaii (type locality: Kona, 3,000 feet).

Hostplant: unknown.

**Thyrocopa ingeminata** Meyrick (figs. 659, moth; 688, female genitalia).

*Thyrocopa ingeminata* Meyrick, 1915*a*:371.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

**Thyrocopa leonina** Walsingham (figs. 660, moth; 676, male genitalia).

*Thyrocopa leonina* Walsingham, 1907*b*:505, pl. 15, fig. 3.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

Known only from the male holotype.

**Thyrocopa librodes** Meyrick (figs. 660, moth; 689, female genitalia).

*Thyrocopa librodes* Meyrick, 1915*a*:370.

Endemic. Kauai (type locality: not further known).

Hostplant: unknown.

**Thyrocopa mediomaculata** Walsingham (figs. 660, moth; 690, female genitalia).

*Thyrocopa* (?) *mediomaculata* Walsingham, 1907*b*:506, pl. 15, fig. 5.

Endemic. Maui (type locality: Haleakala Crater), Hawaii?

Hostplant: unknown.

Walsingham questioned the generic assignment of this species. He said (1907*b*:506): "It is probable that a new genus is indicated by this specimen, but in the absence of the [male] this cannot be determined. The hindwings are narrower than in the typical forms of *Thyrocopa*, and in the forewings veins 7 and 8 are stalked for the greater part of their length. A [female] from Kona (28685) without a head and in very poor condition probably belongs to this species." I do not believe that this species can be separated from *Thyrocopa*. Only the female is known.

**Thyrocopa megas** Walsingham (figs. 661, moth; 677, male genitalia).

*Thyrocopa megas* Walsingham, 1907*b*:495, pl. 14, fig. 10.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

I made the following measurements of the allotype female in the British Museum: second segment of labial palpus 45 units, third segment 35 units, height of eye 20 units.

**Thyrocopa minor** Walsingham (figs. 661, moth; 691, female genitalia).

*Thyrocopa* (?) *minor* Walsingham, 1907*b*:496, pl. 14, fig. 13.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Walsingham inserted the question mark in the name of this species because he knew only the female holotype, and thus he could not determine to which of his "genera" he should assign the species.

**Thyrocopa nubifer** Walsingham (figs. 661, moth; 677, male genitalia).

*Thyrocopa nubifer* Walsingham, 1907*b*:499, pl. 14, fig. 18.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

**Thyrocopa pallida** Walsingham (figs. 662, moth; 678, male genitalia).

*Thyrocopa pallida* Walsingham, 1907*b*:502, 733, pl. 14, fig. 25.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Oahu, Molokai.

Hostplant: unknown.

**Thyrocopa peleana** Swezey (figs. 662, moth; 649, pupa; 692, female genitalia).

*Thyrocopa peleana* Swezey, 1932:200, pl. 13, fig. 3.

Endemic. Oahu (type locality: Waipio Ridge).

Hostplant: *Pelea*.

Dr. Swezey bred the species from burrows of the native cerambycid *Nesithmysus bridwelli* Perkins. "The larvae feed on decaying wood in the burrows, and also on the bark around the entrance, spinning a sheet of web to cover the place where feeding has taken place." (Swezey, 1932:200.)

**Thyrocopa phycidiformis** (Walsingham), **new combination** (figs. 647, head, wing venation; 663, moth; 667, 678, male genitalia; 693, female genitalia).

*Psychra phycidiformis* Walsingham, 1907*b*:490, pl. 14, fig. 4. Type-species of *Psychra*.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

As explained in the discussion of the genus above, I do not consider that this species should be removed from *Thyrocopa*.

**Thyrocopa pulverulenta** Walsingham (figs. 662, moth; 679, male genitalia).

*Thyrocopa pulverulenta* Walsingham, 1907*b*:500, pl. 14, fig. 20.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

The records by Dr. Swezey (1910*e*:138) "larvae in base of grass tufts, also in rotten wood" may be based upon misidentifications.

I have not seen a female.

**Thyrocopa sapindiella** Swezey (figs. 664, moth; 649, pupa; 690, abdominal pelt; 692, female genitalia).

*Thyrocopa sapindiella* Swezey, 1913*f*:274.

Endemic. Oahu (type locality: Niu).

Hostplants: *Abutilon*, *Sapindus oahuensis*.

Parasite: *Agathis hawaiiicola* (Ashmead).

The caterpillars feed upon leaves. Dr. Swezey (1913:274–275) made the following observations:

An egg-mass was found on the upper surface of a leaf beside the midrib near base. It contained 25 eggs, each one pale yellowish, roundish, about 1 mm. in longest diameter, finely reticulated, flat and overlapping shingle-like similarly to the eggs of *Omiodes*. [I question these details. See the note at the end of the quotation below.]

The caterpillars were quite numerous on some trees. The small ones feed on the under surface of the leaves, each producing a web covered with frass under which it feeds, eating off the surface of the leaf. The larger ones hide in rolled-together leaves, often several leaves in a bunch fastened together and there may be two or more caterpillars, each in a silken tunnel.

Small caterpillars are yellowish or pale green, with two lateral fuscous lines; cervical shield with black lateral margins and black dorsal spots; head with two black spots in front and lateral blackish markings, eyes black. Full-grown caterpillar about 30 mm.; pale yellowish with pale brown markings; most of surface above spiracles more or less brownish; head pale yellowish brown with some darker markings on sides and vertex, eyes black, several black dots in middle in front; cervical shield pale yellowish with several blackish dots dorsally, and two black spots longitudinally placed near each lateral margin; tubercles "i" [D1] and "ii" [D2] in direct longitudinal line slightly infuscated, "iii" [SD1] a little above spiracles each with a dark fuscous ring; setae pale; spiracles black, slightly oval.

Pupa 9 mm. Medium brown, darker dorsally; tips of wing sheaths and antenna-sheaths extend a little beyond apex of fourth abdominal segment; a low slightly serrated ridge at apical dorsal margin of metathorax and on abdominal segments; a somewhat interrupted median dorsal ridge on segments 1-4; minute longitudinal ridges on dorsum of abdominal segments, more or less reticulate on the anterior ones; thorax reticulated, somewhat transversely; cremaster with two ventrally curved spines, a minute one near base of each. The pupa is formed within the spun-together leaves where the caterpillar fed.

I believe that it is highly probable that the eggs described for this species by Dr. Swezey in the above account did not belong to this species or to this genus. It was not stated that larvae and moths were reared from the eggs, and I believe that an error in determination was made.

**Thyrocopa seminatella** Walsingham (figs. 664, moth; 679, male genitalia).

*Thyrocopa seminatella* Walsingham, 1907*b*:499, pl. 14, fig. 19.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

**Thyrocopa spilobathra** Meyrick (figs. 664, moth; 686, male genitalia).

*Thyrocopa spilobathra* Meyrick, 1915*a*:372.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

**Thyrocopa subahenea** Walsingham (figs. 665, moth; 680, male genitalia).

*Thyrocopa subahenea* Walsingham, 1907*b*:505, pl. 15, fig. 2.

Endemic. Molokai (type locality: 3,000 feet).

Hostplant: unknown.

**Thyrocopa sucosa** Meyrick (figs. 665, moth; 673, male genitalia).

*Thyrocopa sucosa* Meyrick, 1915*a*:371.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplants: unknown.

**Thyrocopa tessellatella** Walsingham (figs. 665, moth; 680, male genitalia).

*Thyrocopa tessellatella* Walsingham, 1907*b*:498, pl. 14, fig. 16.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

I have not seen the female.

**Thyrocopa usitata** (Butler) (figs. 666, moth; 694, female genitalia).

*Depressaria usitata* Butler, 1881:396.

*Thyrocopa usitata* (Butler) Meyrick, 1883a:33, but error in identification; see *abusa* Walsingham, 1907b:504, 733, pl. 14, fig. 28.

Endemic. Kauai, Oahu (type locality: "probably near Honolulu", Butler), Hawaii.

Hostplant: unknown.

**Thyrocopa vagans** (Walsingham), **new combination** (figs. 646, head, wing venation; 651, moth; 681, male genitalia).

*Ptychothrix vagans* Walsingham, 1907b:489, pl. 14, fig. 3. Type-species of *Ptychothrix*.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

This species is known only from the male holotype which has conspicuously bipectinate antennae. As I stated in the discussion of this genus above, I do not consider that the secondary sexual characters used by Walsingham to elevate this single example to generic status are of generic value. Therefore, I have placed *Ptychothrix* in synonymy.

**Thyrocopa viduella** Walsingham (figs. 666, moth; 695, female genitalia).

*Thyrocopa* (?) *viduella* Walsingham, 1907b:494, pl. 14, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham considered this an unusual species, and he questioned its generic assignment. His conclusion was based on knowledge of only one female.

Subfamily **BLASTOBASINAE** (Walsingham), **new status**

*Blastobasinae* Walsingham, 1894:538, 546, of Tineidae.

*Blastobasidae*: Meyrick, 1894:22, name used without description. Walsingham, 1907a:199, key to genera; 1912 (1909–1915): 148. Walsingham and Durrant, 1909:46. Busck, 1908:187. Hampson, 1919:386.

*Butalinae* Walsingham, 1890: 148; 1891:122, of Tineidae.

Dietz, 1910:1, expanded description; revision of the Blastobasidae of North America.

There appears to be no valid reason for treating the blastobasids as a family distinct from the Gelechiidae. I consider them to be entitled to not more than subfamily rank.

The abdominal tergites on the blastobasids have *transverse*, caudal bands of spines that recall the abdominal features of the Xyloryctinae and Oecophorinae. This is an unusual character in the Hawaiian fauna. The spines are easily seen on dried specimens, but may be accidentally removed during the cleaning process when preparing an abdominal skin for mounting on a microscope slide. If the spines are removed, the coarse, peculiar, spinelike sockets remain in conspicuous bands across the tergites and are unmistakable (figure 699).

Genus **BLASTOBASIS** Zeller

*Blastobasis* Zeller, 1855:171. Walsingham and Durrant, 1909:47. Type-species: *Oecophora phycidella* Zeller, 1839. (Fig. 697, wing venation, male genitalia.)

The genus *Blastobasis* is thought to be almost cosmopolitan in distribution and includes a complex of many species.

**Blastobasis inana** (Butler) (figs. 105*a*, antenna; 696, head, wing venation; 698, moth, male, female genitalia; 699, abdomen, male genitalia; 700, female genitalia).

*Gracilaria inana* Butler, 1881:404.

*Blastobasis inana* (Butler) Walsingham, 1907*b*:648, pl. 25, fig. 3.

*Blastobasis explorata* Meyrick, 1918:158 (type locality: Pusa, Bengal, India).

**New synonym.**

Oahu (type locality: Honolulu), Lanai, Hawaii, and probably the other main islands.

Immigrant. Known previously only from Hawaii, it is a widely dispersed species whose distribution largely remains to be determined. We can now report it from various localities in India and from New Britain (new records). It is possible that several species names will prove synonymous when members of this group are studied in detail. Its scavenger habits have made possible its dispersal by commerce, and it must have been carried far and wide since the days of sailing ships. It is one of the earliest known foreign moths to be recorded in Hawaii.

Hostplants: garden beans, coffee berries, dead sugarcane, *Dioscorea* (yam).

Few records of this moth are known in Hawaii. However, it was commonly taken in Honolulu and in the Pearl Harbor area in light traps when they were placed in operation during the Second World War. An effort should be made to discover more about its habits. I identified specimens reared by W. C.

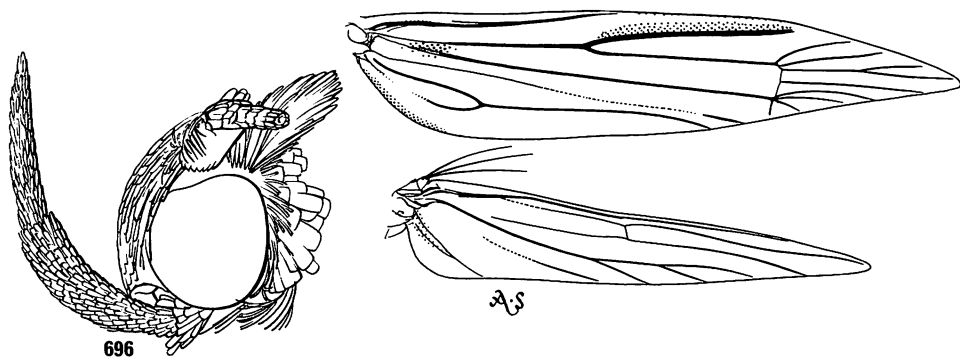


Figure 696—Head and wing venation of *Blastobasis inana* (Butler). Head from specimen from the Koolau Mts., Oahu; Meyrick collection. Wings (BM slide 3940) from the holotype.

Mitchell from fallen coffee berries collected at Kona, Hawaii, in 1964, and the new record from New Britain is based upon material reared from garlic at Rabaul.

This is an obscure, rather mouse-colored species with two small black spots along the middle line of each forewing. The scaling on the anterior part of the thorax is darker, almost black, and contrasts with the mostly pale, tan or cream-colored, scaling of the head. The scales on the front of the head are

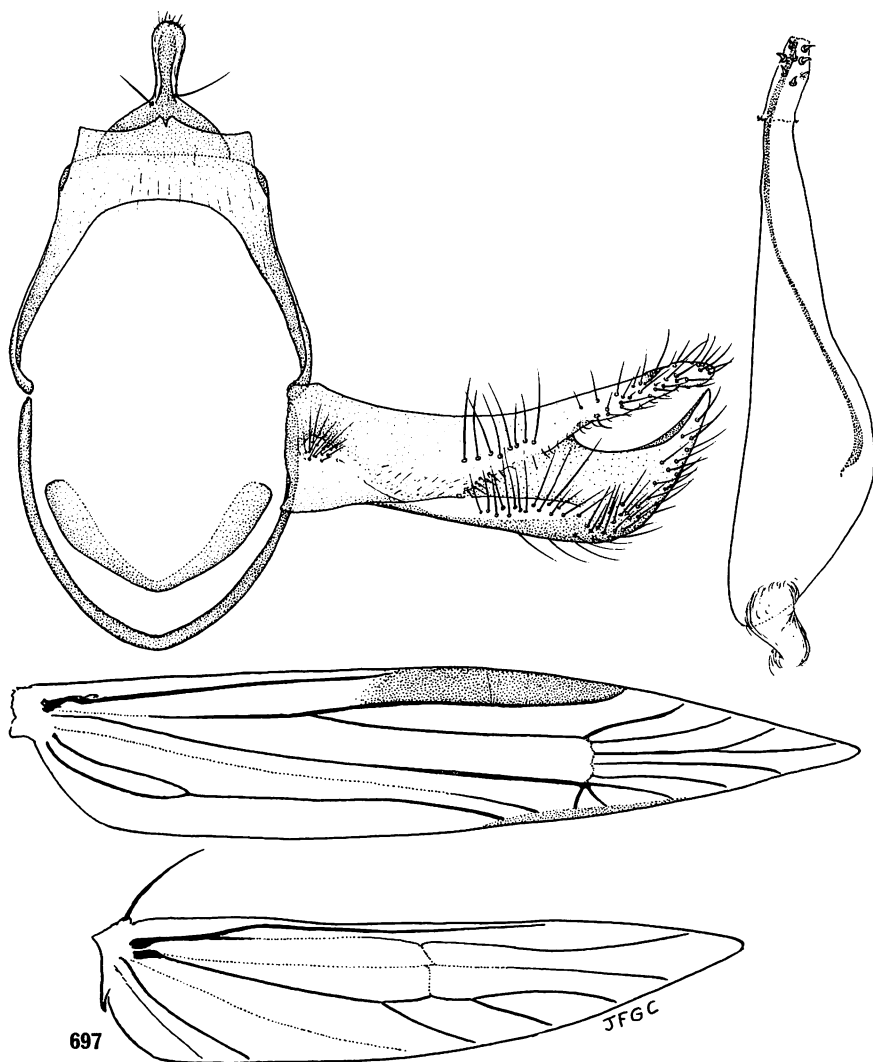


Figure 697—*Blastobasis*. Male genitalia and wing venation of *phycidella* (Zeller), the type-species of *Blastobasis*.



large and broad and lie smoothly forward. The first antennal segment is enlarged, flattened, slightly concave beneath and has a conspicuous pecten. The labial palpi curve strongly upward, and the terminal segment is well-developed and awl shaped. The proboscis is well developed but the maxillary palpi are obsolete. At first sight, this species might appear to belong near *Opogona*, but the squamose proboscis will serve as an immediate means of distinguishing *Blastobasis*. The transverse bands of spines on the abdominal tergites also signal its distinctiveness.

I am indebted to my friend Klaus Sattler for his expert aid in establishing the synonymy of Meyrick's name *explorata*.

Regrettably, I have not seen the larva or pupa of *Blastobasis inana*. I have, however, studied English material of *Blastobasis lignea* Walsingham. Although I do not know how many characters the two species share in the larval and pupal stages, I presume them to be rather similar. I have, therefore, incorporated notes taken from the English material into this text in the hope that they will be of assistance in Hawaii. I have included details of the larvae in the larval keys, and attention is drawn to the impression on the submentum which is a character shared with *Endrosis* and *Thyrocopa*.

The pupa shares with *Thyrocopa*, *Autosticha*, and *Stoeberhinus* the distinction of being among the only genera now known in the Hawaiian Gelechiidae with exposed profemora. The pupa of *lignea* is very compact. The labial palpi are entirely concealed, and the maxillary palpi are not evident. The antennae are contiguous on the abdomen as they are in most typical Gelechiinae. They reach the wing apices which extend on to the fifth abdominal sternite. The fifth abdominal segment is strongly curved caudo-ventrad so that the apex of the sternum is below a line drawn from about the middle of tergite seven, and the fifth sternite is only about one-third as broad as its tergite. Abdominal segments six and seven are rather similarly shaped. The mesothoracic spiracles are transverse; the abdominal spiracles are very small. Abdominal tergites two, three, and four combined are about equal in length to the remainder of the abdomen. The cauda is smoothly rounded, simple, and unarmed. The cocoon is covered with vegetable debris and frass.

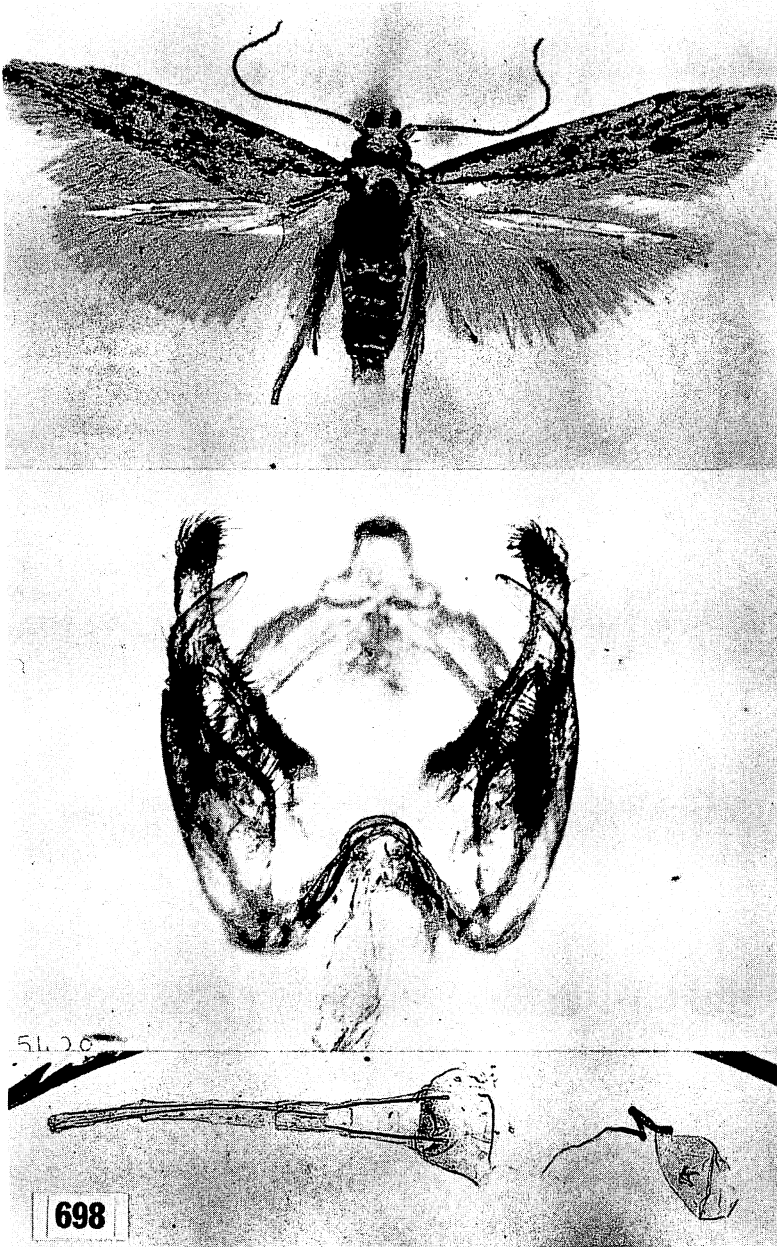
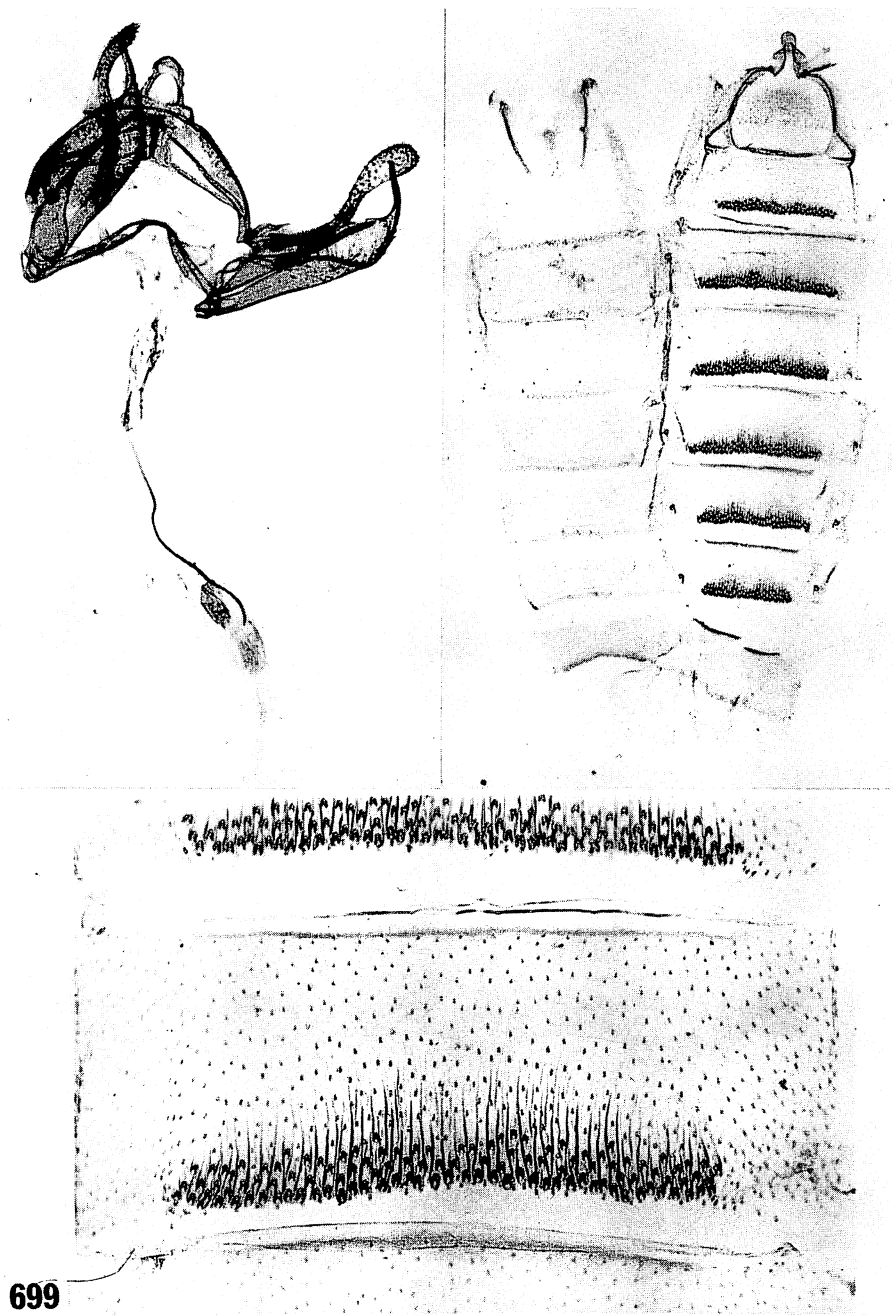


Figure 698—*Blastobasis inana* (Butler). Top, a specimen from Honolulu; forewing=6 mm. Middle, male genitalia, not spread (BM slide 5420) from an Oahu specimen; see figure 699. Bottom, female genitalia (BM slide 3941); see also figure 700.



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Figure 699—*Blastobasis inana* (Butler). Top left, male genitalia (compare figure 698). Top right, the abdominal pelt split open. Bottom, enlargement of abdominal tergites. Kona, Hawaii; ex coffee (slide Z-VII-10-64).

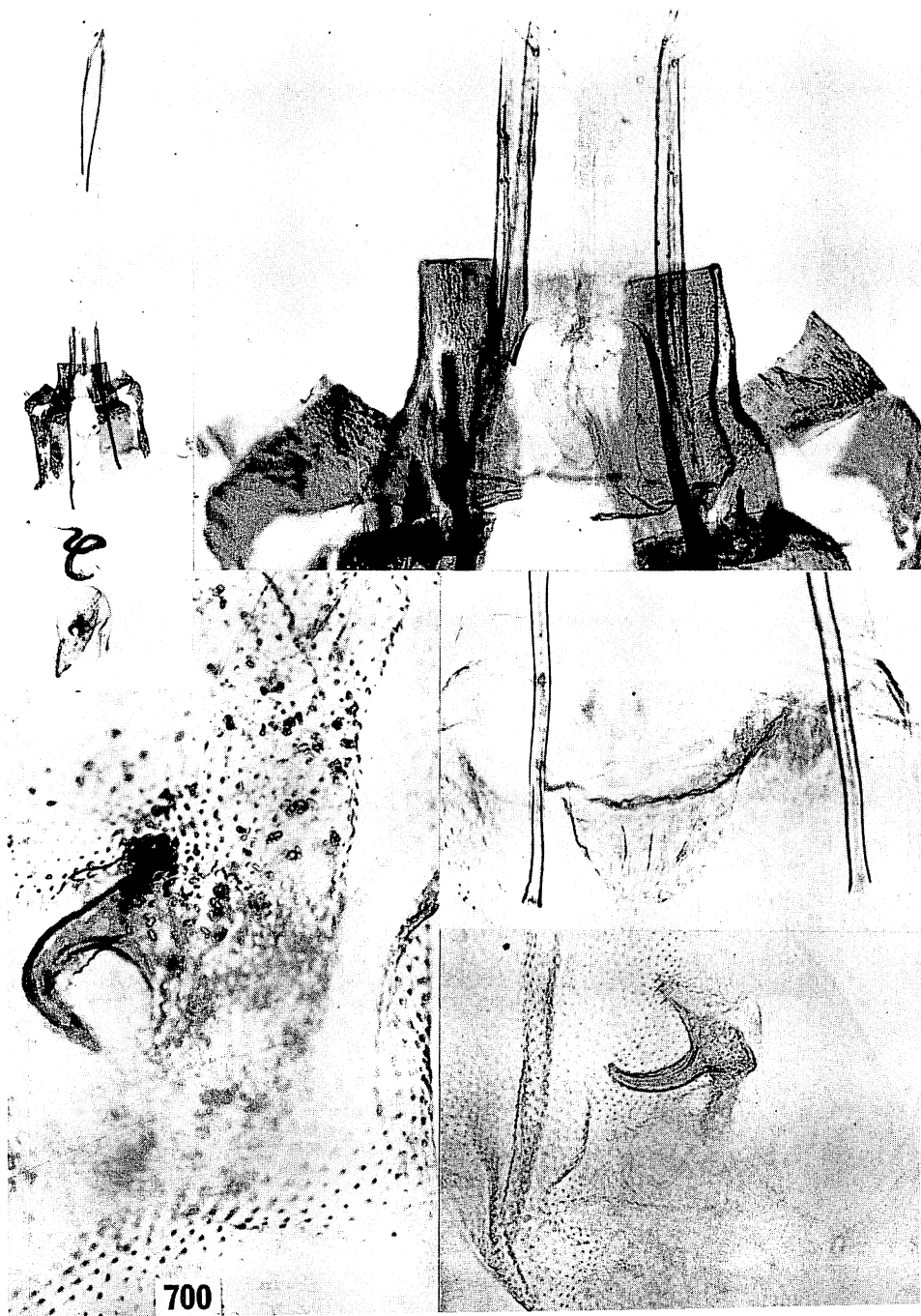


Figure 700—*Blastobasis inana* (Butler), female genitalia. Top, left and right, and bottom left, from the holotype (BM slide 3940); posterior apophyses broken; abdomen broken and glued. Middle right and bottom right, from another specimen (BM slide 3941); see the whole genitalia in figure 698.

Subfamily **CHRYSOPELEIINAE** (Mosher), **new status**

*Chrysopeliidae* Mosher, 1916:104.

*Walshiidae* Hodges, 1962a(1961):81-82; 1962b:7-8, redescription and modification of diagnosis; 1964b:291.

*Walshiinae*: Riedl, 1969:651. Common, 1970:822.

Incorrectly listed as a synonym of Elachistidae by Brues, Melander, and Carpenter, 1954:258.

This family-group name was erected by Mosher during her study of the classification of the Lepidoptera based upon the pupae. Unfortunately, she did not state clearly that she was proposing a new family name. Hodges proposed the name *Walshiidae* for the group, but he, too, neglected to state that he was erecting a new family name. These omissions have been the cause of confusion to other workers. I am indebted to Dr. Hodges for informing me that his name *Walshiidae* is a synonym of *Chrysopeliidae*.

Hodges published a review of the group for North America in 1964. He included a key to separate the *Chrysopeliinae* ("Walshiidae") from the *Momphinae* and *Cosmopteriginae*, and he presented a key to the North American genera. Hodges' paper may be consulted for detailed information regarding this small group. The subfamily is represented in Hawaii only by one introduced American species.

This group differs from our *Cosmopteriginae* in that its members have ocelli, the male genitalia have a developed uncus, and they lack brachia. These are not characters of family-group weight, but they do serve to differentiate the group in the Hawaiian fauna. The female genitalia are generally similar to cosmopterigids. The group might be reduced to a tribe of the *Cosmopteriginae* when the gelechiids become better known.

Genus **ITHOME** Chambers

*Ithome* Chambers, 1875:93. Type-species: *Ithome concolorella* (Chambers) (= *Ithome unimaculella* Chambers).

*Eriphia* Chambers, 1875:55 (homonym of *Eriphia* Meigen, 1826). Type-species: *Eriphia concolorella* Chambers, monotypic.

The extensive synonymy given by T. B. Fletcher, 1929:142, under *Mompha* is muddled and must be revised.

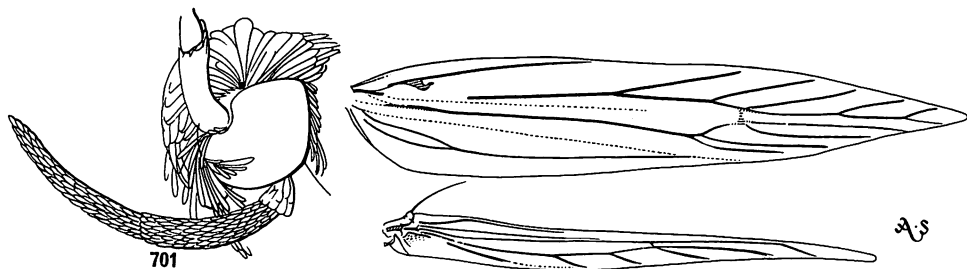


Figure 701—Head and wing venation of *Ithome concolorella* (Chambers) (BM slide 5207).

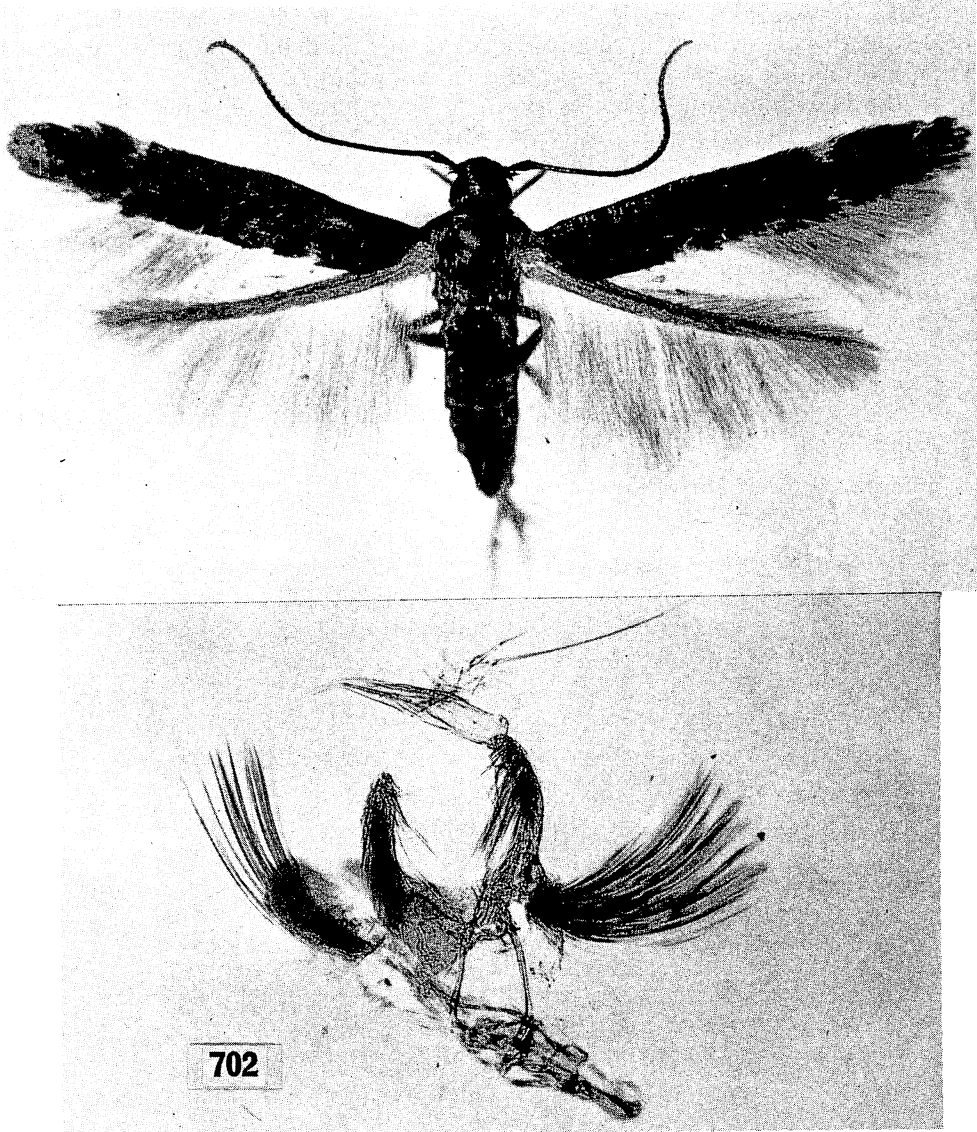


Figure 702—*Ithome concolorella* (Chambers). Top, a female from Illinois (photograph courtesy of USNM and Ron Hodges). Bottom, male genitalia (BM slide 5207); Ewa, Oahu. The moths have an expanse of about 5 to 7 mm.

*Ithome* is mostly a tropical American group. Hodges 1962a(1961) has reviewed the genus in America north of Mexico and has given descriptions, keys, and figures of the five species known from that region.

In the Hawaiian fauna, *Ithome* might be considered to be a member of the Cosmopteriginae. It may easily be distinguished from Cosmopteriginae because it has ocelli, which are lacking on the Hawaiian cosmopterigids.

***Ithome concolorella*** (Chambers) (figs. 701, head, wing venation; 702, moth, male genitalia; 703, female genitalia; 704, male, female genitalia; 705, larva, pupa).

*Eriphia concolorella* Chambers, 1875:55.

*Ithome concolorella* (Chambers) Barnes and McDunnough, 1917:152.  
Namba, 1956:95, figs. 1, A-G (larva, pupa), biology.

*Ithome unimaculella* Chambers, 1875:94.

For detailed synonymy and discussion, see Hodges, 1962a(1961):85, figs. 2, 7, 12.

The mesquite or kiawe flower moth.

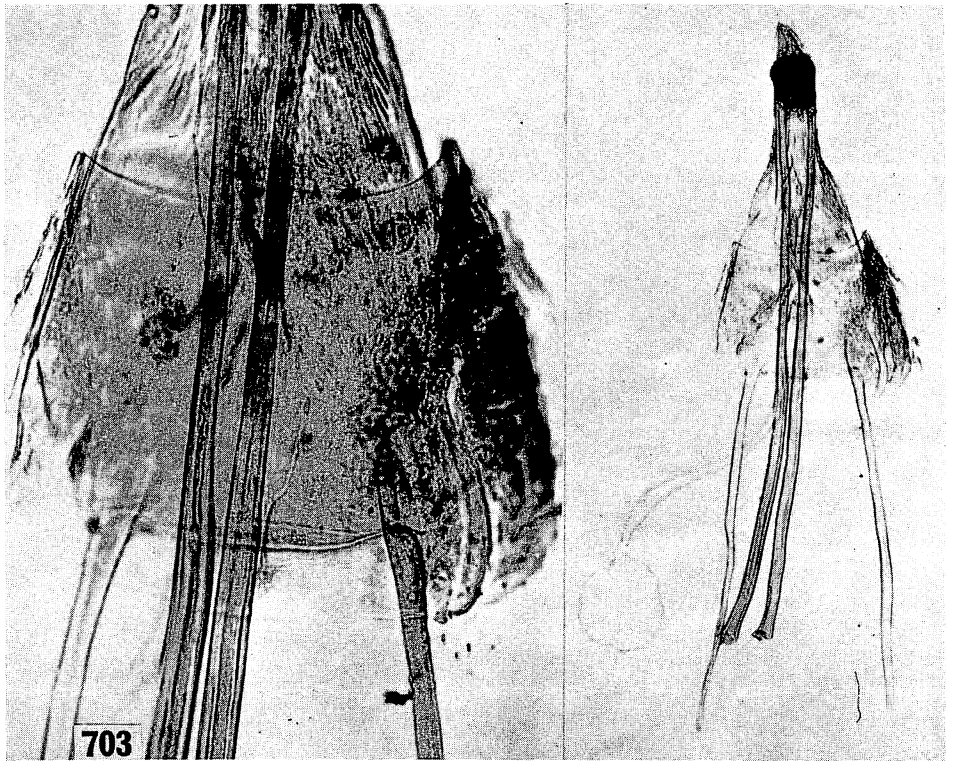


Figure 703—*Ithome concolorella* (Chambers), female genitalia (BM slide 5143); Ewa, Oahu.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. It was described from Texas and is widespread in the southern United States and in Mexico. This species was first recorded in Hawaiian entomological literature by C.F. Clagg who discussed it at the June 8, 1953, meeting of the Hawaiian Entomological Society (*Proc. Hawaiian Ent. Soc.* 15(2):278, 1954). He reported it from Kauai and Hawaii. It was, however, present in Hawaii several years before 1953. It has dispersed rapidly and widely since its establishment in Hawaii.

Hostplants: *Acacia farnesiana* ("klu"), *Prosopis chilensis* (algaroba, mesquite, "kiawe").

Parasites: *Agathis* species near *cincta* Cresson, *Bracon gelechiae* Ashmead, *Pristomerus hawaiiensis* Perkins, *Zatropis tortricidis* Crawford.

It is not known how long this moth has been established in Hawaii, but it was probably introduced during or soon after the Second World War. Evidently its presence was first made known by beekeepers who noted that the blossoms of *Prosopis chilensis*, the most important honey-producing plant in Hawaii, were being destroyed and the honey flow reduced. A marked reduction in honey production has followed the spread of the moth, especially since 1953. Stephen Au found the caterpillars on Kauai in May, 1953, and the moth was also found on Hawaii in the same month. Soon thereafter it was found on Oahu and Maui.

This is a small (expanse about 7 to 8 mm.; total length with wings closed, 3.5 to 4.0 mm.), dark-colored (fuscous) moth. The male genitalia are enclosed in creamy yellow tufts of hairs and scales. Namba (1956:95) has published a good paper on the biology of the moth in which he described the preadult stages and illustrated the larva and pupa.

The following information has been assembled from Namba's account: The cylindrical eggs, about 0.33 mm. long, are inserted in the flower buds and hatch in three to five days. The first stage caterpillar destroys the pistil

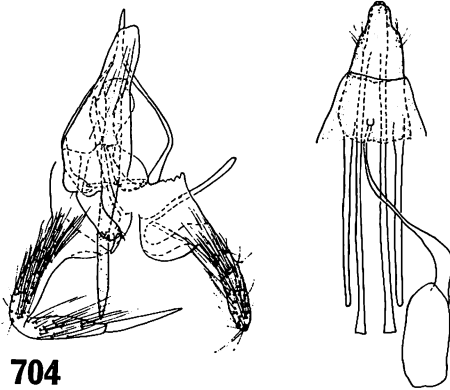


Figure 704—Male and female genitalia of *Ithome concolorella* (Chambers). (After Hodges, 1962.)



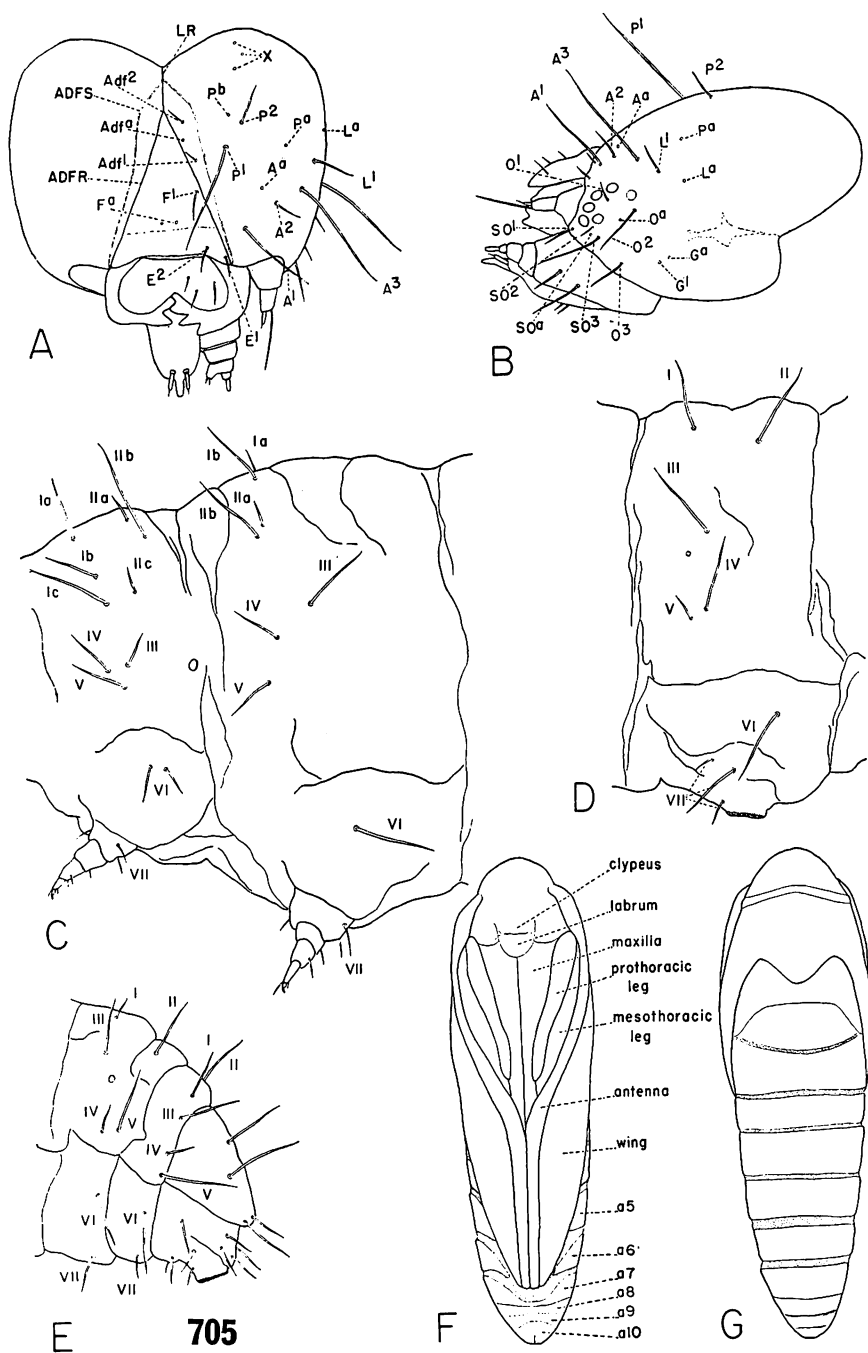


Figure 705—*Ithome concolorella* (Chambers), details of larva and pupa (after Namba, 1956). *A*, *B*, frontal and lateral aspects of head; *C*, lateral aspect of the pro- and mesothorax; *D*, lateral aspect of third abdominal segment; *E*, lateral aspect of abdominal segments 8, 9, and 10; *F* and *G*, ventral and dorsal aspects of pupa.

and stamens in the bud in which the egg was deposited. More mature larvae bore into other buds and opened florets; a single larva may destroy as many as 15 florets. The damaged flower parts are webbed together and formed into a tunnel in which the mature larva may be found. There are four larval instars which were found to last one day, one to four days, two to six days, and three to six days, respectively. The pupal period was found to be six to ten days. The mature larvae leave the hostplant, drop to the ground, and spin silken cocoons. With the egg stage of four days, the preadult period averages about 23 days. As many as one-half of the blossoms of *Prosopis* may be destroyed by the caterpillars.

It will be interesting to observe the progress of this moth in Hawaii. It may eventually cause damage to other acacia-like plants in the islands. Parasites and predators may exert more control upon it after it has been present in the islands for a number of years so that its attacks may not be as severe as during the period of the population's initial growth and dispersal. Its introduction to Hawaii has been a most unfortunate event.

#### Subfamily **MOMPHINAE** (Hübner), **new status**

*Momphae* Hübner, 1825 (1816–1826):414.

*Momphina*: Herrich-Schäffer, 1857:58.

*Momphinae*: (= Laverninae) of Elachistidae, Staudinger, and Rebel, 1901:184 (including *Batrachedra*, *Cosmopteryx*, etc.).

*Momphinae*: Riedl, 1969:651. Common, 1970:822.

*Momphidae*: Spuler, 1910 (1901–1910):381. Hampson, 1918:386, including Cosmopterigidae. Hodges, 1962b:6, redescription. Riedl, 1969:651.

*Batrachedrae* Heinemann and Wocke, 1876:524.

*Batrachedrinae*: Walsingham, 1890:149; 1891:125.

The members of this subfamily, most of which are small and slender, might, upon superficial examination, be considered to be associated with *Bedellia* in the Lyonetiidae. However, the two are not related and can easily be separated. *Bedellia* has a very large and conspicuous pecten composed of hairs and scales on the first antennal segment. Our momphines lack this structure although an occasional specimen may have one or two bristles or long squamae on the first antennal segment. Also, the momphines have squamose proboscides, but those of *Bedellia* are "naked". Some workers include the Chrysopeleinae and the Cosmopteriginae in the "Momphidae". In the future they may come to be considered as tribes within one subfamily of Gelechiidae.

The momphines in Hawaii all have *longitudinal*, medial, double bands of spines on the abdominal tergites (usually to be seen only in descaled dissections although they may be revealed on abraded moths). The only other adult Microlepidoptera in Hawaii now known to have spined abdominal tergites are the Ocophorinae, Xyloryctinae (figure 690), and Blastobasinae (figure 699), but in those groups the spines are arranged in *transverse* instead of *longitudinal* rows. Thus, the presence of double bands of spines arranged in *longitudinal* rows on the abdominal tergites of the moths is now diagnostic of the Momphinae in Hawaii (figure 710). The Hawaiian species were incorrectly

placed in the "Hyponomeutidae" by Walsingham in *Fauna Hawaiiensis*. The momphines are, of course, gelechioid and not yponomeutoid.

Nine species of Momphinae from Hawaii have been recorded as belonging to *Batrachedra* Herrich-Schäffer, 1853 (1843–1856):54 [type-species: *Gracillaria praeangusta* Haworth, 1828 (1803–1828):530; see my figure 707 for the male genitalia]. However, none of these are *Batrachedra*, and two new generic names must be added to the Hawaiian faunal list. It is probable that there are more species involved in the published Hawaiian records than there are names—some misidentifications may have occurred. The number of species of this subfamily in Hawaii is considerably greater than that recorded. Dr. Swezey found the larvae of unknown species, and I have examined undescribed species. It is remarkable that all except one of the described species were collected by Dr. Perkins and described by Lord Walsingham. During all of Dr. Swezey's careful work in the islands he rediscovered only five of the eight species originally found by Perkins, and only one new species was described from Dr. Swezey's collections.

There are two distinct groups of Momphinae in Hawaii, and they can be distinguished by morphological features as well as hostplant group. One of these contains two known species (possibly introduced?); the larvae of one of these feeds on sedge and the larvae of the other feeds upon grass. The larvae of the second group feed, in so far as is now known, upon fern sporangia. The wing venation is similar in the two genera. These groups may be separated as follows:

#### KEY TO THE GENERA OF MOMPHINAE IN HAWAII

1. Male genitalia with uncus apically entire, arms of gnathus apically fused into a single, narrow, median process, and valvae with well-developed claspers; forewings pale straw-colored flecked with black and usually with three small dark dots or dashes—one on the fold, one near apex of cell, and one at about distal third or fourth of wing—forming a very simple pattern; larvae in sedges and grasses. . . . . **Chedra**.
2. Male genitalia with uncus apically forked (bifid) or tripartite (trifid), gnathus apically broad, sometimes divided, and valvae without claspers; forewings with more complex color patterns; larvae feed upon fern sporangia. . . . . **Batrachedrodes**.

In addition to the two species of *Chedra* recorded here, there is before me a male specimen of a *Chedra*-like species that was reared from a pupa that Dr. Swezey took from a stem of *Eragrostis* grass on Mt. Kaala, Oahu, July 11, 1929. It has lost its left wings, and most unfortunately, its abdomen, and I cannot determine its identity. The moth is externally quite similar to the *Chedra* in Hawaii, but it has longer antennae—they are longer than the forewings. I have illustrated details of its pupal skin in figure 708a.

It will be noted that the cauda and antennae of this specimen differ from *Chedra* and *Batrachedrodes*. The wings overlap the base of the eighth abdominal sternum. The hind legs extend slightly beyond the apex of the abdomen. The antennae extend far behind the apex of the abdomen (about the length of the five caudal abdominal segments beyond the apex in the example seen). The spiracles of the eighth abdominal segment are much more protuberant than are those of the other segments, and the abdominal spiracles are much larger than are those of *Chedra microstigma*. The mesothoracic spiracles differ from those of *microstigma* in being slightly curved, somewhat more "thumb-like", and not so semicircular. There is no protruding cremasteral process; the cremasteral area appears nearly bare (it has only some fine hairs), and it lacks the conspicuous, hooked, dorsal setae that are found on *microstigma*. It would appear that this example represents yet another genus of Momphinae in Hawaii, but it is impossible to say more until the genitalia can be studied.

For many years the American Army kept large numbers of horses and mules in Hawaii, and the Army imported large quantities of hay. Hay has also been imported over many years by the dairy and livestock industries. It is possible that the *Chedra*-like species recorded here as being established in Hawaii were imported in such hay.

#### Genus **CHEDRA** Hodges

*Chedra* Hodges, 1966a:636. Type-species: *Chedra pensor* Hodges, 1966a:368, by original designation.

*Chedra* was proposed as a generic name to include two species from North America and one from Chile. Hodges (1966a:637) said that "males of *Chedra* may be separated from those of *Batrachedra* by the presence of the single, strong

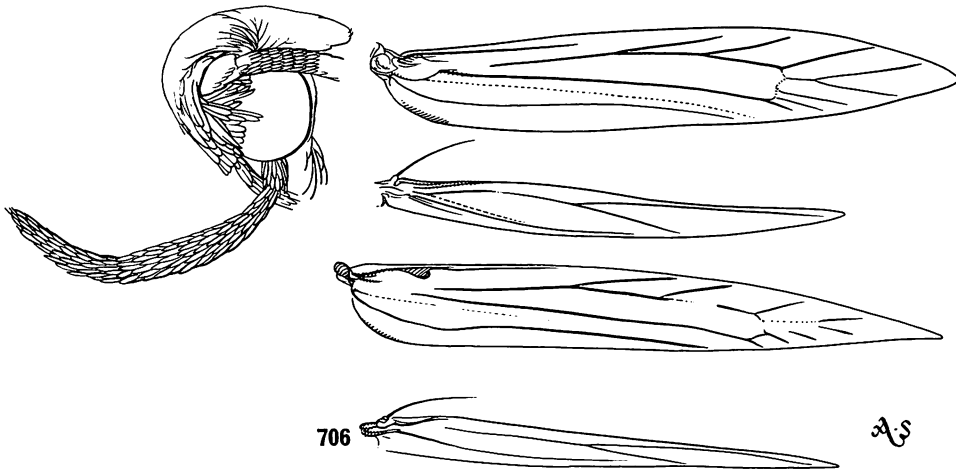


Figure 706—Head and wing venation of *Batrachedrodes* and *Chedra*. Top, left and right, the holotype of *Batrachedrodes syrrhaphella* (Walsingham) (slide BM 4228); Waianae Mts., 2,000 feet, Oahu. Bottom, wings of a paratype BM slide 5257) of *Chedra microstigma* (Walsingham); Waianae Mts., Oahu.

apical spine on the ampulla. The presence of long apophyses . . . , the absence of a signum and accessory pouches, and the corpus bursae being poorly set off from the ductus bursae may be used to separate females of *Chedra* from those of *Batrachedra*." Hodges used the term "ampulla" for the structure on the inner face of the male genital valva which some authors call the clasper. The ampulla was considered originally to be a process of the clasper; see Tuxen, *et al.*, 1956, for example.

The name *Batrachedra* was derived from *batrachos*, a frog, and *edra*, a seat. It refers to the way the moths sit with the legs extended back and the head end of the body elevated. The meaningless name *Chedra* would have been termed a "nonsense name" by Meyrick.

Two species heretofore placed in *Batrachedra* in Hawaii must be transferred to *Chedra*. Although these species appear to be introductions from America, I cannot state positively that they are recent introductions. It is possible that they were introduced with hay from North America. The hostplants of the two known North American species remain undetermined, but the South American species has been reared from the seeds of a sedge. One of the species in Hawaii has been reared from sedges, and the other has been reared from *Eragrostis* grass.

The two species of *Chedra* in Hawaii that are known to me are so closely similar that considerable confusion exists regarding them. The confusion began in 1907 when Walsingham included both species in his type series when he described *microstigma*. Busck, without referring to Walsingham's work, evidently redescribed *microstigma* as *cuniculator* on the basis of Dr. Swezey's information that he had reared a distinct species from sedges. The holotype and one paratype of Walsingham's *microstigma* were collected at an elevation of about 2,000 feet in the Waianae Mountains of Oahu, and six paratypes were collected at Kona, Hawaii. My dissections reveal that the so-called paratypes from Kona represent a different species from the Oahu holotype and paratype. Moreover, Busck's name *cuniculator* appears to have been applied to specimens of *microstigma*. Actually the species reared from *Eragrostis* and considered by Dr. Swezey and others to be *microstigma* is an unnamed species which is the same as the Perkins' material collected in Kona, Hawaii.

Most unfortunately, the Hawaiian specimens which I have been able to examine during this brief study have been inadequate for a proper revision of the group so that I must separate the species on characters of the male genitalia only. The abdomen of the male holotype of *microstigma* is lost. Fortunately, the male paratype of *microstigma* has retained its abdomen, and the abdomens of two of the males of the new species *mimica* from Kona were intact. Because of the lack of sufficient material in good condition, I cannot be satisfied with my preliminary treatment of this genus in Hawaii.

*Chedra* pupae may at first sight appear to resemble the pupae of *Philodoria* in the Gracillariidae. They are, however, easily distinguishable. The abdominal segments of *Chedra* pupae lack the tergal spinules characteristic of *Philodoria*, the dorsal setae are long and conspicuous, and the antennae are shorter and are not recurved over the abdomen. The spiracles are unusually large, and those on the eighth abdominal segment are obviously protuberant.

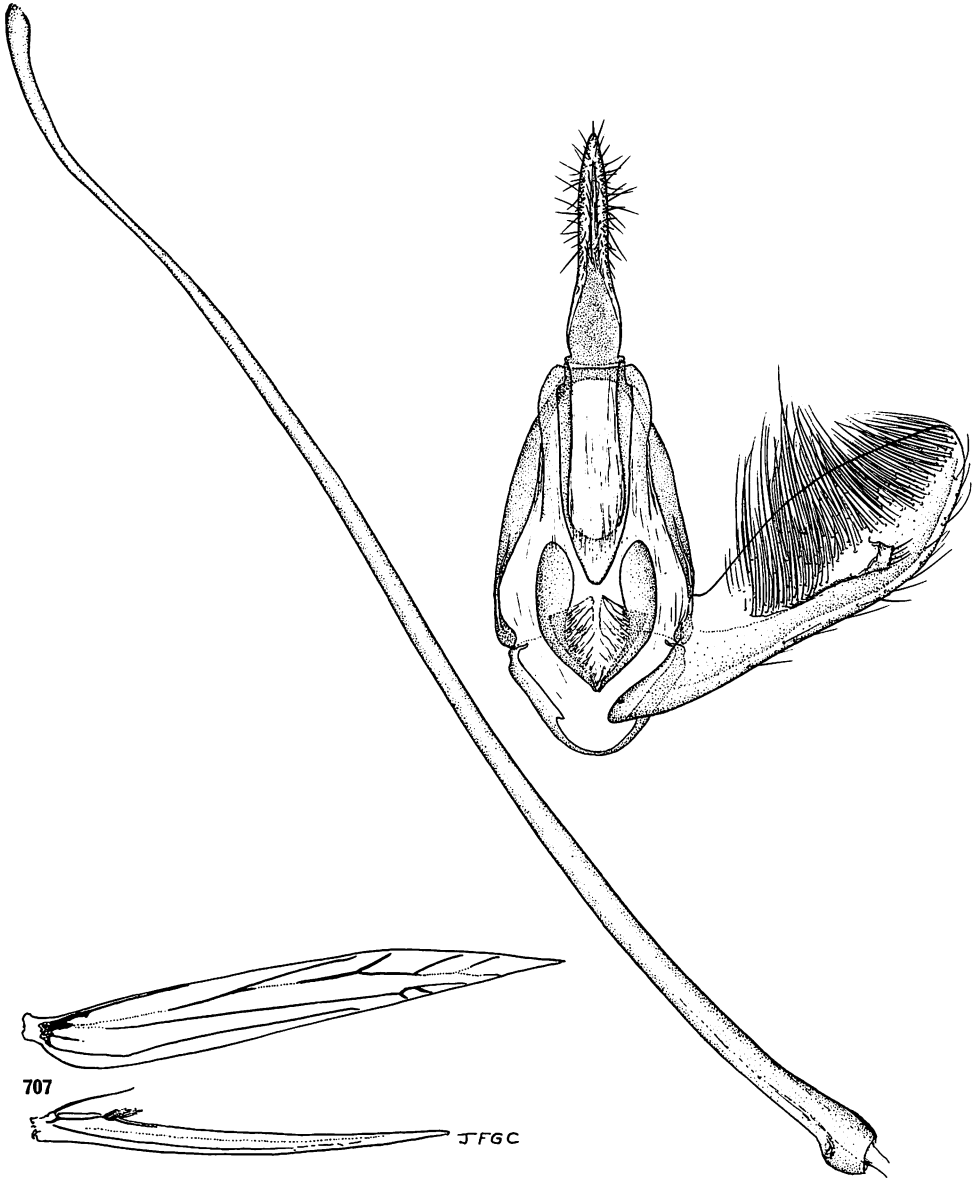


Figure 707—Wing venation and male genitalia of *Batrachedra praeangusta* (Haworth), the type-species of *Batrachedra*. The aedeagus is drawn to the same scale as the remainder of the genitalia.

## KEY TO THE SPECIES OF CHEDRA IN HAWAII

1. Male genital valva with dorsal ("costal") margin slightly convex in outline; uncus obviously swollen before apex; as in figures 710, 711. . . . . **microstigma** (Walsingham).
  2. Male genital valva with dorsal margin obviously concave in outline; uncus in dorsal or ventral aspect straightly acuminate; figure 712. . . . . **mimica** Zimmerman.
- See color plate 5, figure 4.

**Chedra microstigma** (Walsingham), **new combination** (figs. 706, wing venation; 709, moth; 710, 711, male genitalia, abdomen; 713, female genitalia).

*Batrachedra microstigma* Walsingham, 1907b:510, pl. 15, fig. 10.

*Batrachedra cuniculator* Busck, 1914b:106. **New synonym.**

*Batrachedra foliocuniculator*, misspelling by Swezey, 1954:194.

Oahu (type locality of *microstigma*: Waianae Mountains, 2,000 feet; of *cuniculator*: Kewalo Swamps, Honolulu, now filled and occupied by the city).

Immigrant? Possibly a North American species.

Hostplants: *Cyperus laevigatus*, *Scirpus maritimus*.

Parasites: *Bracon swezeyi* (Bridwell), *Chelonus* (*Microchelonus*) *blackburni* Cameron, *Trathala* ("Cremastus", "*Zaleptopygus*") *flavo-orbitalis* (Cameron).

Dr. Swezey knew that *microstigma* had been recorded from the Waianae Mountains of Oahu, but when he found a species boring in the stems of sedges

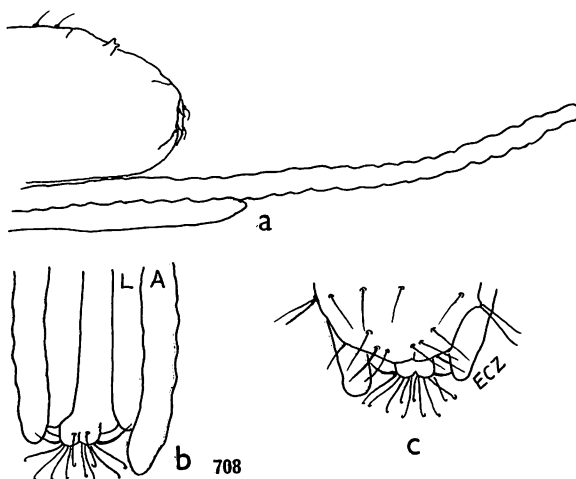


Figure 708—Details of the cast skins of the pupae of two species of Momphinae. *a*, left lateral aspect of the apex of the abdomen of a *Chedra*-like species; ex stem of *Eragrostis*; Mt. Kaala, Oahu. Note how far beyond the cauda the antennae extend. See the discussion of this example in the text under *Chedra mimica*. *b* and *c*, ventral and dorsal aspects of the cauda of *Batrachedrodes sophroniella* (Walsingham); Pauoa, Oahu; ex *Aspidium cyathoides*. On figure *b*, *A*=antenna and *L*=leg; note the separation of the antennae and compare their shorter lengths with those of *a*.

in the former lowland swamps at Kewalo, Honolulu, he concluded that he had a new species. He sent material to Busck who described it as *cuniculator*. Busck said (1914b:106): "Bred by Mr. Swezey, who writes that it is a leaf-miner in sedges, *Scirpus maritimus*, in the swamps near the coast; it also bores in the stems of *Cyperus laevigatus*, which is leafless and has cylindrical stems resembling rushes. Mr. Swezey considers this moth a recent introduction to Hawaii; it had not been noticed until about a year ago." I cannot explain why Dr. Swezey appears not to have seen the species in Honolulu until 1913 or why he then thought that it was a newly introduced species.

I have been unable to separate specimens reared from sedges from the type locality of *cuniculator* from the holotype and paratype of *microstigma* from the Waianae Mountains. The male genitalia are similar, as the illustrations demonstrate. Hence, Busck's name *cuniculator* must fall.

As noted under the discussion of the genus above, Walsingham's paratypes from Kona, Hawaii, are not the same as his holotype and paratype from the Waianae Mountains of Oahu. They evidently represent a new species which is described below.

On the pupa of *Chedra microstigma* the labial palpi, profemora, and maxillary palpi are all exposed. It is unusual, but not unique, for a member of the Gelechiidae to have exposed labial palpi and profemora. The antennae extend beyond the apices of the wings and caudad of the metatarsi, but they do not reach the apex of the abdomen. They touch each other at their extreme apices only. They are kept separated elsewhere by the mid and hind legs which lie between them. The exposed parts of the mesothoracic spiracles form conspicuous, semicircular pilose pads which lie on the mesothorax. On each side of the medial line of the ventro-caudal margin of the cauda is a low process that bears a cluster of about six conspicuous, hooked setae.

***Chedra mimica* Zimmerman, new species** (figs. 709, moth; 712, male genitalia; 713, female genitalia).

*Batrachedra microstigma* Walsingham, 1907b:510, in part.

A mostly straw-colored species flecked or marked with brown and fuscous. Labial palpi in lateral aspect with the second segment fuscous near base with the fuscous extending toward or beyond middle and with a fuscous apical fascia; third segment with a basal fuscous fascia and another between the middle and apex but not extending to apex on sides although sometimes reaching apex along the dorsum; these fuscous maculae are variable. Head and thorax straw color; head without maculae. Antennae straw color with brown annulations. Legs outwardly sprinkled with brown and fuscous and with the bases of the tarsal segments ringed with brown. Wings basically straw color; forewings sprinkled with brown scales and with three small, variable, fuscous dots: one in the fold near the basal third of the wing length, another somewhat basad of the middle of the wing but in the cell and thus costad of the macula in the fold, and the third at the end of the cell at a point about twice as far from the submedial macula as that is from the most basal macula; as illustrated. Male and female genitalia as illustrated. Expanse 6.5 to 12.0 mm.



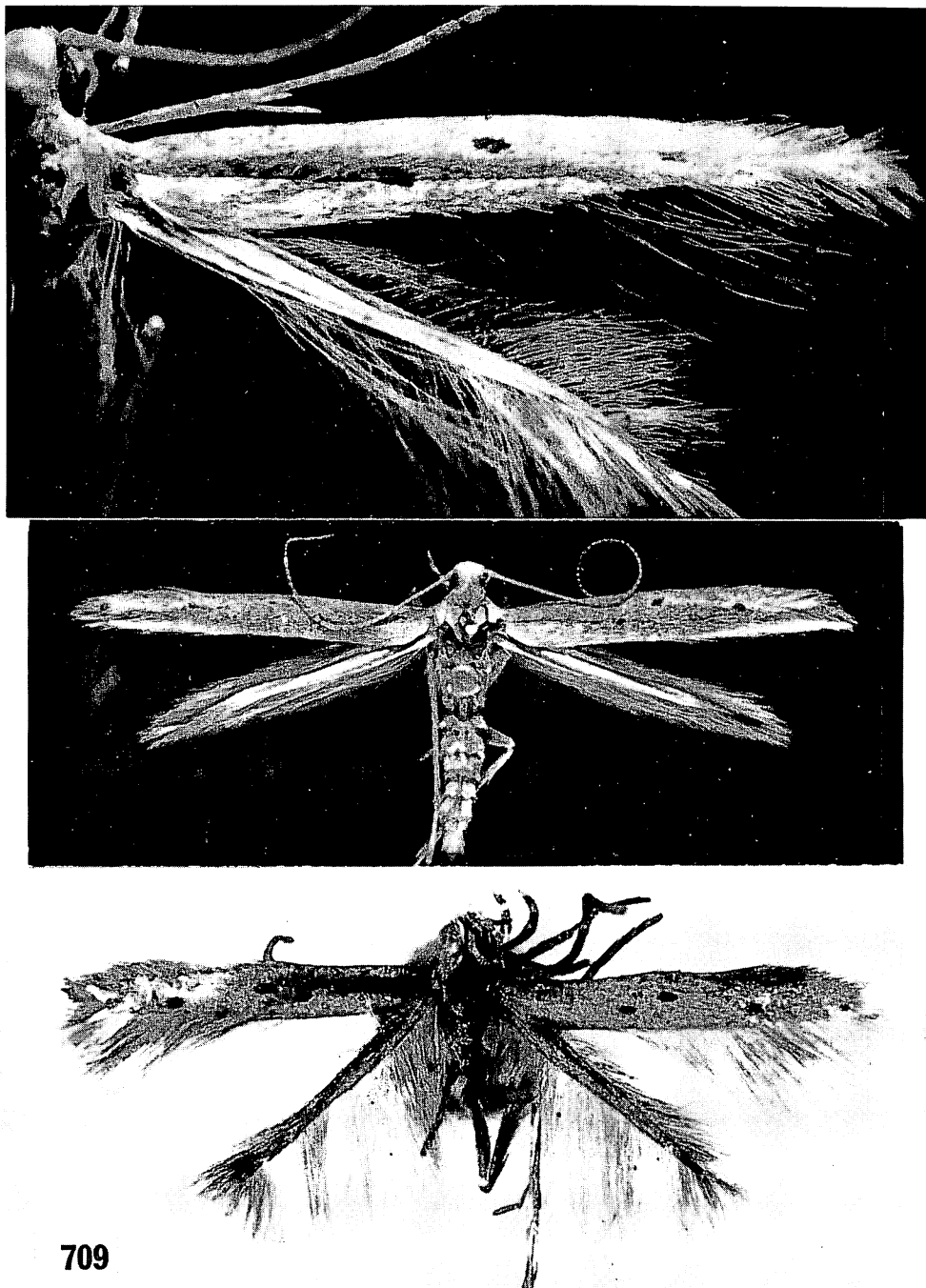
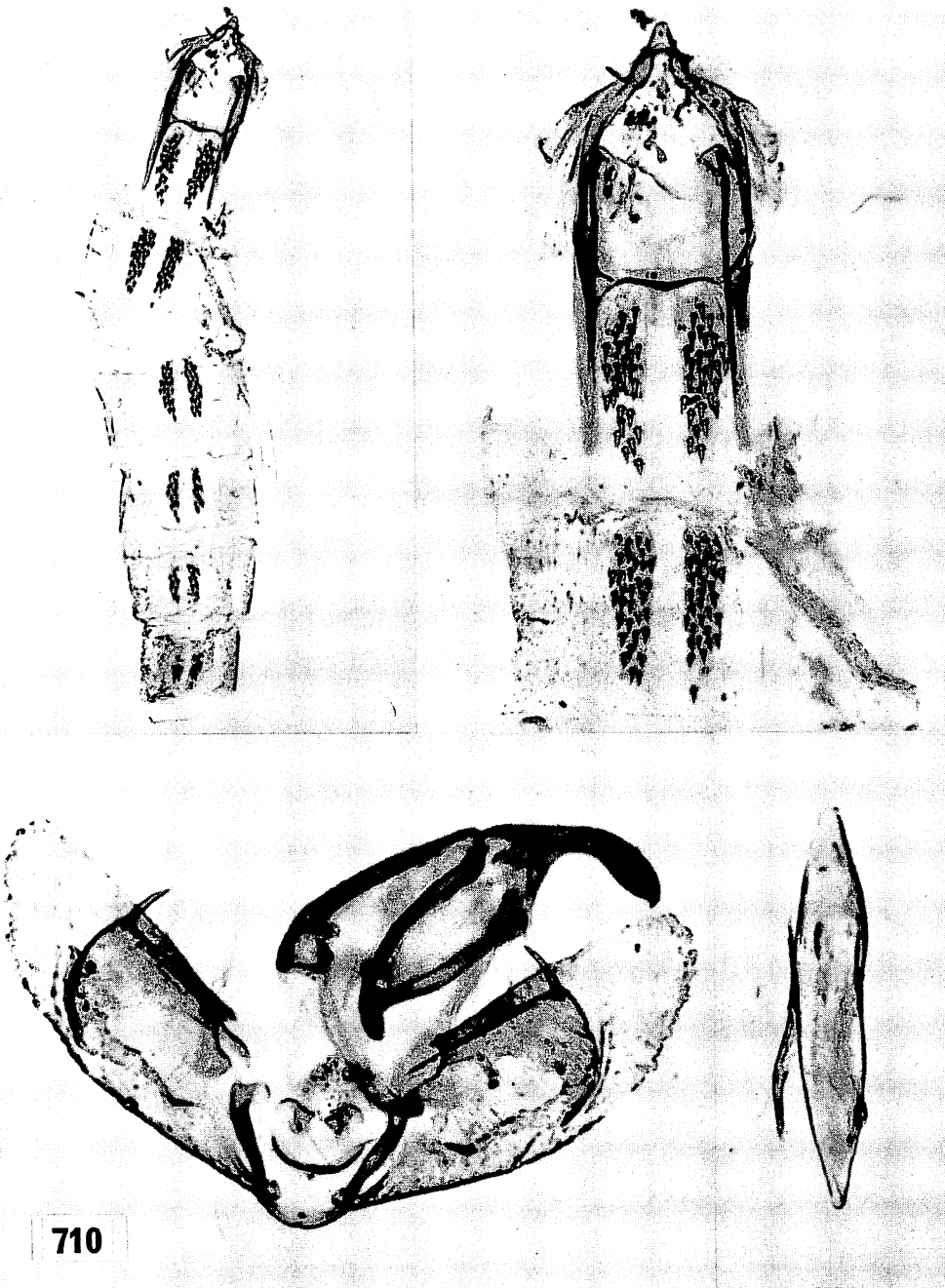


Figure 709—*Chedra* species. Top, *microstigma* (Walsingham), holotype; abdomen lost; Waianae Mts., 2,000 feet, Oahu; forewing 3.6 mm. Middle, the same species from a specimen determined as the synonymous *cuniculator* Busck; Kewalo, Oahu; ex *Cyperus laevigatus*; forewing 5 mm. Bottom, *mimica* Zimmerman, holotype male (BM slide 2240); Kona, above 2,000 feet, Hawaii; forewing 3.5 mm. The three fuscous spots on the straw-colored wing, which is dusted with brown scales, are diagnostic of *Chedra* in Hawaii.



710

Figure 710—*Chedra microstigma* (Walsingham). Top, abdominal skin and enlarged basal tergites. Bottom, male genitalia; the apex of the aedeagus is at the bottom. From a paratype (BM slide 5257); Waianae Mts., Oahu.

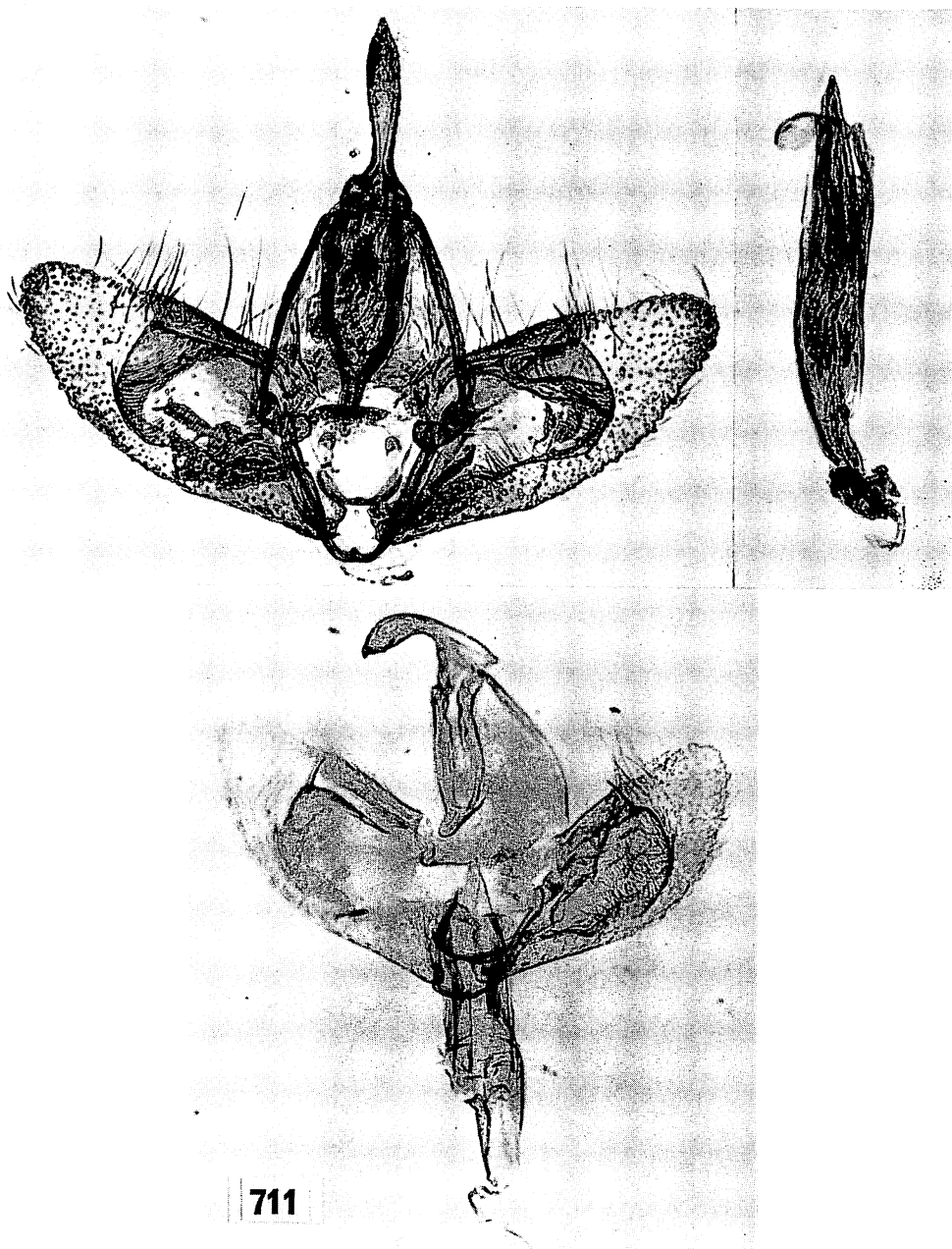


Figure 711—Male genitalia of *Chedra microstigma* (Walsingham) from specimens determined as *cuniculator* Busck, a synonym. Both specimens reared from *Cyperus laevigatus*; Kewalo, Oahu. The top specimen is on BM slide 14304; the bottom specimen is on Busck's slide 176.

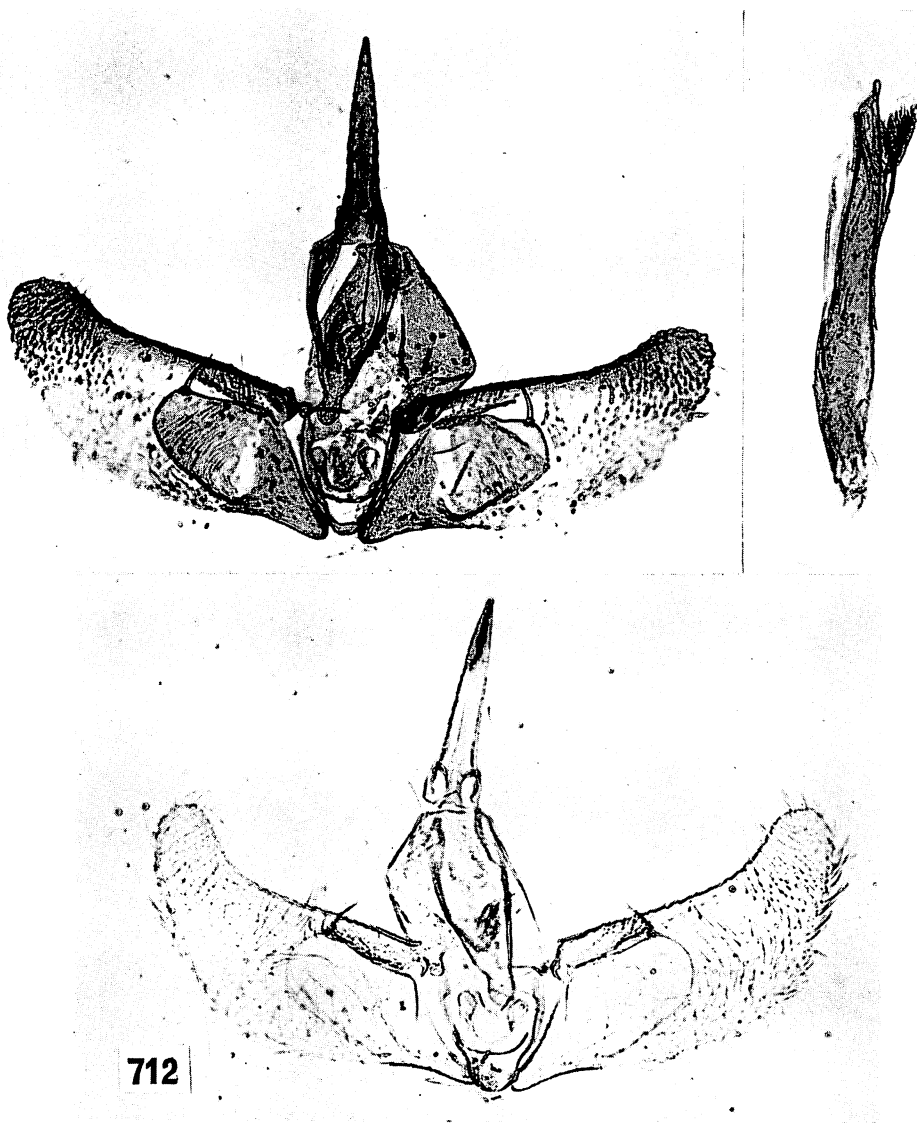


Figure 712—Male genitalia of *Chedra mimica* Zimmerman. Top specimen is a paratype from a former paratype of *microstigma* Walsingham from Kaawaloa, Kona, over 2,000 feet, Hawaii (BM slide 14303). Bottom specimen, the holotype (BM slide 2240), from a former paratype of *microstigma* from Kona, above 2,000 feet, Hawaii. Note the concave costae of the valvae and acuminate uncus, and compare the same of *microstigma* in figure 711.

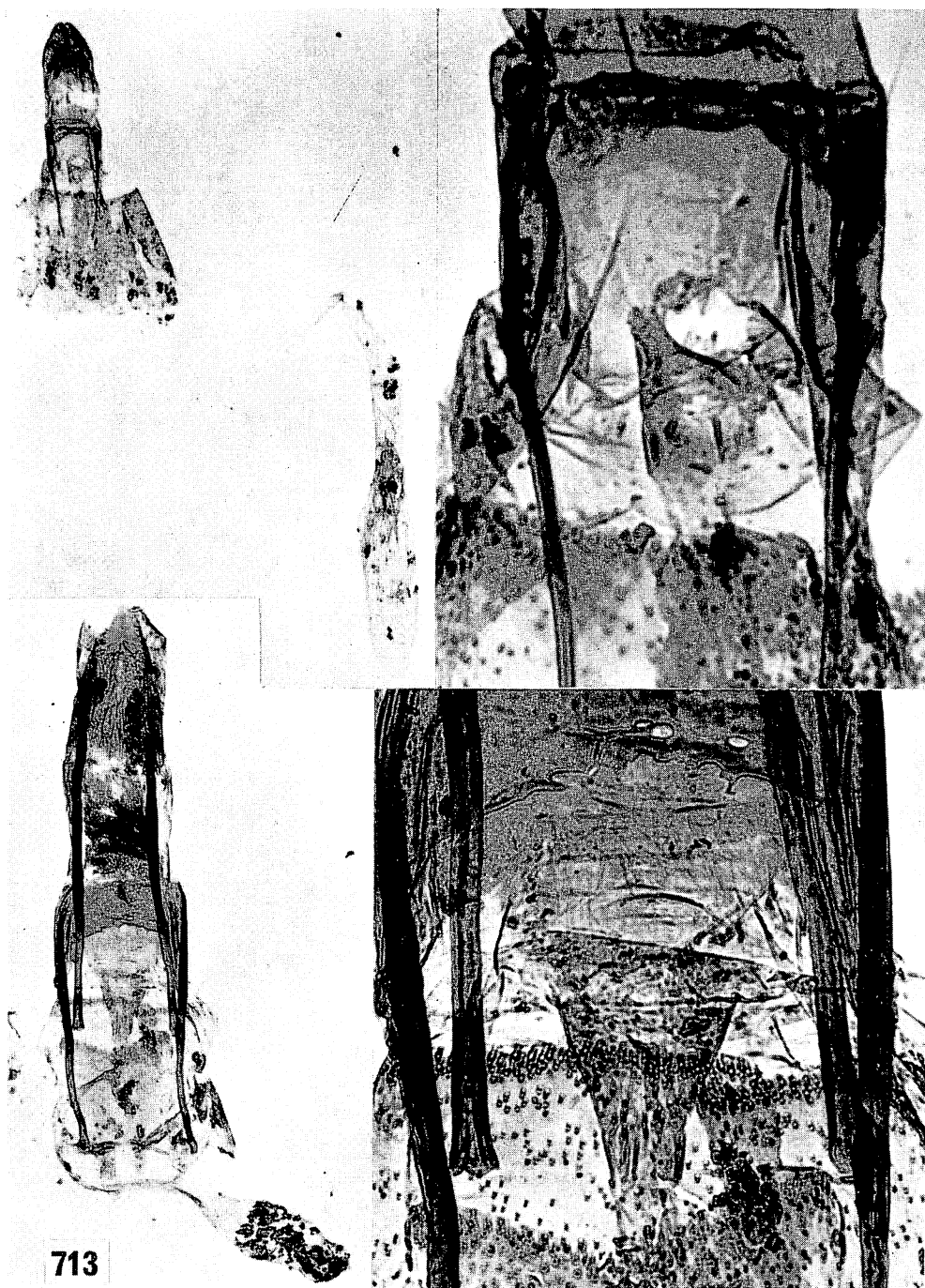


Figure 713—Female genitalia of *Chedra*. Top, *microstigma* (Walsingham) from a specimen determined as *culicator* Busck; Kewalo, Oahu; ex *Cyperus laevigatus* (BM slide 14302). Bottom, *Chedra mimica* Zimmerman, paratype (slide Z-II-14-67); Kolekole Pass, Oahu; ex heads of *Eragrostis*. The abdomens of both specimens appear to be partly decomposed. Note the difference in the breadths of the sclerotized areas connecting the caudal ends of the anterior apophyses.

Holotype male (BM slide 2240); Kona, above 2,000 feet, Hawaii, September, 1892, Perkins; Walsingham specimen number 25349. Allotype female (BM slide 5287); Kona, 4,000 feet, 8 September 1892, Perkins; Walsingham specimen number 25569. One female paratype, Kona, 4,000 feet, Hawaii, 8 September 1892, Perkins; Walsingham specimen number 25562. One male paratype (BM slide 14303), Kaawaloa, above 2,000 feet, Kona, Hawaii, September 1892; Walsingham specimen number 25668. (The foregoing specimens are in the British Museum.) Two female paratypes (in the Bishop Museum) reared "ex heads of *Eragrostis*" grass at Kōlekole Pass, Oahu, 10 April 1927, O.H. Swezey (one of these with genitalia on slide Z-II-14-67). One female paratype with the same data but labeled "*Eragrostis*" (instead of "ex heads of *Eragrostis*") and from the Meyrick collection in the British Museum.

Known distribution: Oahu and Hawaii.

Immigrant? Possibly a North American species.

Hostplant: *Eragrostis* grass; the larvae bore in the stems? and flower heads.

Genus **BATRACHEDRODES** Zimmerman, **new genus**

Head as in figure 706; ocelli absent; antennae about three-fourths as long as forewing, simple, without a distinct pecten on first segment or with only a single bristle; labial palpi as figured, long, upturned, sickle shaped; maxillary palpi minute or rudimentary; proboscis well developed, squamose. Scaling of head and thorax smooth; squamae of face extending laterally over edges of eyes. Wing shape and venation as in figure 706. Legs with hind tibiae with abundant slanting erect hairs along dorsum and with a tuft of long hair-scales from apices; tarsi without any obvious spines protruding above the squamae of the ventral surfaces. Genitalia as in figures 717-724. Larvae feed among fern sporangia.

Type-species: *Batrachedra syrraphella* Walsingham.

Although the species of this group bear a superficial resemblance to some *Batrachedra*, they form an endemic generic segregate. The genitalia are quite distinct from those of the type-species of *Batrachedra*, *praeangusta* (Haworth) (figure 707). Walsingham at first considered them to be distinct, but he changed his mind and published them as *Batrachedra* in *Fauna Hawaiiensis*. However, none of the American *Batrachedra* that I have examined has genitalia like those of the Hawaiian group.

The female genitalia are extraordinary delicate so that the preparation of satisfactory dissections is difficult. This is especially true when the abdomens are decomposed as appears to be the situation with some of the specimens I have studied.

The supposed distribution of the species of *Batrachedrodes* is peculiar, and it appears that there is some confusion in this regard. I have not studied enough specimens to be able to confirm or deny the supposed distribution. Four of the seven described species are said to occur on two or more islands, but no species has been recorded from Kauai or Lanai where surely there are species. Four species have been recorded from Oahu, but all four of them have also been listed from other islands. One species is recorded only from Molokai,

one only from Maui, and one only from Hawaii. Obviously, we know little about the distribution of these small moths, and I cannot guess as to how many species may exist in Hawaii. I regret that the material I have seen is inadequate to make possible a proper study of the group.

The larvae have the interesting habit of living among the sporangia of *Asplenium*, *Elaphoglossum*, *Aspidium*, *Dryopteris*, and perhaps other genera of ferns and they are protected by a webbing. Detailed study of the habits of the group is recommended.

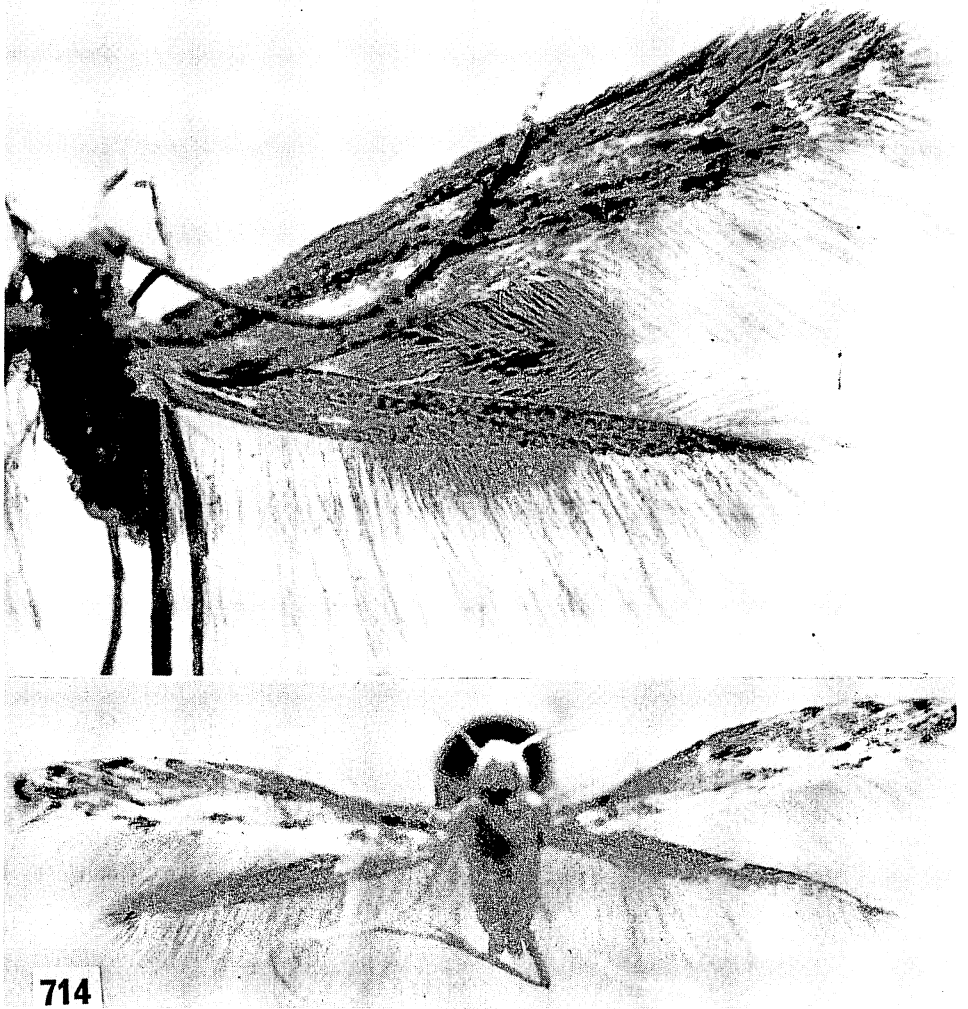


Figure 714—*Batrachedrodes*. Top, *bedelliella* (Walsingham), holotype male (BM slide 4206); Haleakala, 5,000 feet, Maui; forewing 4 mm. Bottom, *ephelus* (Walsingham), holotype male (BM slide 4203); Molokai, above 3,000 feet; expanse 10 mm.

The pupa is enclosed in a dense, parchmentlike, canopylike cocoon spun against the undersides of the fern pinnae. The abdominal tergites of the pupae have long, erect bristles; the wing sheaths extend on the sixth abdominal sternite; and the antennal sheaths reach to about the apex of the abdomen or a little beyond. The labial palpi and the profemora are exposed. It appears that the maxillary palpi are also exposed, but the material available for study is inadequate to make a positive decision. The antennae extend only slightly beyond the apices of the metatarsi, and they are separated from each other for their entire lengths on *lomentella* and *sophroniella* (the only material seen). The exposed parts of the mesothoracic spiracles are narrow and elongate and appear to be joined more to the prothorax than to the mesothorax. The cauda has a medial ventral process (appearing to be a pair of processes fused) which is armed on each side with a prominent cluster of six or seven hooked setae that radiate laterad.

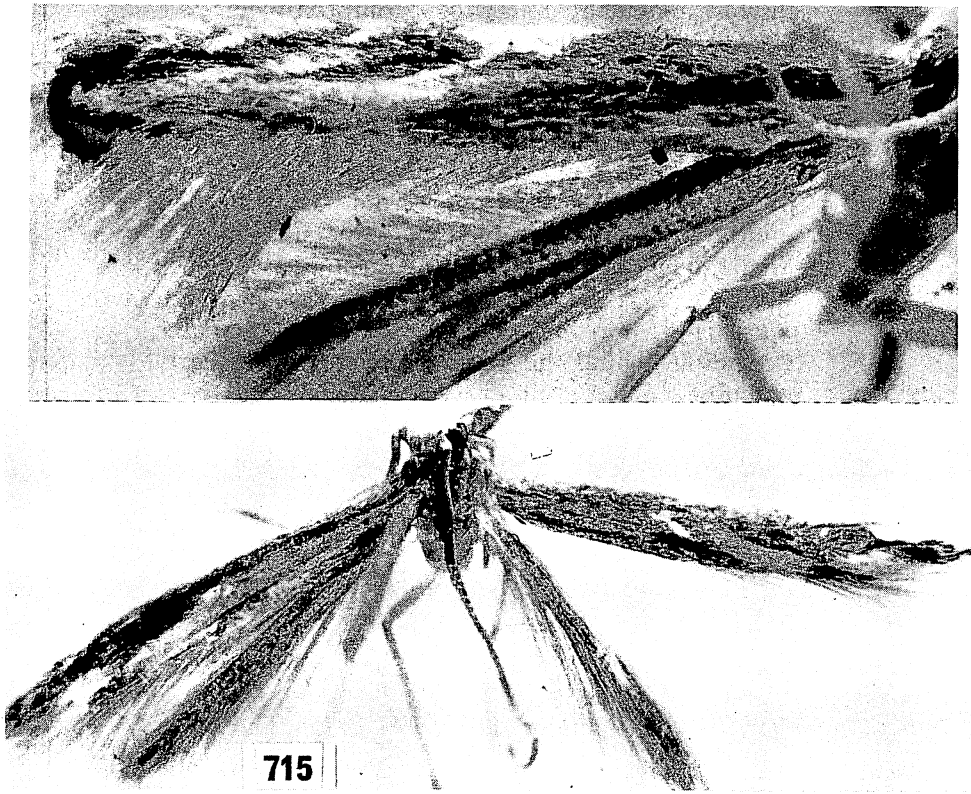


Figure 715—*Batrachedrodes*. Top, *lomentella* (Walsingham), holotype male (BM slide 4227); Waianae Mts., about 2,000 feet, Oahu; forewing 3.75 mm. Bottom, male holotype (BM slide 4207) of *ruficiliata* Walsingham, now a synonym of *sophroniella* (Walsingham); Kona, over 2,000 feet, Hawaii; right wing 4 mm.



## KEY TO THE SPECIES OF BATRACHEDRODES

1. Hindwing of male with a subcostal brush; uncus bifid . . . 2  
Hindwing of male without a subcostal brush; uncus  
bifid or trifid . . . . . 4
- 2(1). Gnathus reduced to an isolated, small lobe on either  
side; forewings with a pattern of brown and fuscous  
maculae on a cream-colored background, as in  
figure 714 . . . . . **ephelus** (Walsingham).  
Gnathus longlobed and with a "bridge" between the  
lobes so that it is somewhat H-shaped . . . . . 3
- 3(2). Fore- and hindwings nearly concolorous fuscous;  
fringes dark; hind tibiae and tarsi almost entirely  
fuscous above; figure 714 . . . **bedelliella** (Walsingham).  
Forewings basically cream-colored and with numerous  
fuscous maculae; hindwings comparatively pale  
fuscous; all fringes pale or white; hind tibiae and  
tarsi pale cream or white with conspicuous fuscous  
diagonal maculae; figure 716 . . . . .  
. . . . . **syrraphella** (Walsingham).
- 4(1). Uncus bifid; posterior marginal areas of forewings  
broadly cream-colored or pale from base to beyond  
middle and without any fuscous maculae in that  
area and no dark scaling behind the fold, as in figure  
716 . . . . . **supercincta** (Walsingham).  
Uncus trifid; forewings with some dark maculae  
extending behind the fold and reaching, or nearly  
reaching, hind margin of wing on basal half . . . . . 5
- 5(4). Forewings with almost entire area from base to middle  
with dark scaling, as in figure 715, and without  
any medial pale vitta from base . . . . .  
. . . . . **lomentella** (Walsingham).  
Forewings with a conspicuous pale (yellow and cream)  
medial vitta extending from base to near apex, as  
in figures 715, 716 . . . . . **sophroniella** (Walsingham).

**Batrachedrodes bedelliella** (Walsingham), **new combination** (figs. 714, moth; 717, male genitalia).

*Batrachedra bedelliella* Walsingham, 1907b:509, pl. 15, fig. 9.

Endemic. Oahu, Molokai, Maui (type locality: Haleakala 5,000 feet), Hawaii.

Hostplants: the larvae feed among the sporangia of *Asplenium nidus* and *Elaphoglossum reticulatum*.

I have not examined specimens from all four islands from which this species has been recorded, and I am unable to comment upon the recorded distribution. The species was described from five specimens from Maui and Molokai.

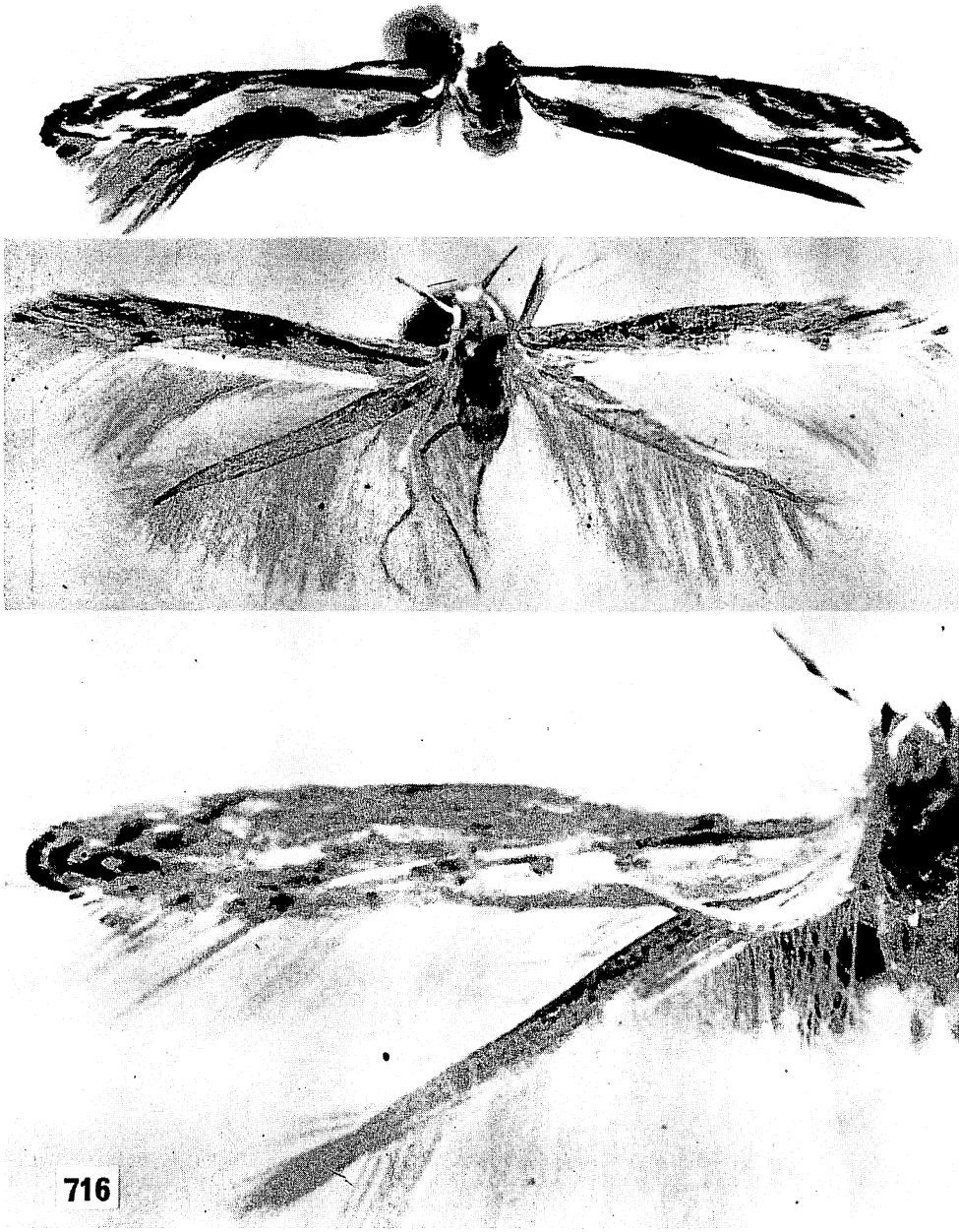


Figure 716—*Batrachedrodes*. Top, *sophonella* (Walsingham), holotype female; near head of Kawailoa Gulch, Oahu; expanse 10 mm. Middle, *supercincta* (Walsingham), holotype male (BM slide 4226); Haleakala, 5,000 feet, Maui; forewing 3.75 mm. Bottom, *syrraphella* (Walsingham), holotype male (BM slide 4228); Waianae Mts., 2,000 feet, Oahu.

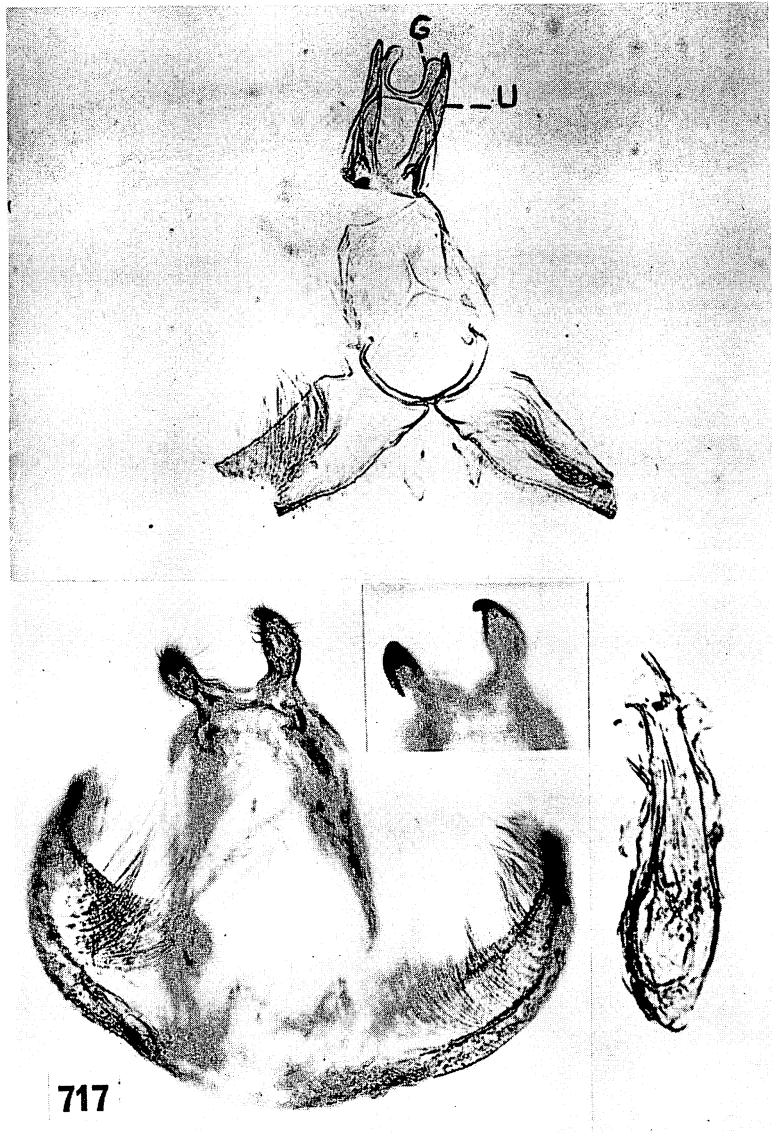


Figure 717—Male genitalia of *Batrachedrodes*. Top, *bedelliella* (Walsingham), holotype (BM slide 4206); Halcakala, 5,000 feet, Maui. The valvae are damaged and the aedeagus lost. The gnathus (*G*) is bent up between the arms of the uncus (*U*) and is viewed from below in this figure. Below, *ephelus* (Walsingham), holotype (BM slide 4203); Molokai, above 3,000 feet. The mount is not flattened, and most of the specimen is out of focus. The small inset figure is a different focus on the uncus. The gnathus is reduced to a small lobe on each side. Although I cannot see any evidence of damage, it is possible that the gnathus has been broken away and only the two stumps remain.

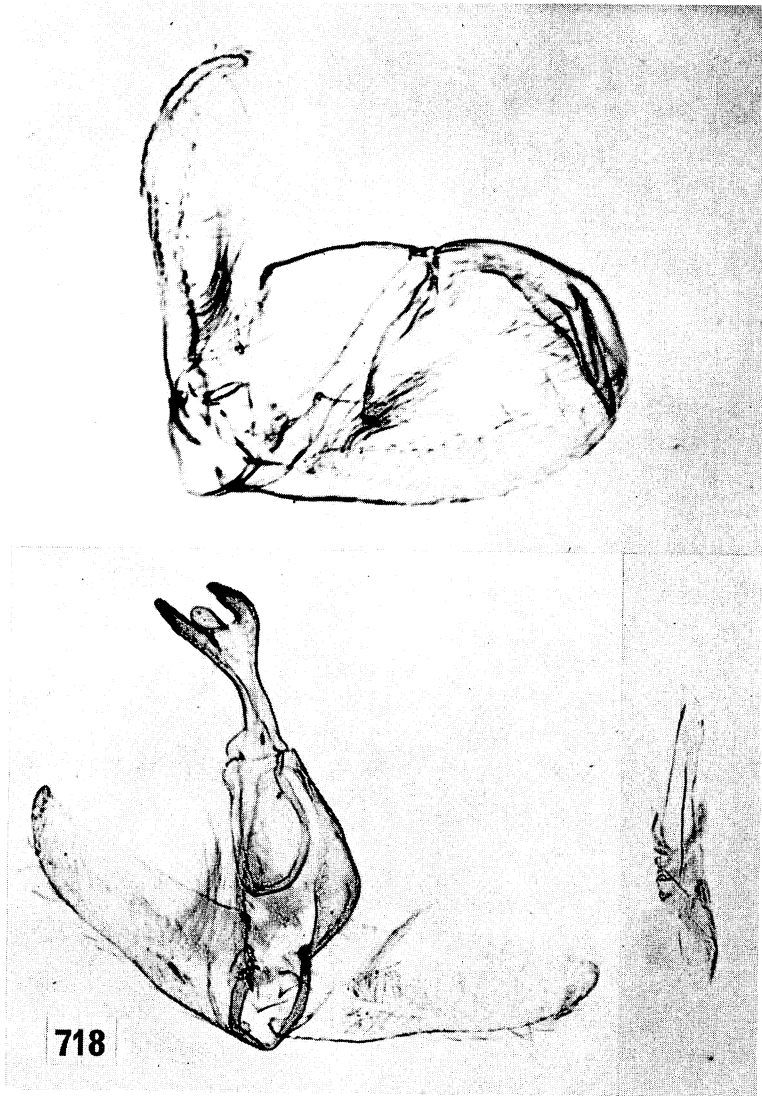


Figure 718—Male genitalia of *Batrachedrodes*. Top, *lomentella* (Walsingham), holotype (BM slide 4227); Waianae Mts., above 2,000 feet, Oahu. This is a poor mount. The genitalia resemble those of *sophroniella*; compare figure 719. Bottom, *sophroniella* (Walsingham), from the holotype of the synonymous *ruficiliata* Walsingham (BM slide 4207); Kona, over 2,000 feet, Hawaii. The figure of the aedeagus is not altogether satisfactory and may be misleading.

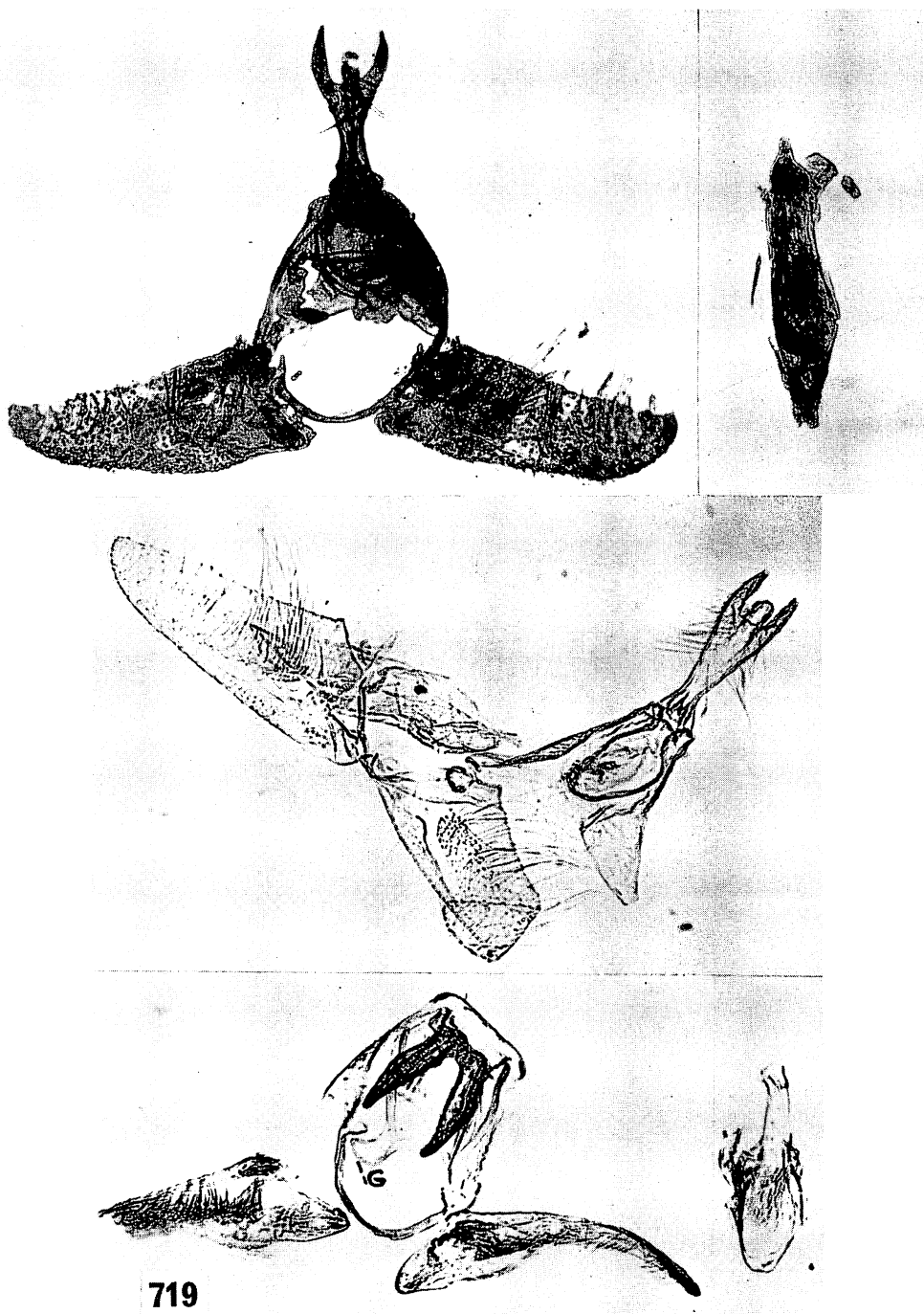


Figure 719—Male genitalia of *Batrachedrodes*. Top, a paratype of *lomentella* (Walsingham) (BM slide 14293); Waianae Mts., about 2,000 feet, Oahu; abdomen decomposed. Middle, *sophroniella* (Walsingham) (Busck slide 177); Mt. Tantalus, Oahu. Bottom, *supercincta* (Walsingham), holotype (BM slide 4226); Haleakala, 5,000 feet, Maui. The valvae have been damaged. Note the median projection on the gnathus (G).

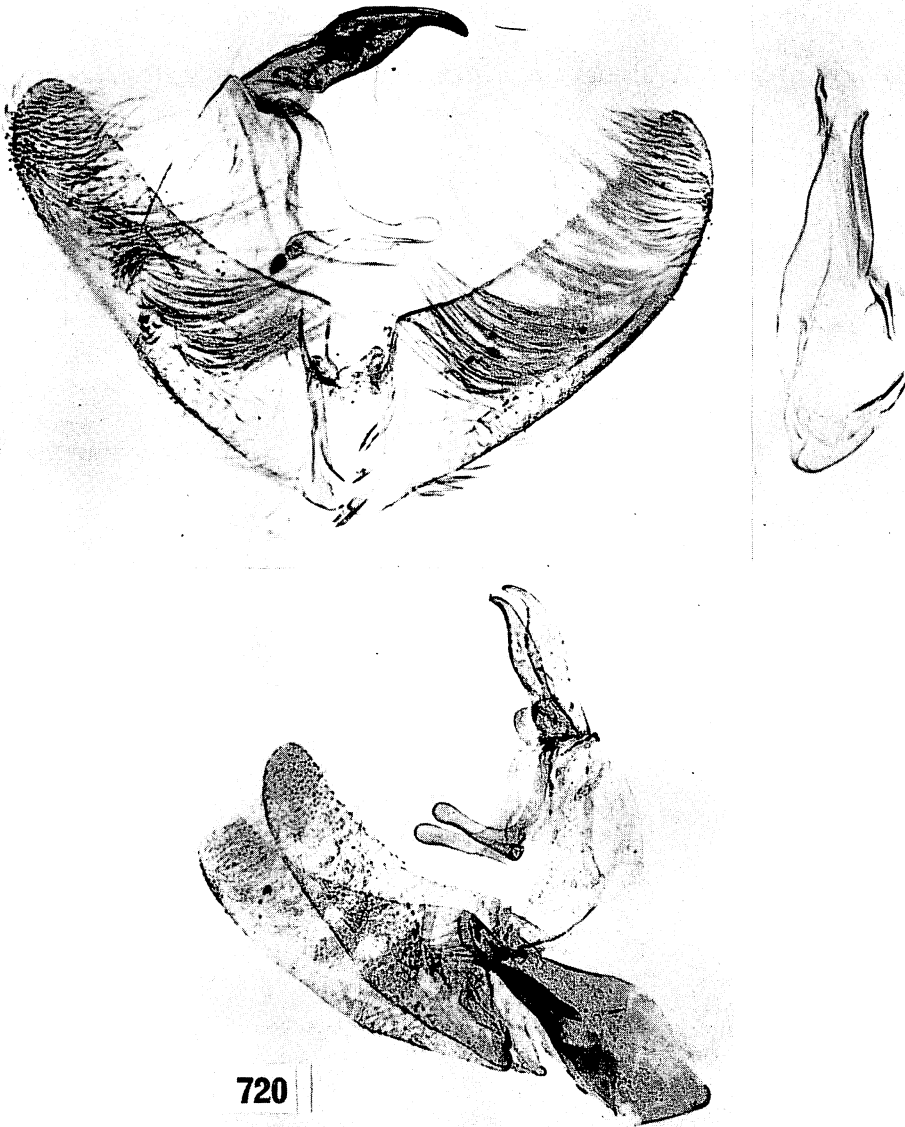


Figure 720—Male genitalia of *Batrachedrodes syrraphella* (Walsingham). Top, the holotype (BM slide 4228); Waianae Mts., about 2,000 feet, Oahu. Bottom, a paratype from Oahu, in lateral view (Busck slide 250) with aedeagus in situ. Compare figure 721.

***Batrachedrodes ephelus*** (Walsingham), **new combination** (figs. 714, moth; male genitalia; 722, female genitalia).

*Batrachedra ephelus* Walsingham, 1907*b*:509, pl. 15, fig. 8.

Endemic. Molokai (type locality: male, over 3,000 feet; female, 4,500 feet).

Hostplant: unknown, but presumed to be a fern.

This moth is known only from the type pair.

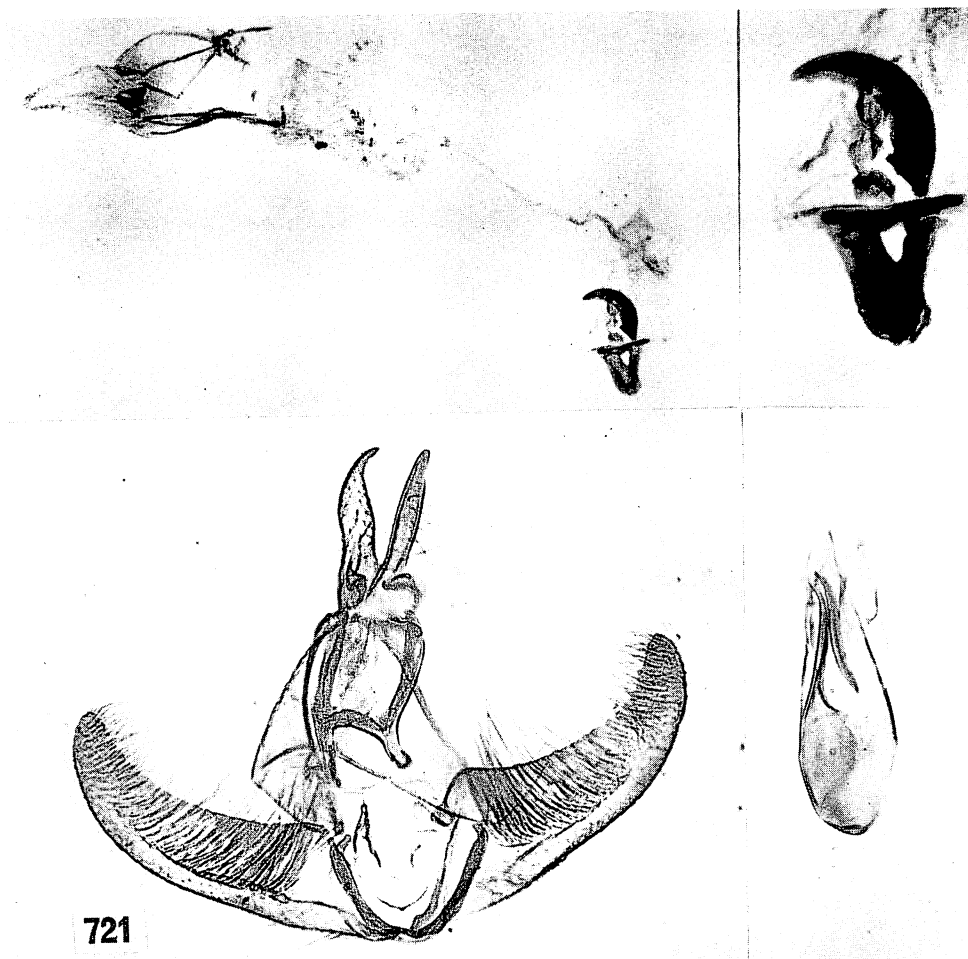


Figure 721—*Batrachedrodes syrraphella* (Walsingham). Top, female genitalia of a paratype (Busck slide 251). The curved piece of the signum has been broken off at the hole in the lower part. Bottom, male genitalia of a paratype (BM slide 2244); Waianae Mts., about 2,000 feet, Oahu. The left arm of the gnathus is partly obscured. Compare figure 720.

**Batrachedrodes lomentella** (Walsingham), **new combination** (figs. 715, moth; 718, 719, male genitalia; 723, female genitalia).

*Batrachedra lomentella* Walsingham, 1907b:511, pl. 15, fig. 13.

Endemic. Oahu (type locality: Waianae Mountains, over 2,000 feet), Hawaii.

Hostplant: described from six specimens found among the dead leaves of an unidentified fern.

This form is very close to *sophroniella*—it has similar male genitalia. It may prove not to be a different species.

**Batrachedrodes sophroniella** (Walsingham), **new combination** (figs. 708, pupa; 715, 716, moth; 718, 719, male genitalia; 723, female genitalia).

*Batrachedra sophroniella* Walsingham, 1907b:511, pl. 15, fig. 14.

*Batrachedra ruficiliata* Walsingham, 1907b:510, pl. 15, fig. 12. **New synonym.**

Endemic. Oahu (type locality: near head of Kawaiiloa Gulch), Maui, Hawaii (type locality of *ruficiliata*: Kona, above 2,000 feet).

Hostplant: *Aspidium* (*Dryopteris*) *cyatheoides*.

Parasites: *Eupelmus* species, *Sierola timberlakei* Fullaway.

This moth was described as *sophroniella* from one female, and as *ruficiliata* from one male. Although the holotype of the latter is a faded, partly abraded specimen, its color pattern agrees with other examples of *sophroniella*, and its genitalia are the same. Hence the name *ruficiliata* is placed in synonymy. I have compared specimens reared from ferns by Dr. Swezey with the holotype of *sophroniella* and have found them to be the same.

The larvae, protected by a web, feed, at times abundantly, upon the sporangia of the hostplant. "When there are no more sporangia, they feed on the undersurface of the frond, eating away the parenchyma and leaving the upper epidermis which then shows as dead spots. Pupation takes place within a cocoon alongside of the midrib of a pinna." (Swezey, 1922:58.)

**Batrachedrodes supercincta** (Walsingham), **new combination** (figs. 716, moth; 719, male genitalia; 724, female genitalia).

*Batrachedra supercincta* Walsingham, 1907b:510, pl. 15, fig. 11.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown, but fern presumed.

Only the holotype and allotype have been seen.

**Batrachedrodes syrrophella** (Walsingham), **new combination** (figs. 706, head, wing venation; 716, moth; 720, 721 (male, female genitalia).

*Batrachedra syrrophella* Walsingham, 1907b:509, 734, pl. 15, fig. 7.

Endemic. Oahu (type locality: Waianae Mountains, about 2,000 feet), Hawaii.

Hostplant: *Dryopteris parasitica*.

The larvae make tubes of white silk among the sporangia upon which they feed. More specimens of this species have been seen than any other of the genus. It has been found in both of the mountain ranges of Oahu, and I presume that it is much more widely distributed than the meager records indicate.



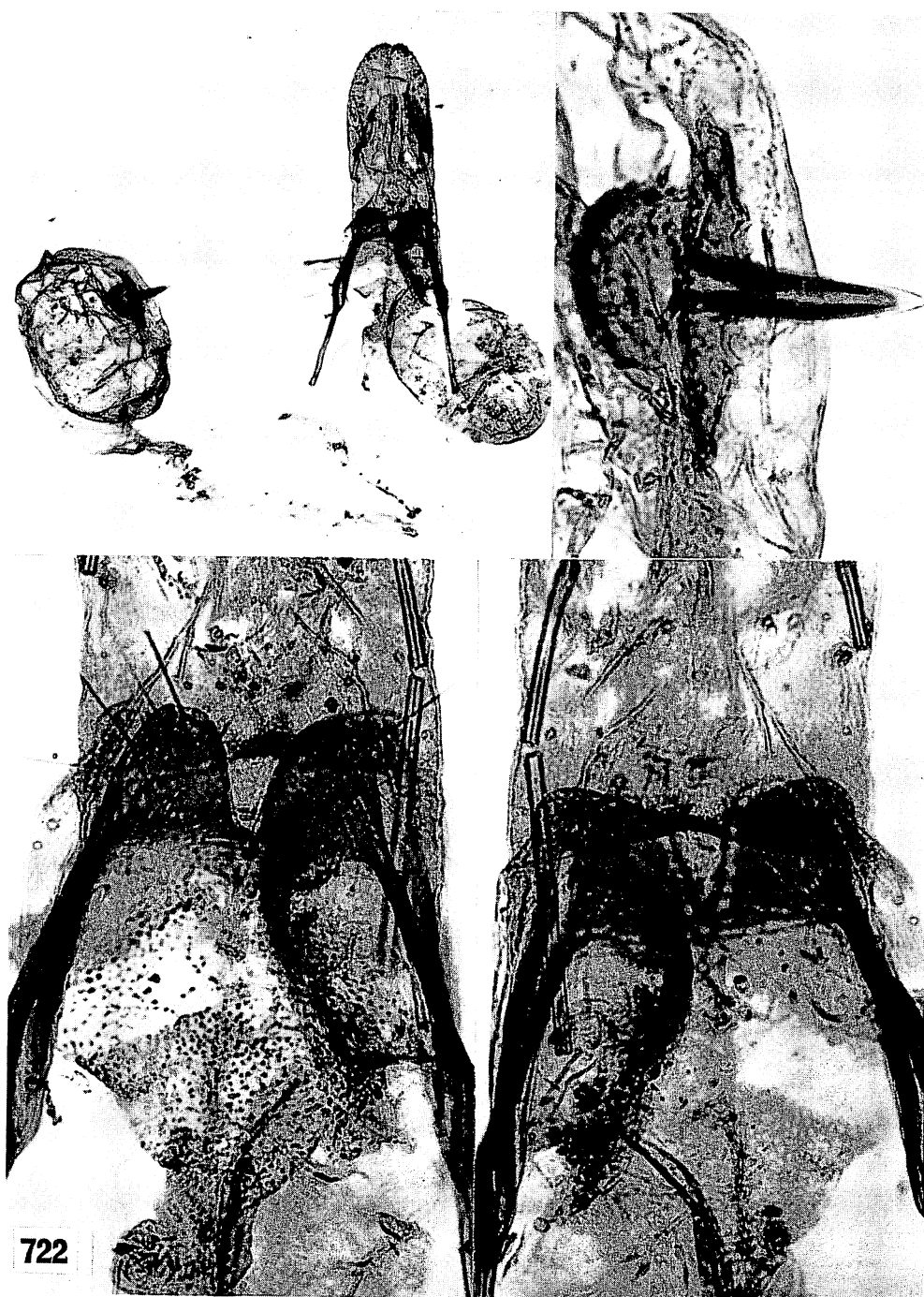


Figure 722—*Batrachedrodes ephelus* (Walsingham), genitalia of the allotype female (BM slide 14305). Bottom, the left figure is dorsal and the right, ventral.

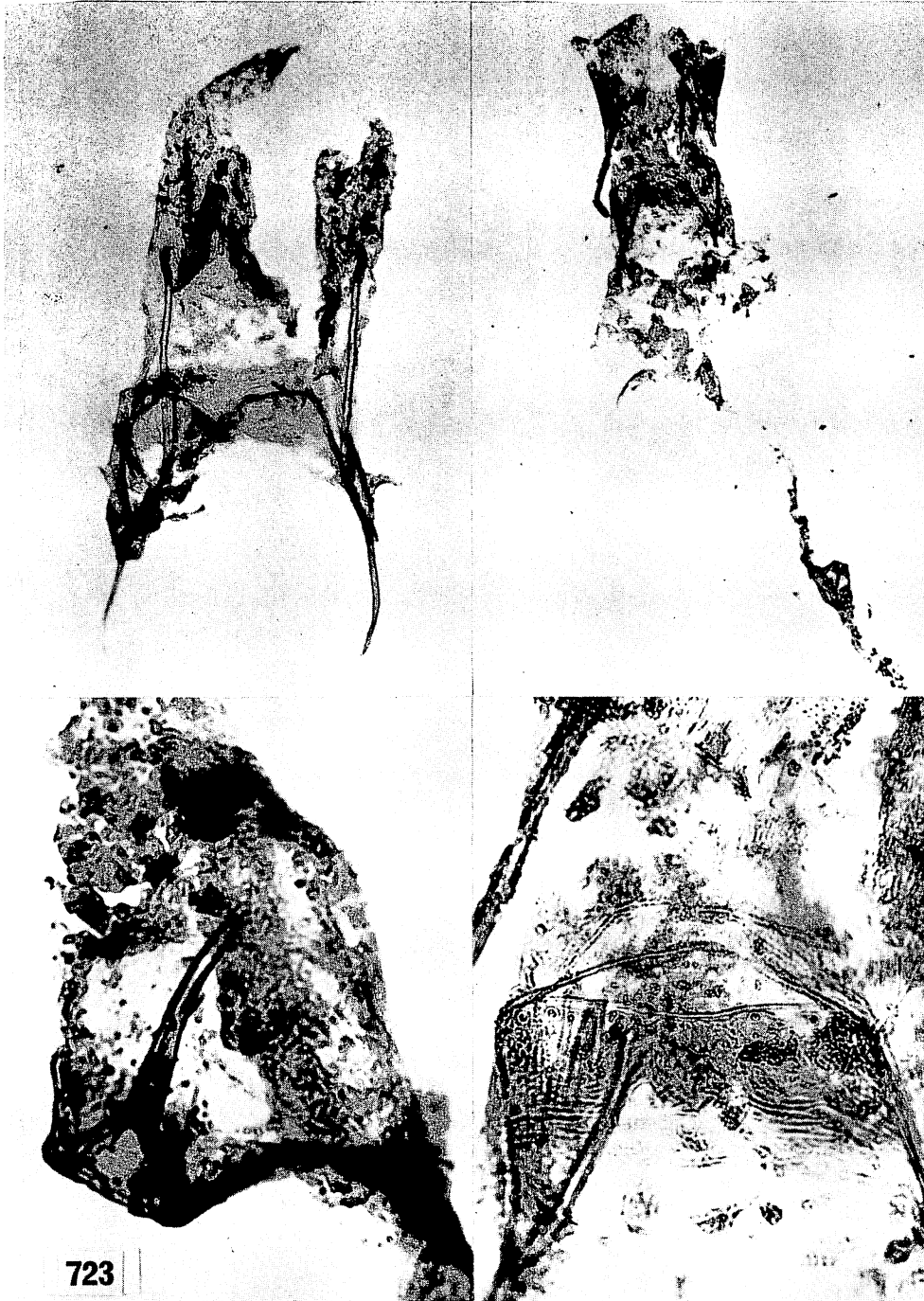


Figure 723—Female genitalia of *Batrachedrodes*. Top left, part of the allotype (BM slide 14294) of *lomentella* (Walsingham); Waianae Mts., about 2,000 feet, Oahu. The abdomen was badly decomposed. Top right and two bottom figures are of a specimen of *sophroniella* (Walsingham) (BM slide 14296); Pauoa, Oahu; ex *Aspidium cyatheoides*. Bottom left is the signum; bottom right is the ostium. The abdomen was decomposed.

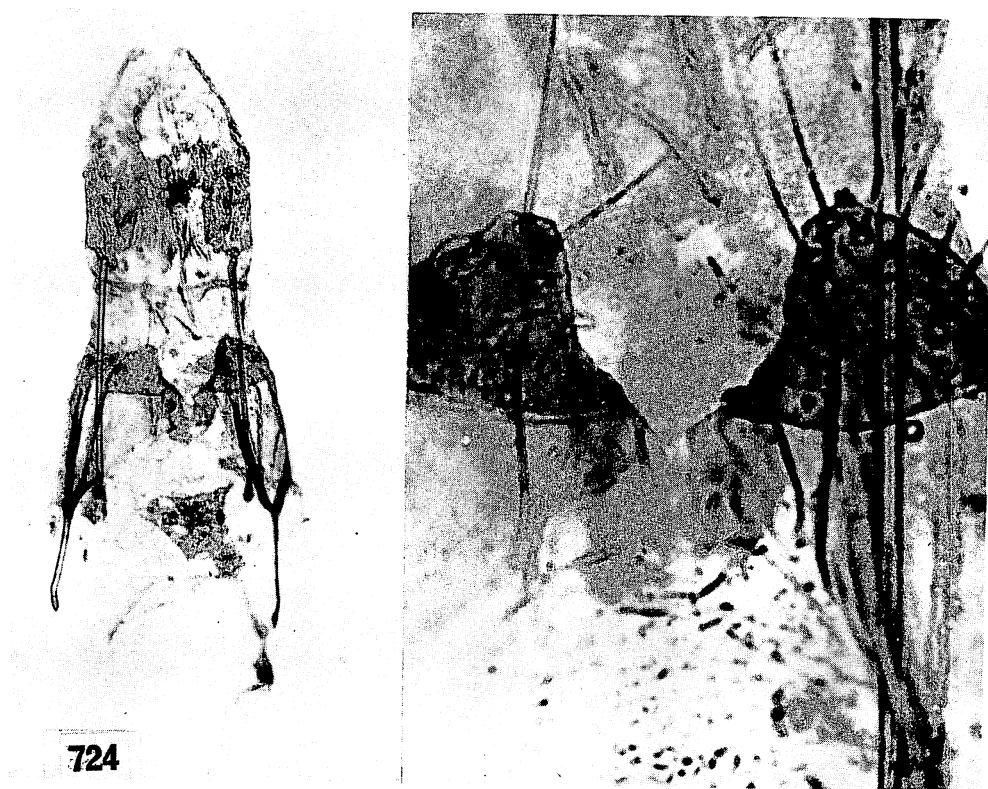


Figure 724—*Batrachedrodes supercincta* (Walsingham), part of the genitalia of the allotype female (BM slide 14295); Haleakala, 5,000 feet, Maui.

Subfamily **COSMOPTERIGINAE** (Wocke), **revised status**

*Cosmopterygidae* Wocke, in Heinemann and Wocke, 1876(1877):520. Meyrick, 1909*b*:410. Busck, 1912:1. T. B. Fletcher, 1928*a*, Indian fauna.

*Cosmopteryginae*: Walsingham, 1891:124, of Tineidae. Spuler, 1898*a*:32, of Lavernidae.

*Cosmopterigidae, auctorum*. Diakonoff, 1954*b*:63, key to New Guinea genera. Hodges, 1962*b*:1, revision of North American fauna; 1966*b*:155. Common, 1970:822, details on Australian fauna.

*Cosmopteriginae*: Riedl, 1969:651.

*Lavernidae*: in the sense of Walsingham, 1890:147, and Busck, 1909:93.

*Diplosaridae* Meyrick, 1915*a*:339; 1919*b*:351–372. Hampson, 1918:386, as a synonym of Hypsocomomidae.

*Hypsocomomidae* Hampson 1918:386. Brues and Melander, 1932:233. Brues, Melander and Carpenter, 1954:261. **New synonym.**

*Hypsocomomini*: Handlirsch, 1924:888. **New synonym.**

Some authors have included the cosmopterigines in the “Mompidae”, others have assigned them to the Lavernidae, and Walsingham, for reasons unknown, placed them in the “Hyponomeutidae” in *Fauna Hawaiiensis*. Hampson’s name Hypsocomomidae is only an invalid replacement name for Meyrick’s Diplosaridae which is a synonym of Cosmopteriginae. Meyrick always referred to the Hawaiian members of the group as “Diplosaridae” which he kept separate from the “Cosmopterigidae”. (See the quotation from Meyrick under *Irenicodes* below).

The reason for the use of the spelling Cosmopteriginae instead of the more correct Cosmopteryginae is as follows: The type-genus was originally spelled *Cosmopterix* by Hübner because of incorrect transliteration, and under Article 32a(ii) of the Code of Nomenclature, this is the correct original spelling. Zeller (1839) emended it to the correctly transliterated form *Cosmopteryx*, but under the Code this correction is not now allowed. I consider it unfortunate that the more correct form *Cosmopteryx* is not accepted. See also Hodges, 1966*b*:155–156, regarding the designation of a type-species for *Cosmopterix* and related problems.

The Cosmopteriginae is the largest family-group of Hawaiian Lepidoptera and one of the largest of all groups of organisms in Hawaii. It is poorly understood the world over. The more than 350 Hawaiian species included here exceed the combined total of 168 Hawaiian Macrolepidoptera reported in my seventh volume and the 226 Hawaiian Pyraloidea listed in my eighth volume of *Insects of Hawaii*. It is probable that the number of Hawaiian Cosmopteriginae exceeds 500 species. A large number of species in collections remains to be described, and untold numbers of uncollected new forms must exist on all of the islands. This extraordinary development of the Cosmopteriginae in such a small land area (about 6,440 square miles) is a great contrast to the cosmopterigine fauna of America north of Mexico. Hodges, in his 1962*b* American revision, records only 67 species in 10 genera from that vast region, and the largest genus, *Cosmopterix*, includes only 28 species as compared with more than 350 species for the largest genus in Hawaii. One could spend a long lifetime studying this one subfamily in Hawaii and not exhaust the

possibilities of interesting, highly exciting, and worthwhile research. I regret most sincerely that, because of frustrating difficulties beyond my control, I am unable to pursue the study of this family in Hawaii as my experience dictates that it should be followed. I realize more than any other person how inadequate is my introduction to this astounding Hawaiian complex of complexes.

A concise description of the Cosmopteriginae is difficult because the group is so large and diverse. A study of the illustrations, especially those of the genitalia, will reveal the essential features of the group. In Hawaii, the following combination of characters will enable members of this subfamily to be separated from all others in the islands:

Head and pronotum smooth scaled, the scales often broad; ocelli absent; proboscis well developed, squamose; maxillary palpi present, usually rather short; labial palpi upcurved in front of face, variable in shape, often long and slender, never with erect, specialized bristles; antennae varying from about three-fourths of the length of the forewings to about as long as the forewings, first segment with or without a pecten of several setae. Legs variable. Wings with shape and venation variable, as in figures; forewings with 9 to 12 veins, vein 7, when present, runs to costa or occasionally to apex but never to termen; hindwings not broader than forewings and often much narrower than forewings, the apex not produced in the Hawaiian species, venation variable, costal contour variably arcuate but not irregular and not lobed. Abdominal tergites without setose bands. Male genitalia as illustrated, uncus evidently lost in most species and the gnathus (or gnathus and socii?) developed into asymmetrical arms that may appear uncuslike; lobes of anellus developed, often asymmetrical and in some forms the right arm may be reduced and only the left arm evident; valvae variable, often asymmetrical and often armed with extraordinary, modified setae and processes. Female genitalia with the ostium often heavily sclerotized and protuberant, evidently retractile in some species and long and tubelike in others. (Note: for simplification, and because

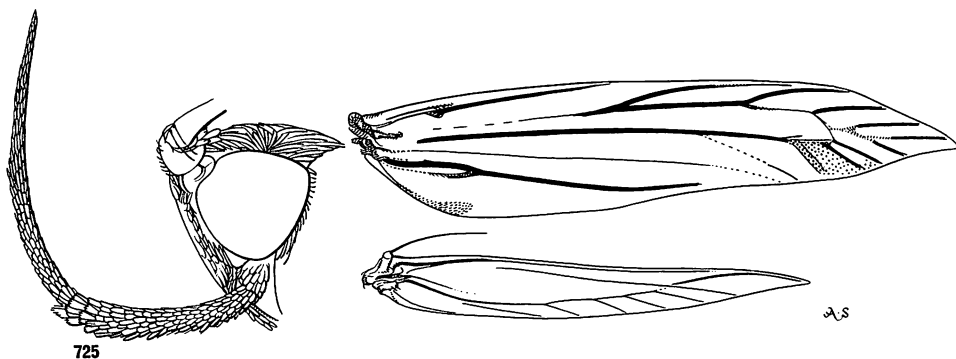


Figure 725—Head and wing venation of *Trissodoris honorariella* (Walsingham) from the holotype male from Pitcairn Island (BM slide 9610). The dots at the end of the cell indicate the tuft of specialized, erect, yellow setae on the underside of the forewing of the male.

it appears that the homologies of the ostial area are not completely understood, I have called the *ostium* that which might also be called the *sterigma* or the fused *lamellae antevaginalis* + *lamella postvaginalis*, or the *lamellae vaginales*.)

The identification of Hawaiian Cosmopteriginae is difficult. Before attempting determinations in this subfamily, one should become familiar with the morphology of the group by careful and detailed study of illustrations and specimens. Dissections are essential for the determination of most species. Some species are closely similar in external appearance, and, unless extreme care is taken, misidentifications and improper associations can easily be made.

## KEY TO THE GENERA OF COSMOPTERIGINAE IN HAWAII

Note: I have placed *Ithome* (Chrysopeleiinae) in this key, because it might be considered a typical cosmopterigine without careful study or a specialist's knowledge.

1. Ocelli present (minute; check your specimen carefully); one small, dark-colored species about 7 mm. in expanse; larvae feed in blossoms of *Prosopis* and *Acacia*; figures 701, 702. . . . . **Ithome** in the Chrysopeleiinae.  
Ocelli absent, Cosmopteriginae. . . . . 2
- 2(1). Hindwings very narrow, straplike or narrowly blade-like, and/or the cell much attenuated distad, narrowly pointed at apex and discocellulars very short, if distinguishable, as in figures 725, 732–734. . . . . 3  
Hindwings at most moderately narrowed and cell at least moderately broad distad and discocellulars either well developed or absent with cell broadly open at apex, or not as described above. . . . . 4
- 3(2). Forewing boldly marked with broad, alternating, pale and dark fasciae, vein 5 from cell near 4 and vein 6 out of 7; hindwing with vein 6 from apex of cell or connate with 7; scaling on posterior, apical corner of basal antennal segment of both sexes extended, thus forming a “notch” with the base of the remainder of the antenna; figures 725, 727, 730. . . . . **Trissodoris**.  
Forewing without such fasciae, vein 5 out of 8 and distant from 4, vein 7 out of 8 and 6 out of 7; hindwing with vein 6 long-stalked with 7; basal antennal segment lacking such an apical expansion of the scaling; figures 732–736. . . . . **Anatrachyntis**.
- 4(2). Forewing (at least in male, the only sex known) with an extraordinary, thornlike process protruding from the scales on the ventral surface beyond apex of cell (as a modification of vein 3), as in figures 775,

777, cell narrow, venation unusual; hindwing with only seven veins, veins 4 and 5 evidently fused; venation of fore- and hindwings as in figure 775

..... **Hyposmocoma (Euperissus) sordidella** (Walsingham).

Forewing without such an elongate process (but compare figure 776 of *Hyposmocoma (Euperissus) mystodoxa*) and with different venation; hindwing usually with eight fully developed veins except in *Asymphorodes* and a few species of *Hyposmocoma*.....5

- 5(4). Venation unusual, differing in the two sexes, as in figures 745 and 746; hindwing with vein 8 obscure or reduced or with only seven or fewer veins; forewing with vein 3 leaving cell opposite to a point between origins of veins 10 and 11; male genitalia as in figures 749–752, with vinculum well developed and elongate, thus the valvae are articulated far from base of tegumen; right anellar lobe obsolete, the left lobe developed but adhering closely to aedeagus; forewings of known species brown with white or cream-colored vittae, as in figure 748; the moths rest with antennae extended forward in front of body

..... **Asymphorodes.**

Venation different from above, as in figures 758–774 and 807–866; hindwings usually with eight distinct veins; forewings with vein 3 leaving cell opposite to a point between veins 9 and 10, often near apex of cell; male genitalia different from figures 749–752, and with vinculum rudimentary or obsolete and the valvae apparently articulated to base of tegumen; both anellar lobes fully developed and free; forewings of many colors and patterns; the moths rest with antennae extended caudad.....

..... **Hyposmocoma.**

#### Genus **TRISSODORIS** Meyrick

*Trissodoris* Meyrick, 1914a:775 (the page number is incorrectly stated by Neave, 1940:568, to be 776). Type-species: *Stagmatophora honorariella* Walsingham, 1907b:515, by original designation.

Although only two species were previously assigned to this genus, we know that there are several distinct new species on various islands from southeastern Polynesia westward. It is possible that *Trissodoris* is a synonym of an earlier name, but studies of the problems involved have not been completed.

The larvae mine the leaves of *Pandanus*, in which they make characteristic "keyholes". Although most of the reared material seen has come from dead leaves, Dr. Swezey found a new species mining green *Pandanus* leaves when we were collecting together in Samoa in 1940.

Bradley (1957:30) described a form which he called *Trissodoris honorariella* subspecies *pansella* from Rennell Island (off the southern Solomon Islands). Although it is closely similar to *honorariella*, I believe that the differences exhibited by this form, such as the difference in the right brachium for example, demonstrate that the moth is a full species. It should be known as *Trissodoris pansella* Bradley, **new status**. Only one male of *pansella* is known, but it appears that the patch of specialized setae on the underside of the forewing differs from that of *honorariella*.

The species that was formerly called *Stigmatophora*? *sordidella* Walsingham is here transferred to *Hyposmocoma*.

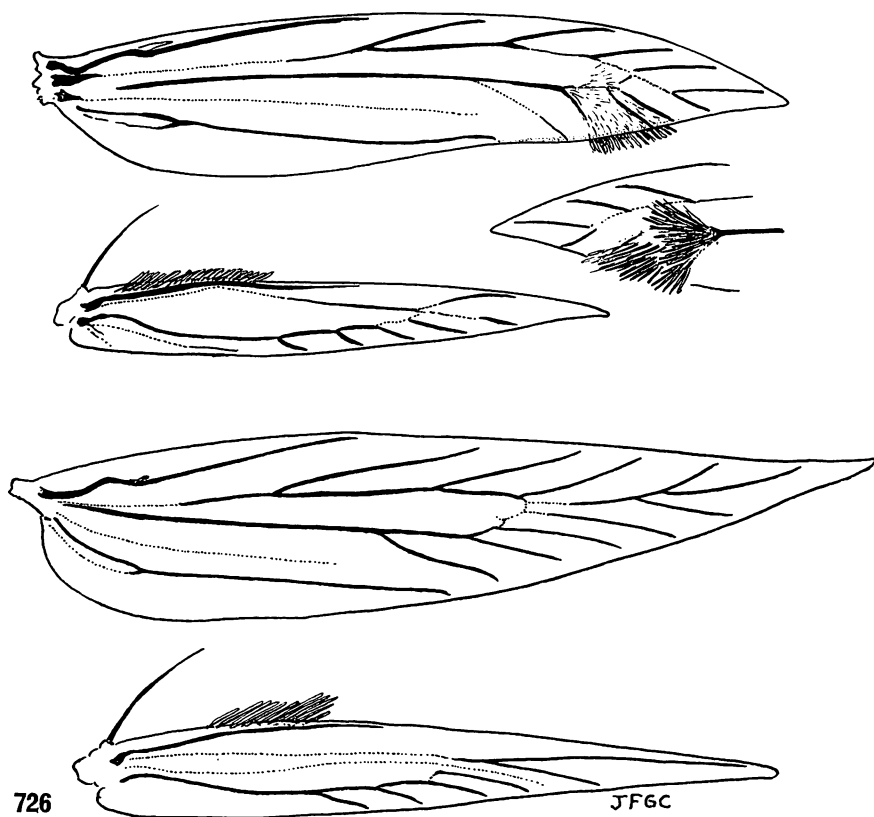


Figure 726—Top, wing venation of *Trissodoris honorariella* (Walsingham) with an inset of the underside of the apex of the forewing of the male to show the tuft of erect hair, setae, and scales. Bottom, wing venation of *Stigmatophora heydeniella* (Fischer von Roeslerstamm), the type-species of *Stigmatophora*, in which genus *honorariella* was originally described in *Fauna Hawaiiensis*.



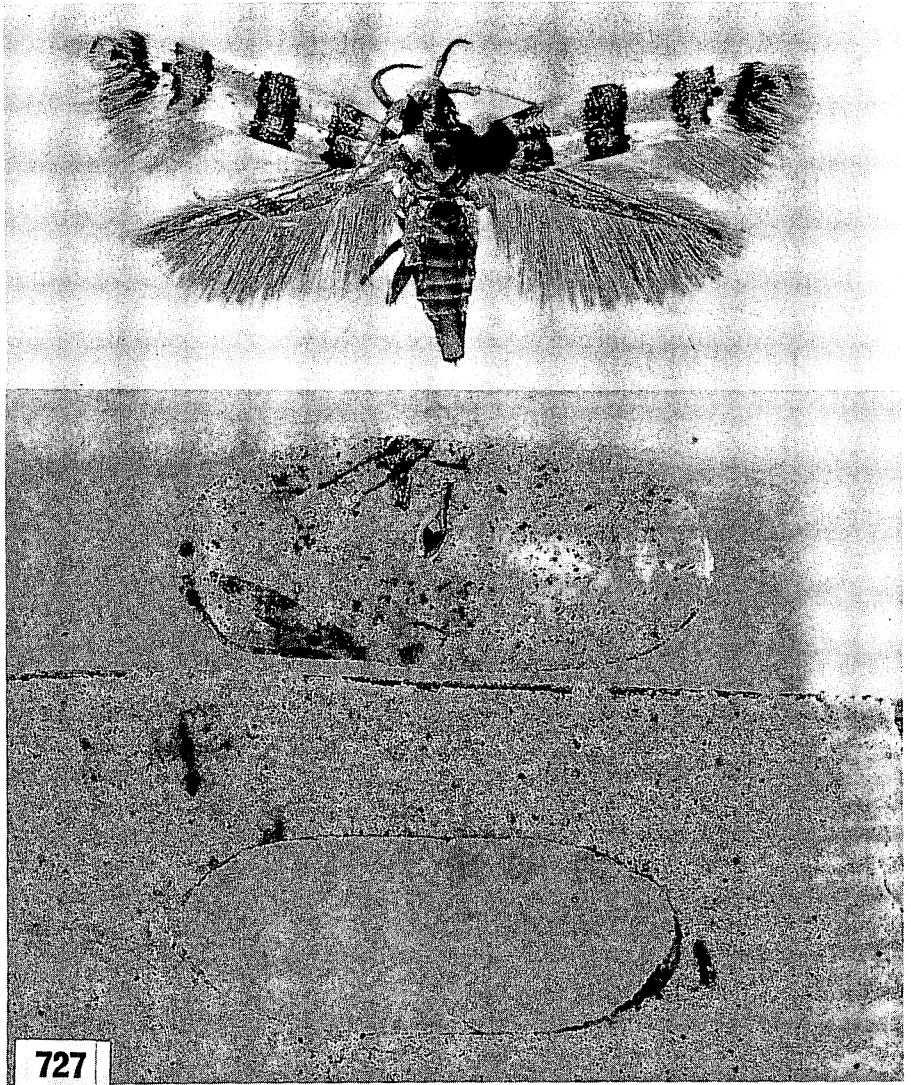


Figure 727—*Trissodoris honoraeiella* (Walsingham). Top, a female from Laie, Oahu; forewing 6 mm.; the background scaling of the forewings is creamy white, the inner areas of the fasciae are brownish yellow, and their edges are fuscous. The dorsal squamae of the abdomen are peculiar. The scales are deeply divided into sharp points so that it appears that the abdomen is clothed with dense yellow spines. Middle, pupal case. Bottom, part of a *Pandanus* leaf showing a typical hole from which a pupal case has been removed by a larva. Length of the pupal case is 12.5 mm.; the hole near its middle is a pinhole. Specimens from Oahu.

**Trissodoris honorariella** (Walsingham) (figs. 725, 726, head, wing venation; 727, moth, pupal case; 728, 729, male genitalia; 730, female genitalia, underside male moth; 731, pupa).

*Stigmatophora honorariella* Walsingham, 1907*b*:515, pl. 15, fig. 21, male. Perkins, 1913:clxv.

*Trissodoris honorariella* (Walsingham) Meyrick, 1914*a*:776; 1927*c*:92. Swezey, 1942:212. Clarke, 1965*a*:550, pl. 271 (illustrates the wings, wing venation, head, and genitalia of the holotype which is in the British Museum).

*Stigmatophora quadrifasciata* Walsingham, 1907*b*:516, pl. 15, fig. 22, female. Synonymy by Meyrick, 1914*a*:776.

*Trissodoris quadrifasciata* (Walsingham) Swezey, 1954:146.

The Pandanus leaf perforator.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. Described from Pitcairn Island (type locality of *honorariella*), New Guinea (type locality of *quadrifasciata*), and Hawaii. The first specimens collected in Hawaii were taken by Blackburn on Lanai. The species is supposedly widespread from Ceylon in the west through the New Hebrides, Fiji, and Samoa to Pitcairn and the Marquesas in the east, but it is not recorded from most of the localities in which it occurs. The genitalia of males from Kauai and Oahu agree with those from Hivaoa, Marquesas.

Hostplants: *Pandanus* species.

Parasite: *Eupelmus* (species not determined).

This pretty, boldly marked moth is common and widespread in Hawaii, and I suppose that it may be found throughout the range of its host *Pandanus* in the islands. Its presence is easily detected because of the conspicuous "key hole" perforations its larvae make in dead *Pandanus* leaves. Figure 727 illustrates one of these perforations. The larvae mine the interiors of the dead leaves. When they reach maturity the larvae cut through both upper and lower leaf surfaces which are as smoothly and regularly cut as if by a metal punch. Then the larvae fasten the cut-out sections of leaf together to form their large pupal cases. The cases thus made are usually pulled into the surrounding mined-out interior of the leaf, and this results in clean-cut, ovate holes being made which pass completely through the leaves. Where the moth is common, the dead leaves are frequently riddled with holes.

The habits of this moth have enabled it to be distributed far and wide by the native peoples of the Pacific. These people use the leaves of *Pandanus* for the making of mats, baskets, and other plaited items which for generations have accompanied voyaging islanders, and the moth has thus been widely dispersed by man.

The female genitalia are extraordinary. The ovipositor is armed with a pair of long, slender, serrated, sawlike blades (see figure 730). The caudal parts of the abdomen are strongly sclerotized, and the blades are attached to stout apophyses which are activated by strong muscles. It is obvious that the saws are used to cut into plant tissue, and they must be efficient organs. I have not seen any structure similar to these double saws in other Hawaiian moths

I have studied. I have not seen such organs described, although various moths with cutting or piercing ovipositors of different kinds are known.

The males have a strongly developed, long brush of yellow hairs on the metapleuron beneath the anterior corner of the root of each hindwing, and there is a peculiar patch of erect yellow setae on the underside of each forewing of the male, as shown by figures 726 and 730.

The larvae of *Trissodoris* are unusual and distinctive in the Hawaiian fauna. They are very long and slender and reach a length of about 15 mm. The

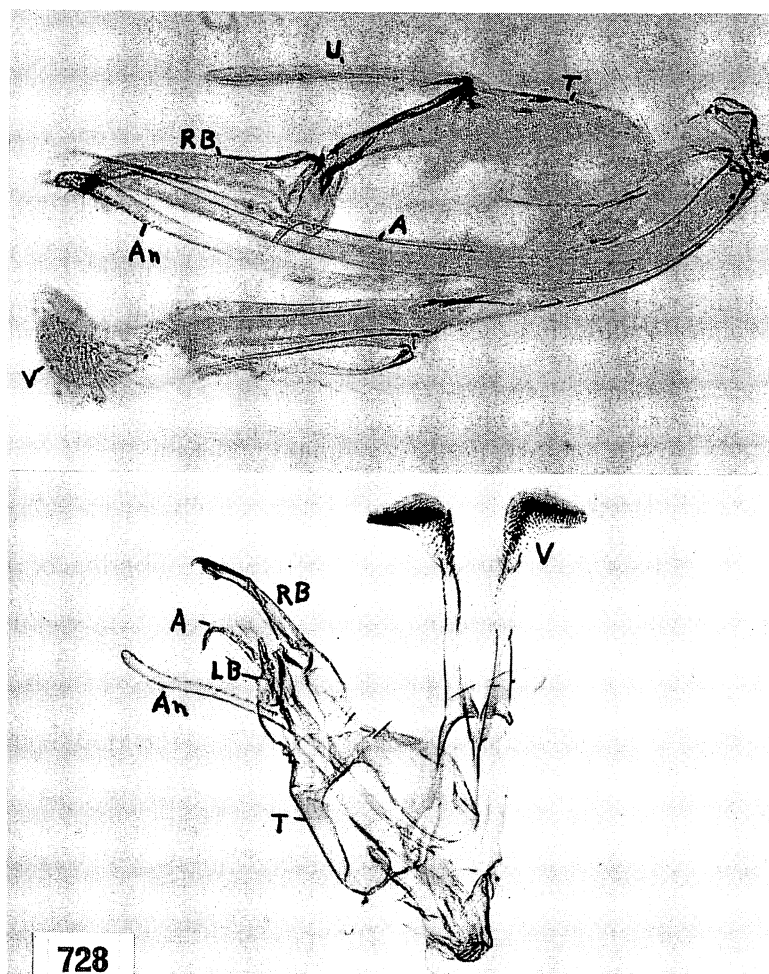
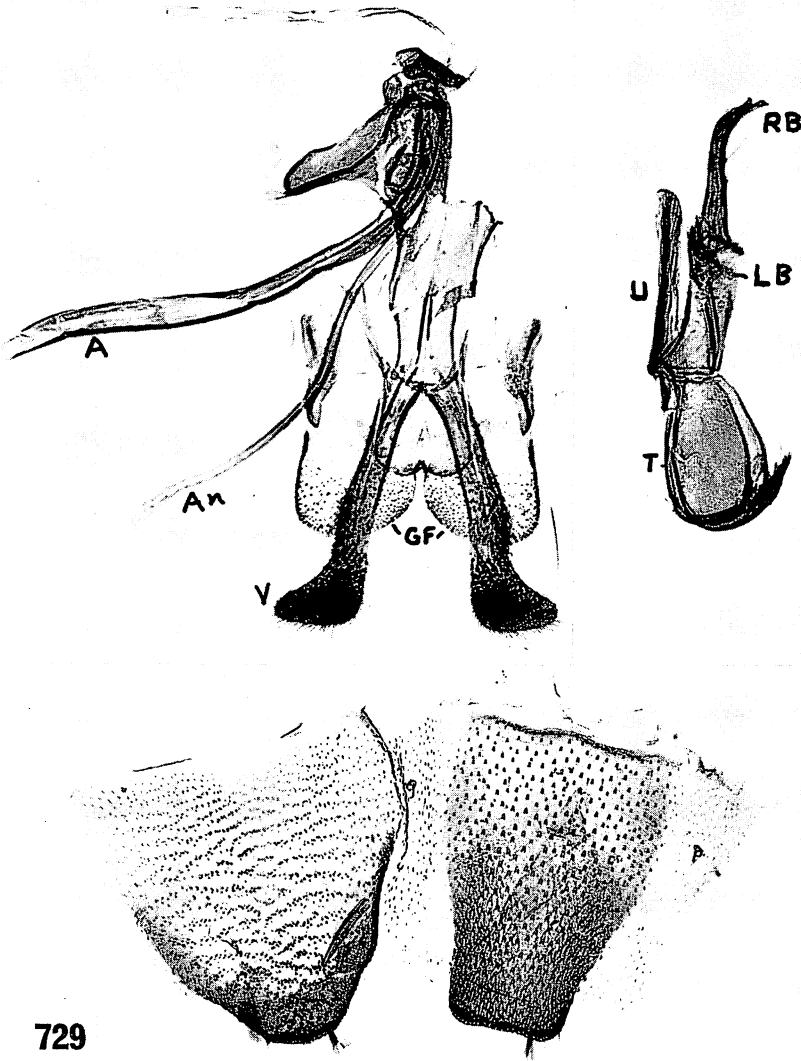


Figure 728—*Trissodoris honorariella* (Walsingham), male genitalia. Top, the holotype from Pitcairn Island (BM slide 9610 Clarke); lateral aspect; aedeagus in situ. Bottom, a specimen from the Marquesas (Busck slide 132); aedeagus removed. *A*, aedeagus; *An*, anellar lobe; *LB*, left brachium; *RB*, right brachium; *T*, tegumen; *U*, uncus.

thoracic segments are notably broader than the abdominal segments; the mesothorax is the broadest segment. A particularly noteworthy character is that the ventral proleg-bearing abdominal segments are narrower cephalad than caudad. The ventral prolegs are within the caudal third of the segments and thus appear unusually far caudad. The mandibles have four teeth. The



729

Figure 729—*Trissodoris honorariella* (Walsingham), male genitalia. Top left, aedeagus, anellar lobe, valvae, and genital "flaps" of eighth sternum. Top right, tegumen, uncus, and brachia. Bottom, apex of abdomen split open to show dorsal, lateral, and ventral surfaces. Kaena, Oahu (slide Z-VI-25-61). *A*, aedeagus; *An*, anellar lobe; *GF*, genital flaps; *LB*, left brachium; *RB*, right brachium; *T*, tegumen; *U*, uncus; *V*, valva.

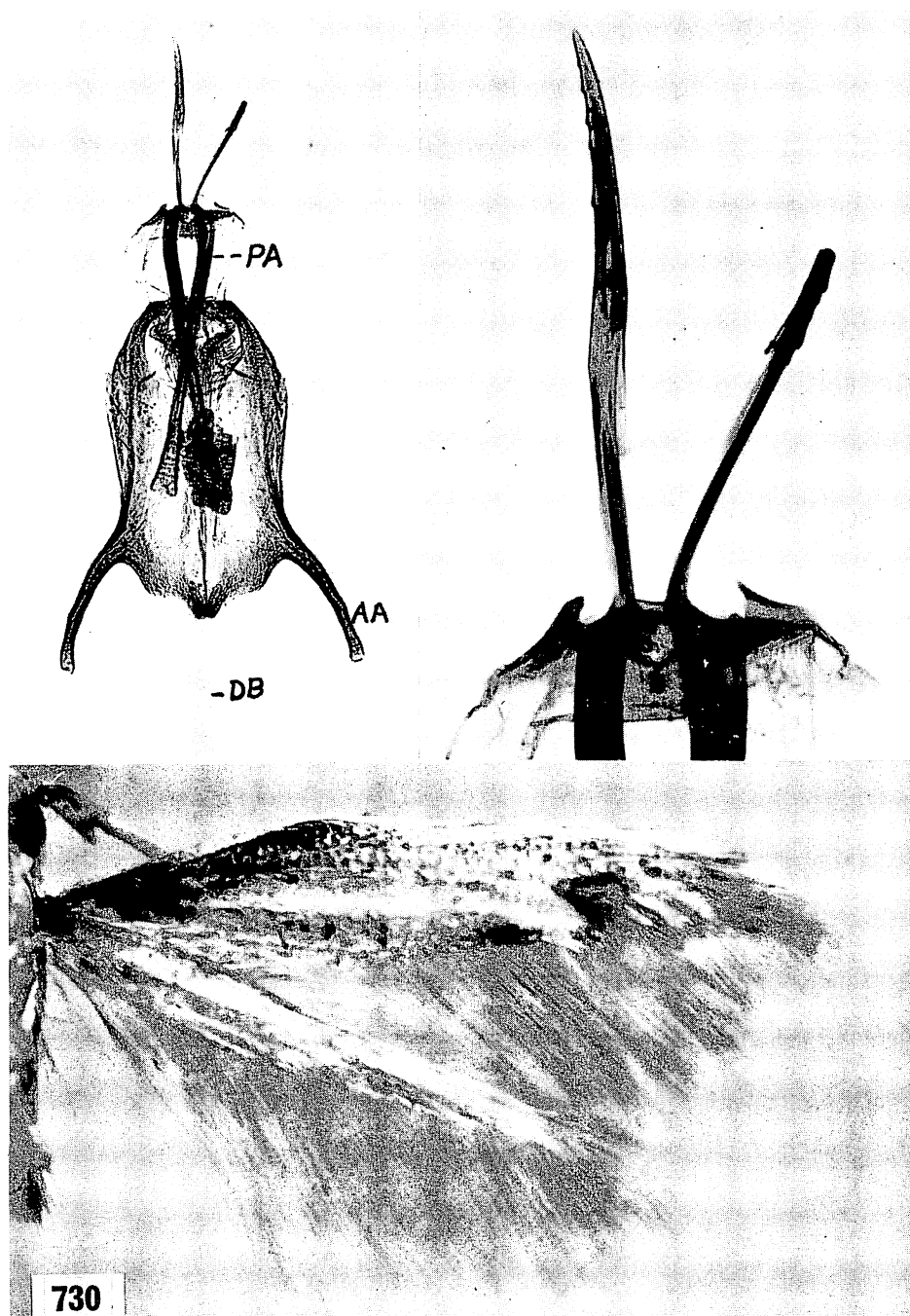


Figure 730—*Trissodorus honorariella* (Walsingham). Top, female genitalia; one "saw" lobe broken; Laie, Oahu (slide Z-VI-26-61). Bottom, ventral aspect of a male from Buru to show the strong "notch" on the antenna and the cluster of erect yellow hairs and setae near the distal quarter of the forewing. AA, PA, anterior and posterior apophyses; DB, ductus bursae.

adfrontal sclerites of the head extend only about one-half the distance to the vertical triangle and do not reach the P2 setae. The prothoracic prespiracular L setae are arranged in a subhorizontal line at the lower edge of a distinctly pigmented, elongate, slightly oblique macula cephalad of the large, elongate spiracle which has well pigmented peritremes. The thoracic leg coxae are much more distantly separated than the transverse diameters of the coxae.

On abdominal segments 1 to 8 the D1 setae are short, the D2 setae very long and almost directly in line caudad of the D1 setae (the D2 setae are very slightly more distantly separated than the D1's). On abdominal segments 1 to 7 the SD1 setae are above the spiracles and about two to three times as far from the spiracles as the lengths of the spiracles. The spiracles are ovate, those on segment 8 are about twice as long as those on segments 1 to 7 and the prothoracic spiracles are larger than those of the eighth abdominal segment. On abdominal segments 1 to 8, seta L3 is near the caudal margin of the segments and in line beneath seta D2. The SV setae on abdominal segments 1 to 8 are arranged as follows: 2 on 1, 3 on 2 to 6, 2 on 7, and 1 on 8. The crochets on the ventral prolegs are arranged in complete biordinal circles, and the crochets may appear longer on the cephalic sides of the prolegs.

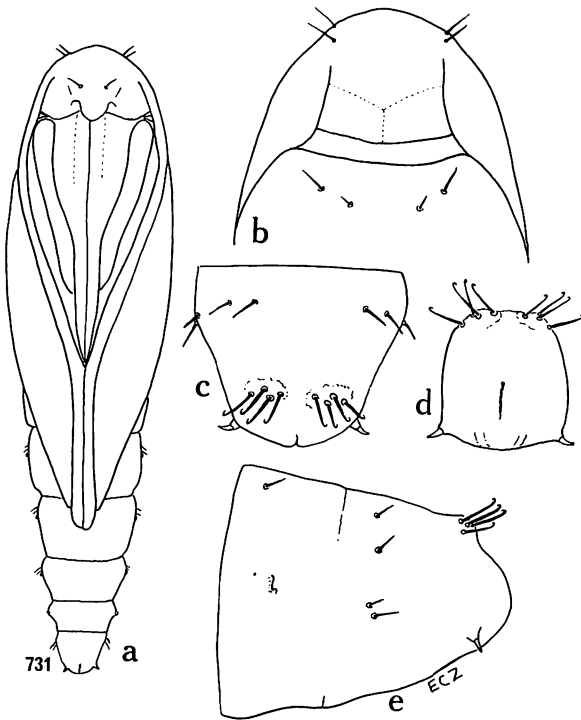


Figure 731—Details of the pupa of *Trissodoris honorariella* (Walsingham). Lihue, Kauai, ex *Pandanus* leaf. Length 5.5 mm. *a*, ventral aspect of pupa; *b*, dorsal aspect of head, pronotum, and part of mesonotum; *c*, dorsal aspect of cauda; *d*, direct caudal aspect of cauda; *e*, left lateral aspect of the three caudal abdominal segments.

Genus **ANATRACHYNTIS** Meyrick

*Anatrachyntis* Meyrick, 1915a:325. Type-species: *Gracilaria*? *falcatella* Stainton, 1859b:121 (= *Pyroderces spodoctha* Meyrick), by original designation (figs. 732, 740).

*Sathrobrotia* Hodges, 1962b:73. Type-species: *Batrachedra rileyi* Walsingham.

**New synonym.**

While studying in the British Museum with J. D. Bradley in 1958, he and I found that the genitalia of this genus are distinct from those of *Pyroderces* Herrich-Schäffer (type-species: *Cosmopterix argyrogrammos* Zeller, 1847a:38; male genitalia on my figure 738). Therefore the two species heretofore assigned to *Pyroderces* in Hawaii are transferred to *Anatrachyntis*. Much confusion exists concerning this group of difficult, poorly known or misunderstood species, but it is beyond the scope of this book to extend the study beyond the species occurring in Hawaii. The genus is probably a large one, and many of

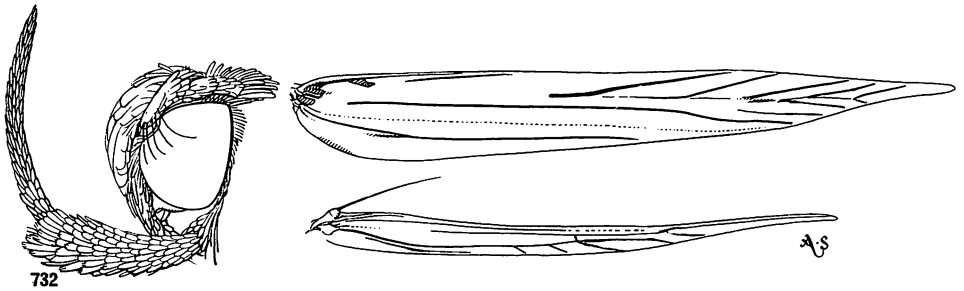


Figure 732—Head and wing venation of *Anatrachyntis falcatella* (Stainton), the type-species of *Anatrachyntis*; India (BM slide 5213); color pattern of palpus not shown. The number of setae in the antennal pecten on this and other species of the genus is variable. Evidently, veins 2 and 3 are fused in the forewing and not 3 and 4.

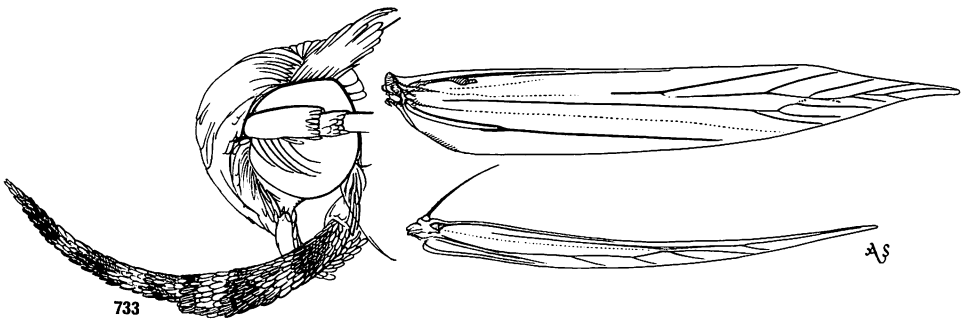


Figure 733—Head and wing venation of *Anatrachyntis rileyi* (Walsingham). Head from a Honolulu specimen; wings from an Oahu specimen (on Corbet slide 6 in the British Museum).

the species are closely similar in appearance. Specific determinations are not easy, and no doubt many records in literature are based upon misidentifications.

When Meyrick described *Anatrachyntis*, he made a serious error in stating that ocelli are present—they are absent.

Hodges found independently that *Pyroderces* has been used in a compound sense. However, the generic name *Sathrobrotia* proposed by him is unnecessary and is a synonym of Meyrick's *Anatrachyntis*.

*Anatrachyntis* appears to have its greatest development in the Oriental Region. It has spread eastward as far as Australia and New Zealand, south-westward into Africa, and it has penetrated America. The three representatives in Hawaii are widely distributed foreign species.

The female genitalia include a peculiar mass of densely packed squamae which lies to the right of the tubelike ostium. It appears as a heavy, dark mass in dissections. This structure requires study and description. No doubt it is associated with scent dispersal. I have not seen anything similar to it elsewhere.

The larvae of *Anatrachyntis* have the following features in common (Capps, 1956): Prothorax with three setae in the prespiracular group, these borne from a pinaculum; pronotal shield with seta D1 on or above the level of XD1. Abdominal proleg crochets uniordinal and in a complete ring. Eighth abdominal segment with seta SD1 directly in front of the spiracle. Ninth abdominal segment with paired seta D2 not on a pinaculum; seta D1 close to seta SD2 and on the same pinaculum. Setae L1 and L2 of proleg-bearing abdominal segments close together below the spiracle.

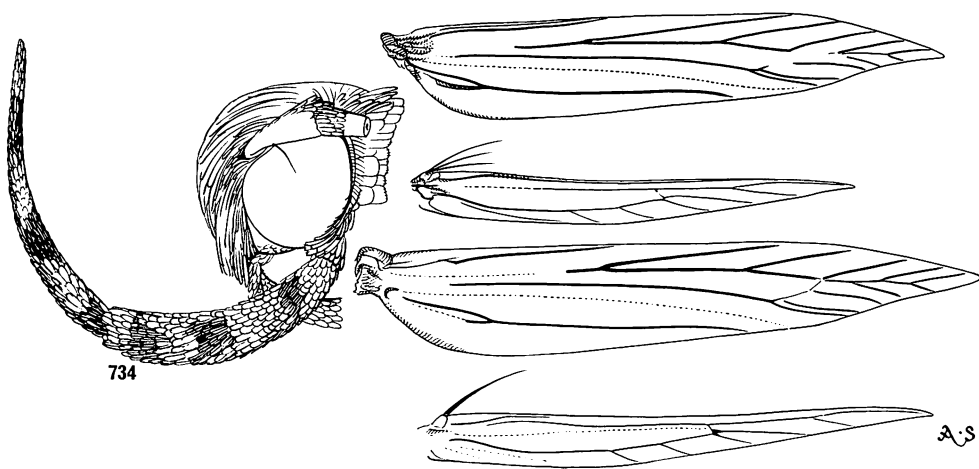


Figure 734—Head and wing venation of *Anatrachyntis incertulella* (Walker). The head is from the female holotype from Hawaii (Beechy Expedition); the upper wings are from a female paratype from Rapa (BM slide 4308); the lower wings are from a male specimen from Honolulu (Busck slide 174). The antennal pecten is evidently abraded.



## KEY TO THE SPECIES OF ANATRACHYNTIS IN HAWAII

1. Background color of forewings more or less mauve; under-  
side of abdomen with conspicuous, dark, diagonal lines  
directed dorsocaudad; male and female genitalia as in  
figures 740, 741, right brachium of male genitalia ex-  
panded distad and subspatulate. . . **incertulella** (Walker).  
Background color of forewings orange-brown to reddish  
brown; undersides of abdomen without such diagonal  
lines; right brachium of male genitalia acuminate. . . . . 2
2. Outer side of metatibia with the diagonal white area  
arising immediately above base of submedial spur  
divided by a line of brown squamae, as in figure 739*d*;  
left anellar lobe of male genitalia expanded, broad and  
blunt distad, as in figure 739*a, b*; female with the tube-  
like ostium shorter and broader than in *badia*, much  
shorter than caudal margin of seventh (caudal) sternite,  
as in figure 742. . . . . **rileyi** (Walsingham).  
Outer side of metatibia with the white fascia immediately  
above the submedial spur entirely white, as in figure  
739*e*; left lobe of anellus of male genitalia acuminate,  
sharply pointed, as in figure 739*c*; ostium longer and  
more slender than in *rileyi*, about as long as the caudal  
breadth of the seventh (caudal) sternite, as in figure 742  
. . . . . **badia** (Hodges).

**Anatrachyntis badia** (Hodges), **new combination** (figs. 735, 736, moth;  
737, moth, head, leg; 739, leg, male genitalia; 742, female genitalia).

*Sathrobrotia badia* Hodges, 1962*b*: 76, figs. 60, 118, 170.

*Pyroderces rileyi*, in part as used by Busck, 1917:362–366, pl. 8, fig. D, and  
other authors as a misidentification.

Oahu, Molokai, and probably most of the other Islands, but it has been  
confused with *rileyi*.

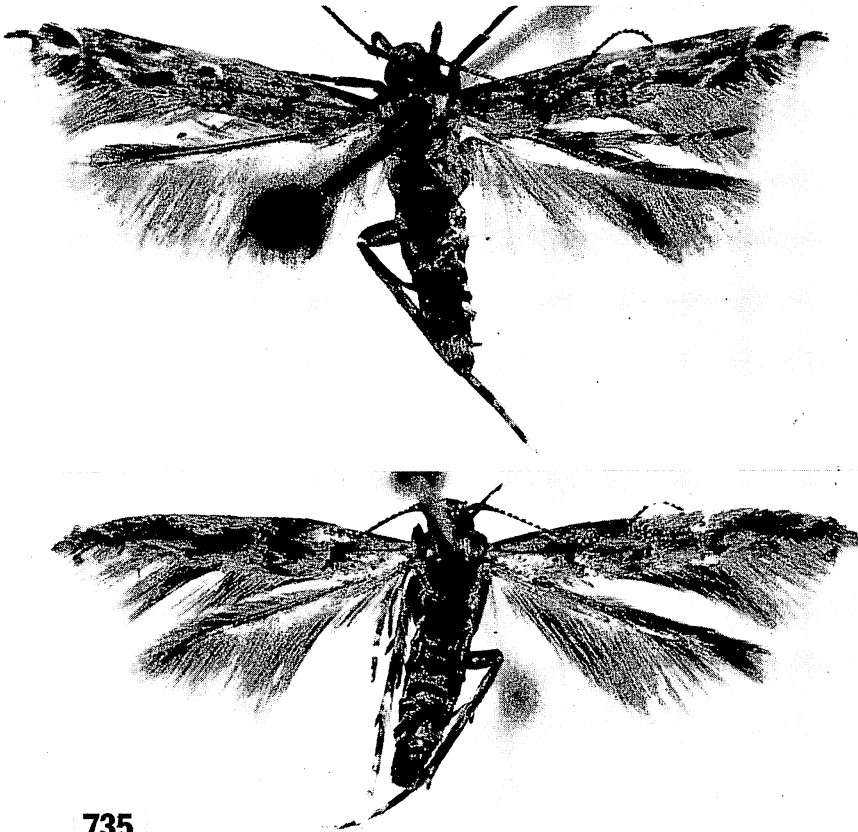
Immigrant. Known from a long series of specimens from many localities in  
the southern United States from Florida to California and as far north as  
Maryland (type locality: southern Florida). The true range remains to be  
determined because of confusion regarding its identification.

Hostplants: These have not yet been determined in Hawaii because the  
species has been confused with *rileyi*. It has been reared from staminate flowers  
of the introduced *Pinus pinaster* by C. J. Davis. Dr. Swezey reared specimens  
from the "cocoon" of an *Argiope* spider, but he misidentified them as *rileyi*.  
Hodges (1962:77) recorded it in America from the cones of several species of  
*Pinus*; *Cassia* pods; "mummy" fruits of peach and loquat; lime, grapefruit,  
banana, cabbage, coconut blossoms; and elm leaves. The larvae are scavengers  
whose habits are evidently generally similar to those of *rileyi*.

Parasites: None have as yet been recorded in Hawaii, but most or all of those recorded from *rileyi* may also attack this species.

*Anatrachyntis badia* is so superficially similar to *rileyi* that it has long been confused with that species even by some expert microlepidopterists. During the preparation of this text I had become aware of confusion regarding *rileyi* in Hawaii. I am indebted to Ronald Hodges for telling me that he had seen specimens of *badia* from Hawaii and thus alerting me to the presence of this species.

Many of the records and details regarding *rileyi* in Hawaii probably apply to this species because of misidentifications. I regret that I have not been able to examine all of the specimens which formed the bases for the Hawaiian records of *rileyi* and thus to be able to correct the published accounts of the species in Hawaii.



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Figure 735—*Anatrachyntis* species. Top, *incertulella* (Walker); Manoa, Honolulu; forewing 5.75 mm. This is the first species of Microlepidoptera that was described from Hawaii. Bottom, *badia* (Hodges); Manoa, Honolulu; forewing 5.25 mm.; bred from an *Argiope* spider egg case; this example was misidentified and recorded as *rileyi* (Walsingham). See also figure 736.

**Anatrachyntis incertulella** (Walker), **new combination** (figs. 734, head, wing venation; 735, moth; 740, 741, male, female genitalia).

*Gelechia incertulella* Walker, 1864a:658.

*Stigmatophora* (*Proterocosma*) *incertulella* (Walker) Walsingham, 1907b:515, pl. 15, fig. 20.

*Aeoloscelis aulacosema* Lower, 1904:172 (type locality: Mackay, Queensland).

Synonymy by Meyrick, 1928a:497.

*Pyroderces incertulella* (Walker) Meyrick, 1928a:497.

*Stigmatophora* (*Proterocosma*) *tridigitella* Walsingham, 1907b:515. Synonymy by Meyrick, 1928a:497.

The pandanus flower moth.

Oahu, Hawaii (type locality: "Sandwich Islands, Presented by the Lords of the Admiralty"). The type was collected by the Beechey Expedition and was one of the first species of Lepidoptera to be collected in Hawaii.)

Immigrant. Widely distributed in the Pacific from Australia, Fiji, Austral Islands, Rapa, Pitcairn, and many other localities.

Hostplant: *Pandanus*.

Parasite: *Idechthis* species.

The larvae feed in large numbers in the male inflorescences of *Pandanus*. Swezey (1954:146) said "... from one inflorescence 266 adult moths were reared. In the absence of flowers, the caterpillars feed on dead leaves." I have often seen large numbers of the moths swarming at the male blossoms of *Pandanus*.

**Anatrachyntis rileyi** (Walsingham), **new combination** (figs. 64, larval head; 219, moth, larva; 733, head and wing venation; 736, moth, female genitalia; 739, leg, male genitalia; 740, male genitalia; 742, female genitalia; 743, larva; 744, larva, pupa).

*Batrachedra rileyi* Walsingham, 1882:198. Swezey, 1909d:22, pl. 3, figs. 9-11.

*Pyroderces rileyi* (Walsingham) Durrant, 1912:207 (in part), fig. 3. Busck, 1917:362-366, figs. 5, 6, 7, pls. 7, 8, 10, 11, 12 (in part). Williams, 1931:158, pl. 27, figs. 9-11. Silvestri, 1943:247-250, figs. 307-309. Peterson, 1962:136, pl. L13, figs. Q-U, larva.

*Sathrobrotia rileyi* (Walsingham) Hodges, 1962b:74, figs. 59, 117, 169; redescription, hosts, and distribution in North America.

*Batrachedra stigmatophora* Walsingham, 1897b:104. Synonymy suggested by Hodges, 1962b:74, established by him (1962b:121) after consultation with J. D. Bradley, and I have confirmed the synonymy after study at the British Museum.

*Pyroderces stigmatophora* (Walsingham) Meyrick, 1914b:203.

*Anatrachyntis stigmatophora* (Walsingham) Meyrick, 1915a:326.

In 1914b:203, Meyrick reduced his *tripola* to a synonym, but in 1915a:326 he said that he was in error and that two species are involved.

The pink cornworm, pink bud moth or pink scavenger caterpillar.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii. Although I have not examined specimens from Kauai, I have no doubt that the species is present there and is widely distributed over all of the main Hawaiian Islands.

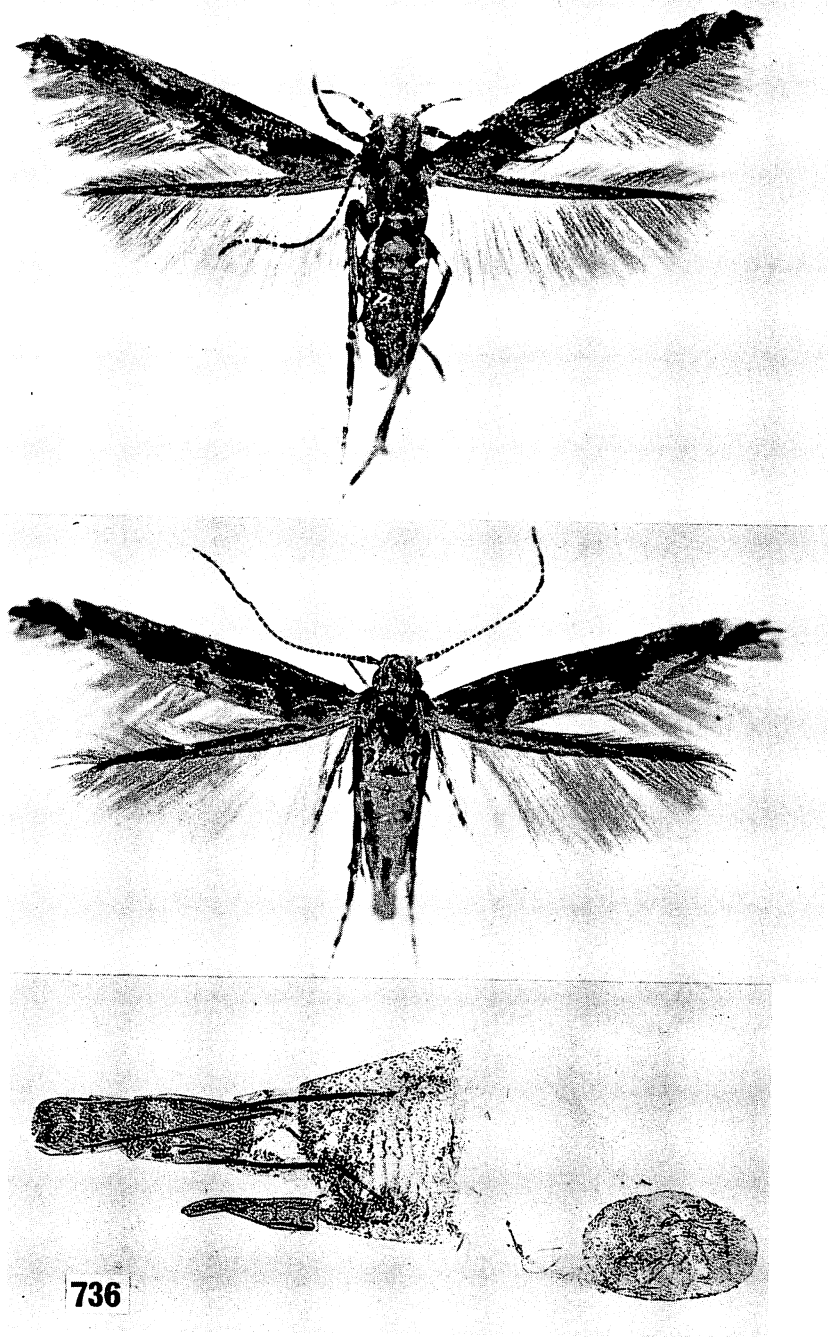


Figure 736—*Anatrachyntis* species. Top, *badia* (Hodges), a female from Florida; see also figure 735. Bottom, *rileyi* (Walsingham), a female from Texas. (USNM photographs, courtesy Ron Hodges.) Bottom, lateral aspect of the female genitalia of *rileyi* (Walsingham); Makiki Valley, Honolulu; ex *Ricinus* capsule (slide Z-VI-28-61).

Immigrant. Described from specimens bred from "rotten cotton-bolls" at Savannah, Georgia, and widely distributed in the southern United States. It is evidently dispersed widely in some of the warm or tropical areas of the world, and it is probably an introduction to North America. Meyrick thought it to be an African species. It was first recorded from Hawaii by Dr. Swezey in 1909*d*:22. Although the species was collected in Hawaii as early as 1892 by Dr. Perkins, it was not included in *Fauna Hawaiiensis*. I have examined specimens collected at Kaimuki, Honolulu, by Perkins in 1907. Williams, 1931:159, stated that it was known there prior to 1892.

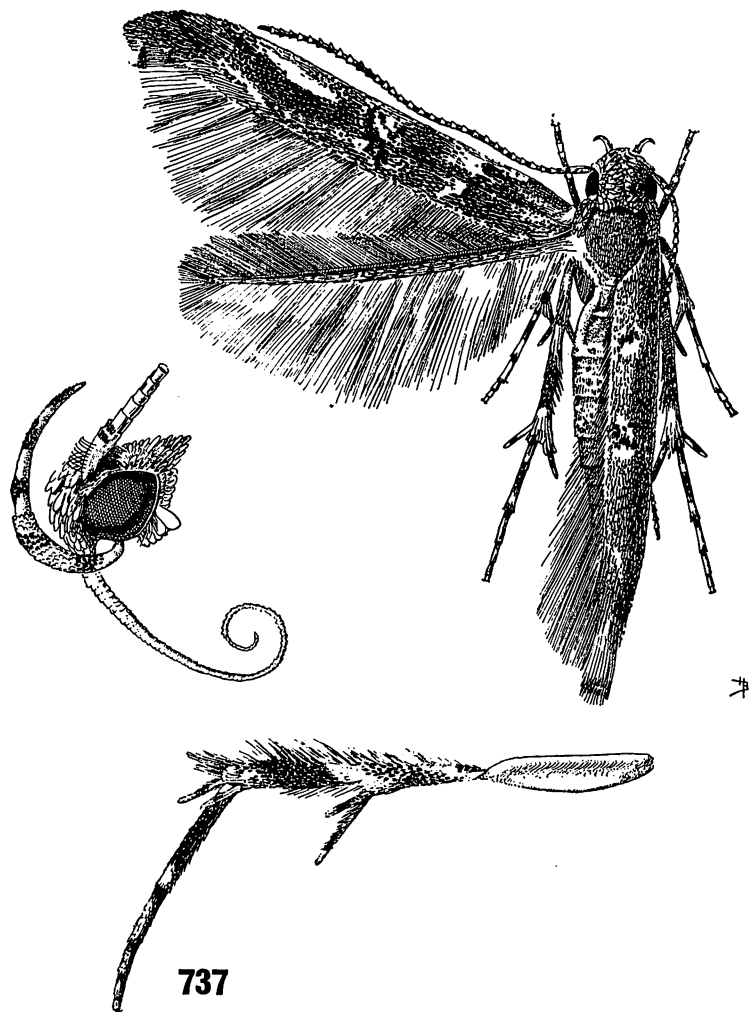


Figure 737—*Anatrachyntis badia* (Hodges), with lateral views of head and a hind leg. This was incorrectly determined as *rileyi* by Busck. (The figures are from Busck, 1917.)

**Hostplants:** It is a general feeder in vegetable trash. It has been found in many kinds of old leguminous pods, aloe, banana, coffee beans, coffee cherries, castor oil beans and pods, cotton bolls, eggplant, milo maize grain, old maize silk, dead *Panicum torridum*, pineapple (dried parts, fruits, stored seeds), *Rochea*, *Samanea saman*, *Sapindus oahuensis*, tamarind, and other hostplants.

**Parasites:** *Agathis hawaiiicola* (Ashmead), *Apanteles* species, *Idechthis* species, *Perisierola emigrata* Rohwer, *Pristomerus hawaiiensis* Perkins, *Trathala flavo-orbitalis* (Cameron).

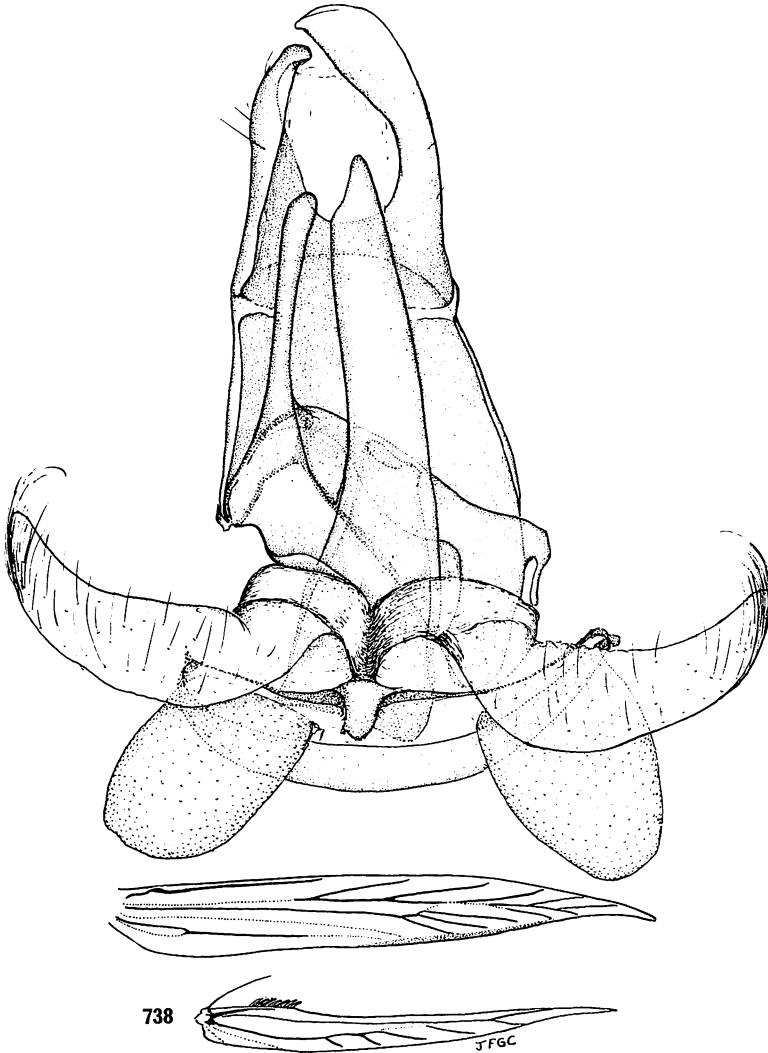


Figure 738—Male genitalia and wing venation of *Pyroderces argyrogrammos* (Zeller), the type-species of *Pyroderces*, to which genus two of the species of *Anatrachyntis* found in Hawaii had for long been referred. (USNM slide 3799 Clarke.)

Predators: *Conocephalus saltator* (Saussure), *Pachodynerus nasidens* (Latreille), *Polistes aurifer* (Saussure), *Polistes olivaceus* (Degeer).

Some of the above data no doubt belong to *Anatrachyntis badia* because of misidentifications. See the details under that species for further information.

The larvae of this common, widely distributed moth normally act as scavengers in dead plant material. They do on occasion, however, damage living plant tissues. They have been found as leaf miners in the aloe and *Rochea* mentioned above; they have heavily infested and damaged milo maize; they have destroyed pineapple seeds and they may feed upon the surface of pineapple fruits or tunnel into the fruits, thus allowing the entrance of rot organisms. The larvae are found frequently in the "eyes" of the pineapple fruit where they feed upon the withered stamens and pistils. The webbing they

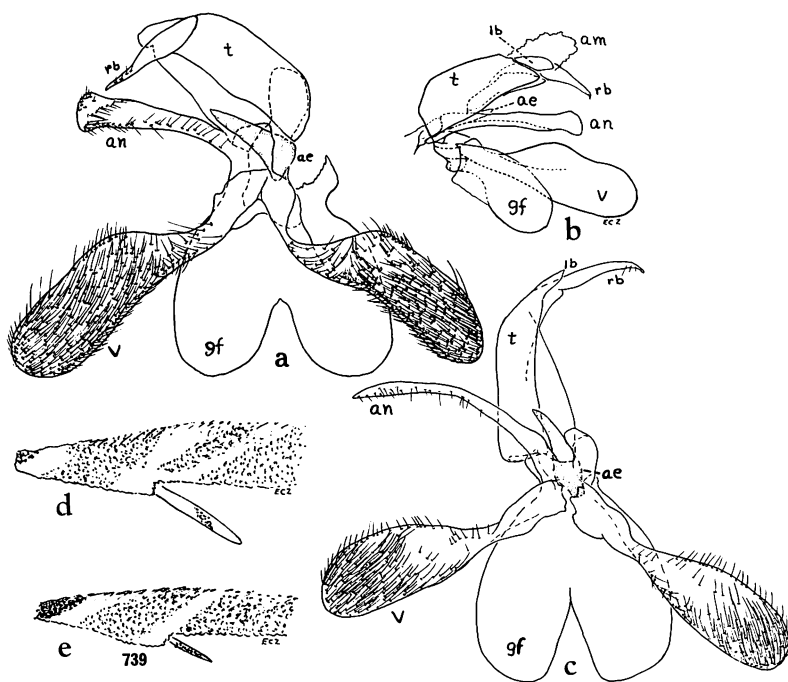


Figure 739—Details of *Anatrachyntis*. *a*, male genitalia of *rileyi* (Walsingham) (Hodges slide 975, Argentina); aedeagus probably drawn too broad; note the broad apex of the anellar lobe. *b*, lateral aspect of the same species in natural position from a specimen from Louisiana; setae omitted and drawn to a smaller scale. *c*, male genitalia of *badia* (Hodges) (Hodges slide 1031, Florida); note the narrow, pointed apex of the anellar lobe and compare with *rileyi*. *d* and *e*, rough sketches of the ectal sides of the basal and submedial parts of the metatibiae of *rileyi* (Walsingham) (*d*) and *badia* (*e*) to show the color patterns; dorsal setae omitted. (Drawings for *a* and *c* kindly loaned by Ron Hodges, but the lettering is mine, as are figures *b*, *d*, and *e*.) *ae*, aedeagus; *am*, anal tube membrane; *an*, anellus lobe; *gf*, genital flap; *lb*, left brachium; *rb*, right brachium; *t*, tegumen; *v*, valva.



Figure 740—*Anatrachyntis* genitalia. Top, left and right, male genitalia of *incertulella* (Walker), holotype (BM slide 4391, photographed from the underside of the slide); "Sandwich Islands, Beechy"; originally incorrectly determined as a female. Top right, genitalia of another male from Manoa, Honolulu (Busck slide 174). Middle, ostium of a Manoa, Honolulu specimen (Busck slide 175) of *incertulella*. Bottom left, male genitalia of *rileyi* (Walsingham); Honolulu (Busck slide 95). Bottom right, male genitalia of *falcateella* (Stainton), the type-species of *Anatrachyntis*, for comparison; India (BM slide 5213; photographed from beneath the slide). *ae*, aedeagus; *an*, anellar lobe; *gf*, genital "flap"; *lb*, left brachium; *rb*, right brachium; *t*, tegumen; *v*, valva.



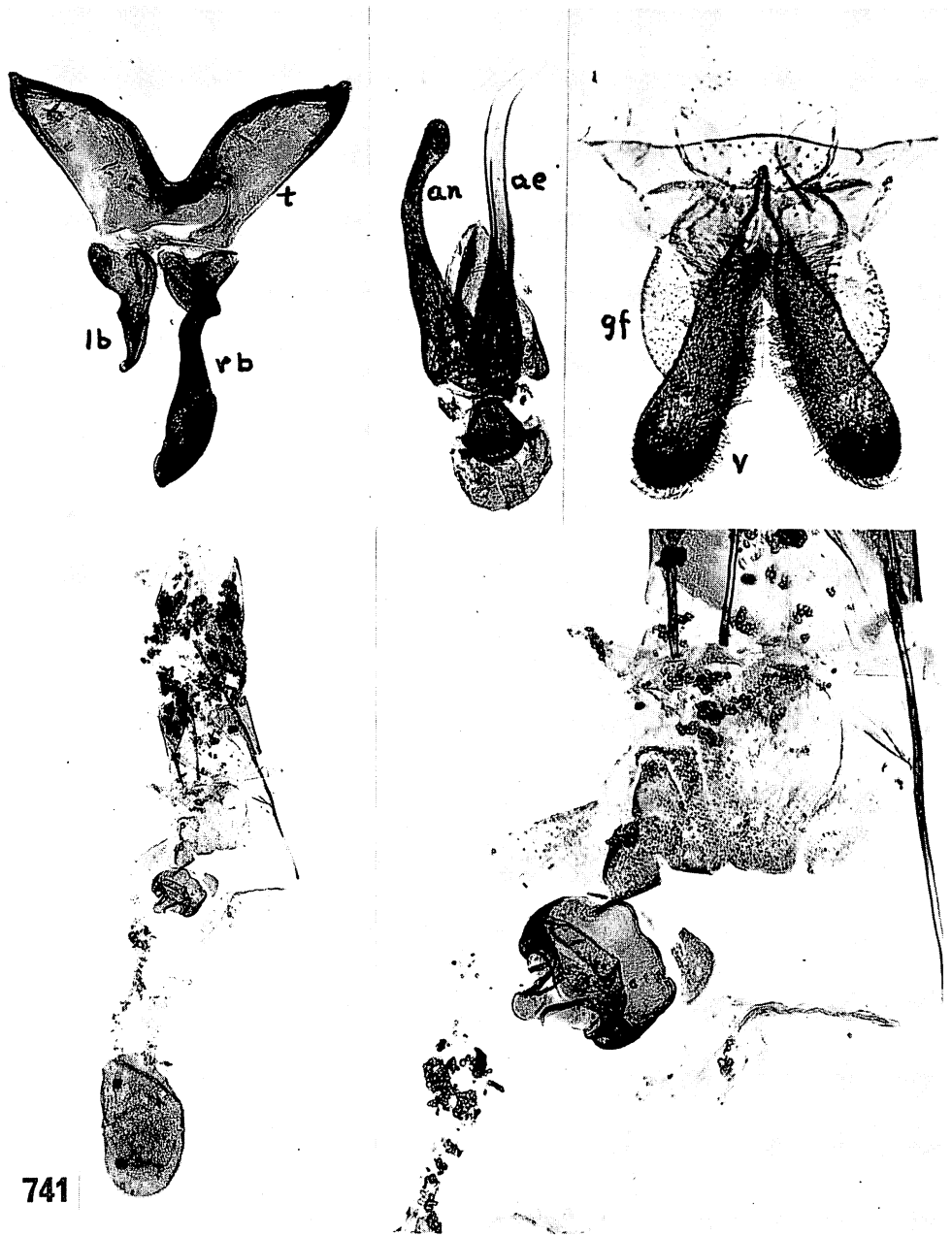


Figure 741—Male and female genitalia of *Anatrachyntis incertulella* (Walker). Top, dismembered male genitalia: left, dorsal aspect of flattened tegumen (*t*), left brachium (*lb*), and right brachium (*rb*); middle, left anellar lobe (*an*) and aedeagus (*ae*); right, valvae (*v*) and genital “flaps” (*gf*) (slide Z-VI-30-61). Bottom, female genitalia (partly decomposed) (slide Z-VI-29-61). Both specimens from Manoa, Honolulu.

spin gives the fruits an objectionable appearance, and the frass may be bothersome. Illingworth, in his paper "Pests of Pineapple in Hawaii" [*Proc. Hawaiian Ent. Soc.* 7(2):254, 1929], considered the "tiny pink caterpillars of this species . . . particularly troublesome on the fruits" of pineapple. He said, "This pest is pretty well controlled by predaceous wasps and beetles. . . ." I do not know to what beetles he referred, and I wonder if he meant to say "grasshoppers" instead of "beetles". He also reported upon this moth in *Pineapple News*, pp. 67-71, 1927. For additional details of damage to pineapple, see Linford, 1940:437. The larvae may feed on the surface of banana fruits and may eat into the fruits on rare occasions. Swezey once bred the moth from an old egg case of an *Argiope* spider, and (1954:100) he found them "very abundant in 'dead heart' of *Panicum torridum* bored by *Acrapex exanimis*."

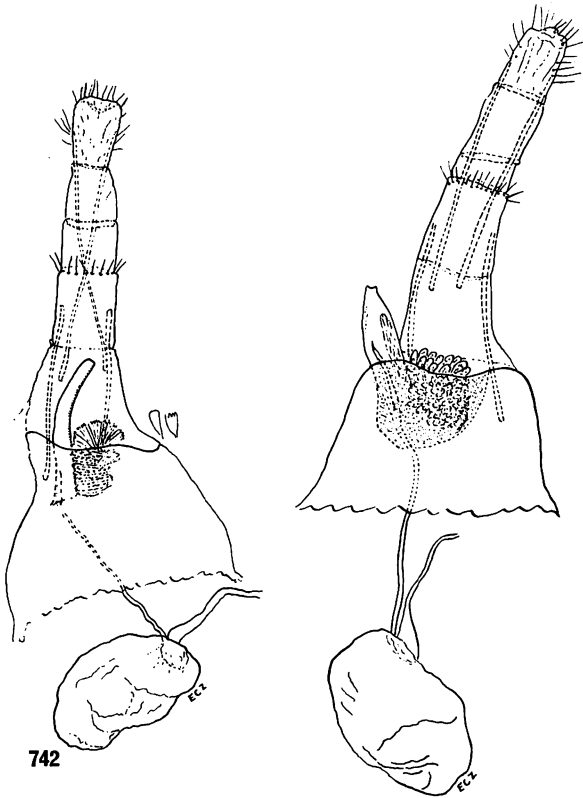


Figure 742—*Anatrachyntis* female genitalia. Left, *badia* (Hodges) from a Honolulu specimen. Two squamae from the mass of squamae that lies at the right of the tubelike ostium are separately enlarged. The one with the dentate apex is of the type that surrounds the main mass. The smooth-tipped squama is of the type that makes up the main bulk of the scale mass and that appears to be deciduous. Right, *rileyi* (Walsingham) from a specimen from Texas. The apical contours of sternite 7 (the caudal sternite) may appear variable in dissections.

The larvae of this tiny little moth, I have found feeding in various situations, most frequently on dead vegetable matter or refuse substances, hence, not particularly injurious. I have found them feeding beneath leaf-sheaths of dead cane, also in bored cane sticks, and in places where the leaves are dirty and sticky from having been attacked by Aphis or leaf-hoppers. I have also found them feeding in the tassels. Once I found them very numerous in sweet corn ears feeding on the "silks," inner husks, the pith, and other parts of the cob. I have also seen them in ears of field corn, eating into the kernels of corn and into the cob. [Probably after having been attracted to the decaying silk.] Another time I observed them numerous on a large woody twining bean vine, feeding on dying leaves and ripening pods, especially where there was an accumulation of debris, webs, frass, etc., on account of infestation by mealy bugs, *Lecanium*, *Tortrix* and *Cryptoblabes* larvae. Similarly, I have found them feeding on lantana infested by *Orthezia*, and on palm leaves infested with mealy bugs and leaf-rollers; also on dead leaves of pandanus, banana and various other plants. On the banana, I have found them feeding in the bunch on the dead or injured fruit, and on the skin of the ripened fruit, which they have penetrated sometimes and eaten into the fruit inside.

Mr. D. T. Fullaway has reported it from cotton infested with mealy bugs. The original description of the species is from specimens bred from rotten cotton-bolls in the United States. It has been present in these Islands for a number of years no doubt, as they were found by Dr. Perkins when he first came (1892), though it is not included in the Fauna Hawaiiensis. . . .

Eggs are deposited mostly singly, occasionally two together; about .5 mm. long, roundish-ovate, flattened below where in contact with surface of object, convex above and coarsely reticulate.

They hatch in a few days. The freshly hatched larvae are about 1 mm. long, pinkish with black head and cervical shield.

The full-grown larva . . . is about 7-8 mm., pinkish except head which is pale brown, and cervical shield which is dark brown; tubercles concolorous, [setae] ii wider apart than i, iii above spiracle, iv + v below.

The larva pupates in a whitish cocoon amongst the frass where it has fed. The pupa . . . is 4-5 mm. uniform, medium brown; wing-cases and antenna-cases extend to apex of sixth abdominal segment; abdominal segments apparently immovable; terminal segment with numerous slender hooked bristles, a few also on the two preceding segments. The pupal period is eleven to thirteen days. (Swezey, 1909d: 23-24.)

When at rest, the moth extends its antennae straight out in front of its head.

This species is closely similar to *Anatrachyntis falcatella* (Stainton, 1859b: 121, *Gracilaria*) Meyrick, 1915a: 325, the type-species of the genus, but there are slight external differences and more obvious specific differences in the genitalia.

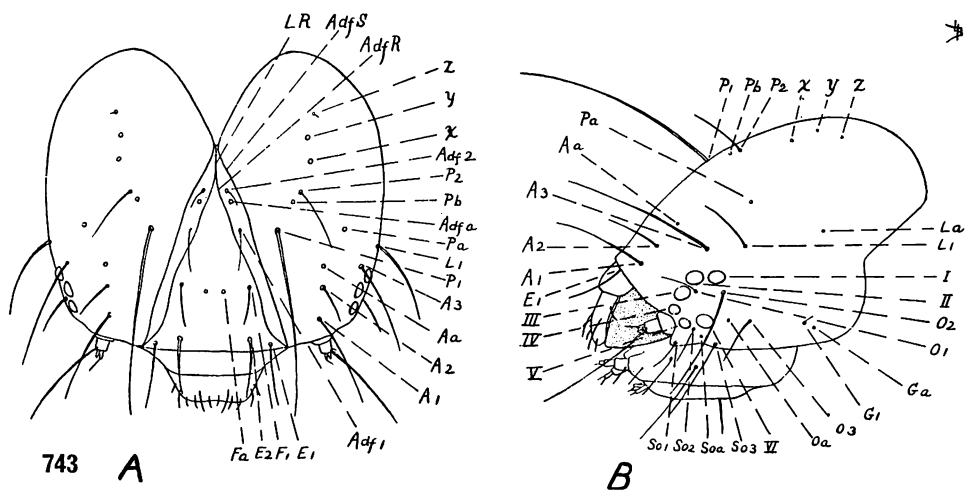


Figure 743—Frontal and lateral aspects of the head capsule of *Anatrachyntis rileyi* (Walsingham), as determined by Busck. The nomenclature is that of Heinrich. See my figure 64 for an explanation of the lettering and its modification into the modern Hinton system. (After Busck, 1917.)

It is also closely similar to other species in the genus.

Busck (1917:365–366) called this species “the scavenger bollworm, an insect mistaken for the pink bollworm” of cotton. He gave an extended discussion of the species, including descriptions of the adult, larva, and pupa which I believe are worthy of inclusion here to assist in the identification of this common moth.

Moth.—Labial palpi light reddish brown; second joint with two ill-defined darker brown annulations; terminal joint with three blackish annulations. Head light chestnut-brown; lower face yellowish iridescent. Antennae whitish with sharply defined, narrow, blackish brown annulations. Forewings chestnut brown with whitish straw-coloured streaks, edged by irregular black scales; an oblique whitish fascia on basal third

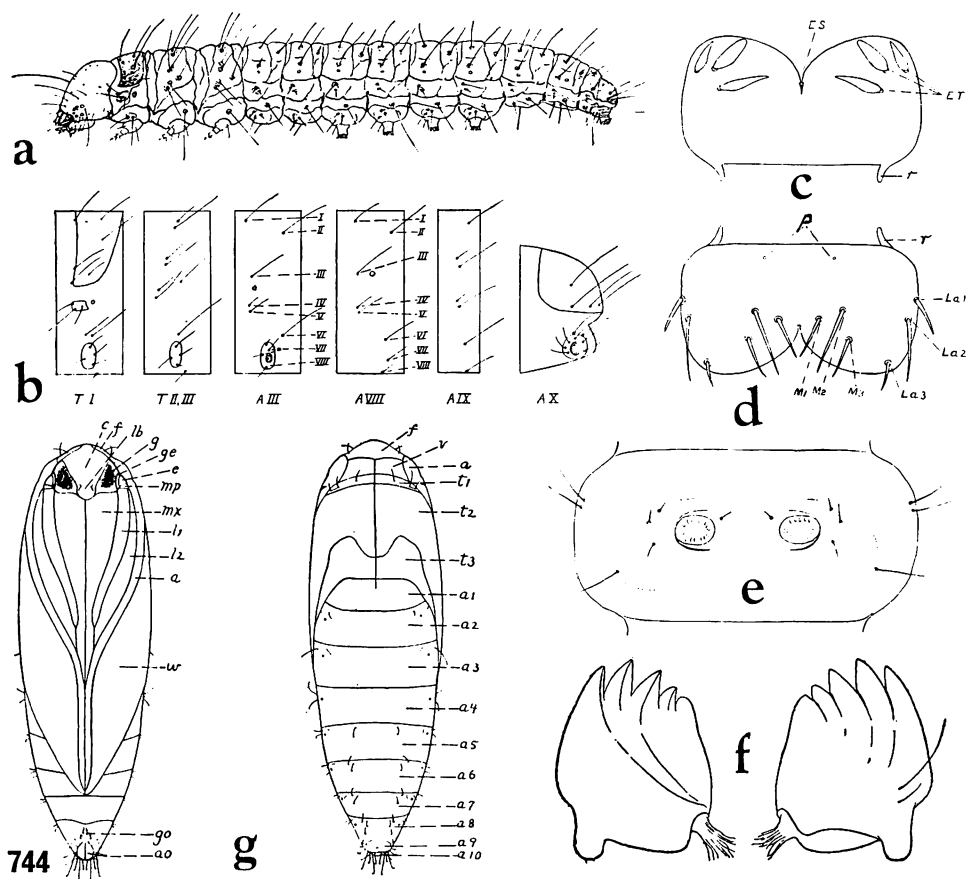


Figure 744—*Antrachyntis* supposedly *rileyi* (Walsingham), as determined by Busck, but possibly *badia* (Hodges). *a*, lateral aspect of a mature larva; *b*, setal map of parts of a larva (*T*, thoracic segments; *A*, abdominal segments); *c*, epipharynx (*ES*, epipharyngeal shield); *ET*, epipharyngeal rod); *d*, labrum (*La1*, *La2*, *La3*, lateral labral setae; *M1*, *M2*, *M3*, medial labral setae; *P*, labral punctures; *r*, epipharyngeal rod); *e*, ventral aspect of third abdominal segment; *f*, ventral and dorsal aspects of a right mandible; *g*, ventral and dorsal aspects of pupa (*a*, antenna; *a1* to *a10*, abdominal segments; *ao*, anal opening; *c*, clypeus; *e*, eye; *f*, frons; *g*, gena; *ge*, glazed eye; *go*, genital opening; *mp*, maxillary palpus; *mx*, maxillae or proboscis; *l1*, *l2*, fore and middle legs; *v*, vertex; *w*, wing. (After Busck, 1917.)

edged on the inner side with black; an ill-defined group of black scales in the middle of the wing, edged with white; a subcostal longitudinal white streak at apical third, terminating in black scales; a similar, fainter, subdorsal streak terminating in black scales at apex of the wing; cilia yellowish gray. Hindwings dark fuscous with paler cilia. Abdomen reddish brown. Legs . . . light reddish, with black annulations on tarsi and tibiae. . . .

Alar expanse 9 to 12 mm.

Full-grown larva.—The full-grown larva is 7 to 8 mm. long, cylindrical, deep wine red. Head light brown, with blackish trophi. Thoracic shield broad, undivided, strongly chitinated, dark brown. Anal plate light brown. Tubercles small, whitish, bearing long, light-brown setae. Crotches [crotchets] of abdominal feet 20 to 24 in complete circle. . . .

Pupa.—The pupa . . . is 7 to 8 mm. long, light yellowish brown, smooth, with four short setae on the vertex and six short setae on the first thoracic segment; two short, paired setae near the spiracles and four short hooked setae dorsally on fifth to ninth abdominal segments, two anterior and two posterior on each joint. Anal opening large, slitlike, surrounded by about twelve long, hooked setae; no cremaster developed; tip of abdomen bluntly rounded, armed with four long and four shorter strong, hooked setae. Frontoclypeal suture distinct and abruptly curved upward near median line. Clypeus and pupal eyes distinctly indicated, labrum and mandibles less so; antennae close together at their tip, reaching nearly to the tips of the wings; wings reaching to posterior edge of sixth abdominal segment. Spiracles small, normal.

Unfortunately, Busck's illustration of the male genitalia is inaccurate and misleading, and his figure of a hind leg is that of *badia* instead of *rileyi*. He probably included *badia* in his concept of *rileyi*.



Figure 745—Head and wing venation of *Asymphorodes dimorpha* (Busck). Head from a male from Honolulu. Male wings from a paratype (BM slide 5418) from Honolulu, with a separate enlarged sketch of the peculiar structure on the hindwing viewed from the edge. Female wings (Busck slide 107) from an example from Midway Island. In the forewing of another male example studied, vein 6 rises out of 7, and 7 arises from 8 farther basad; yet another example has veins 2 and 3 in the forewing arising from the same point. Obviously, the venation is variable.

Genus **ASYMPHORODES** Meyrick

*Asymphorodes* Meyrick, 1928a: 498. Type-species: *Asymphorodes valligera* Meyrick by original designation.

The following diagnosis will serve to distinguish the species of *Asymphorodes* now known in Hawaii from the other genera of Cosmopteriginae established in the islands: External facies closely similar to *Hypsmocoma* but venation and genitalia distinctive. Ocelli absent; maxillary palpi small; labial palpi long, slender, strongly upcurved; proboscis well developed; antennae held stretched out directly in front of head in life, length between one-half and two-thirds that of a forewing, the first segment with a pecten of several setae. Legs evidently as in *Hypsmocoma*, without unusual characters. Wing venation unusual, differing between the sexes and between the two species known in Hawaii (see figures 745 and 746); forewing with 12 veins, cell pointed distad because of the great angle of the discocellulars, veins 6, 7, and 8 or 6, 7, 8, and 9 arising from a common stem; in the male, vein 1a + b in the forewing unusual,

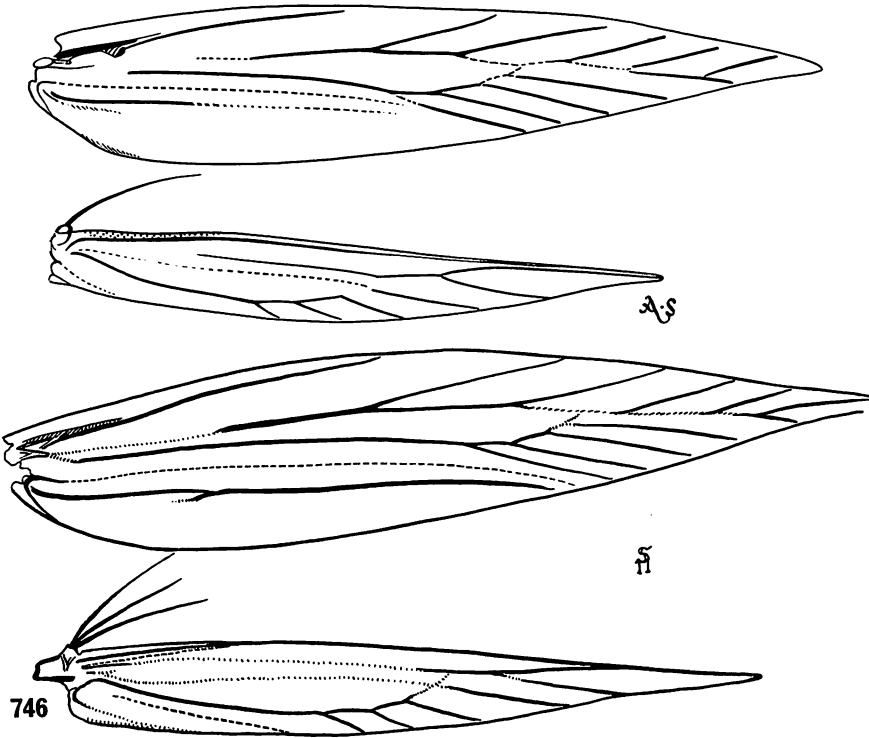


Figure 746—Wing venation of *Asymphorodes triaula* (Meyrick). Male from Wailupe Valley, Oahu (slide Z—V—20—62—2). Female from Ewa, Oahu (slide Z—V—20—61—1).

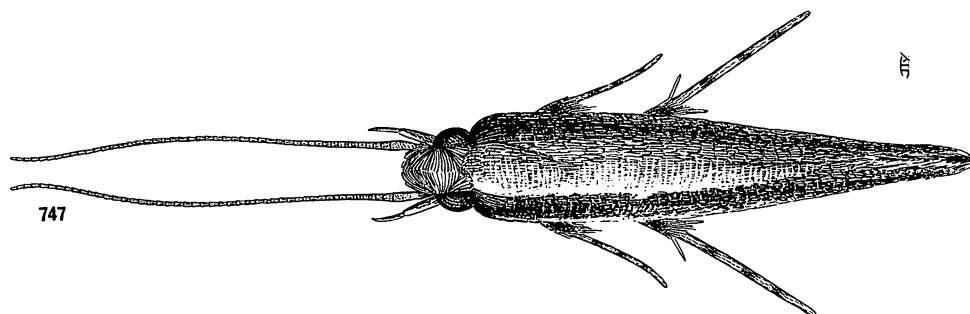


Figure 747—*Asymphorodes dimorpha* (Busck) in resting position. (After Williams, 1931.)



Figure 748—*Asymphorodes* species. Top, *dimorpha* (Busck); Honolulu; forewing 4.0 mm. Bottom, *triaula* (Meyrick); holotype, probably from Honolulu; forewing 4.5 mm (the photograph unfortunately does not reveal the streaked appearance of the apical parts of the forewings).

bent abruptly to approximate a right angle toward posterior wing margin near origin of vein 2, vein 1c evidently joining 2 near or at its origin in male, as figured; hindwing with seven veins in the female and in the male of one of the two Hawaiian species, but the venation greatly reduced and peculiar in the other species. Male genitalia as illustrated, with epiptygmata (genital "flaps") well developed, vinculum well developed and valvae thus articulated far from bases of tegumen; uncus absent; gnathus (?) divided into two brachia; right lobe of anellus obsolete, left lobe closely appressed to aedeagus. Female with ostium sclerotized, protruding; ovipositor long and genitalia otherwise as illustrated (figures 750 and 751).

When Busck described the first of the two species of *Asymphorodes* known in Hawaii, he incorrectly placed it in his genus *Petrochroa* (which I consider a synonym of *Hyposmocoma*). When Meyrick described the second species, he incorrectly assigned it to *Aphthonetus* (which I also place in the synonymy of *Hyposmocoma*), although he had described *Asymphorodes* only a few years previously.

Meyrick stated in his original description that *Asymphorodes* has ocelli, but that is incorrect—the genus lacks ocelli. I had concluded that the species known to me in Hawaii represent a new genus, but Klaus Sattler recently discovered that they belong to Meyrick's genus.

*Asymphorodes* was originally described to receive 16 species from the Marquesas Islands. Meyrick later (1934b:349–352) described an additional nine species from the Marquesas and one from Tahiti (1934c:109). The genus

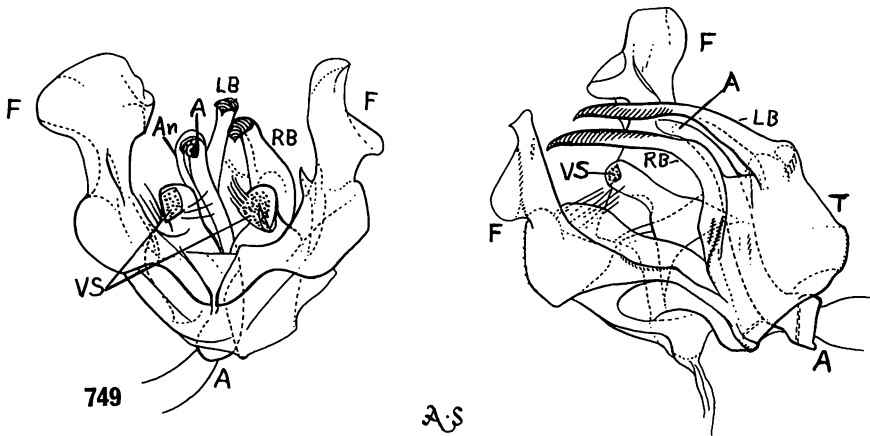


Figure 749—*Asymphorodes dimorpha* (Busck). Damaged male genitalia with the valvae broken off (BM slide 5442). Do not be confused by the absence of the valvae; see figure 750 for the valvae. A, aedeagus; An, anellus lobe, closely adherent to the aedeagus; F, the highly modified, heavily sclerotized genital "flaps"; LB, left brachium; RB, right brachium; T, tegumen; VS, stumps of the valvae which have been broken off. The left drawing is in subventral aspect and that on the right in dorsolateral aspect. Compare figure 750.



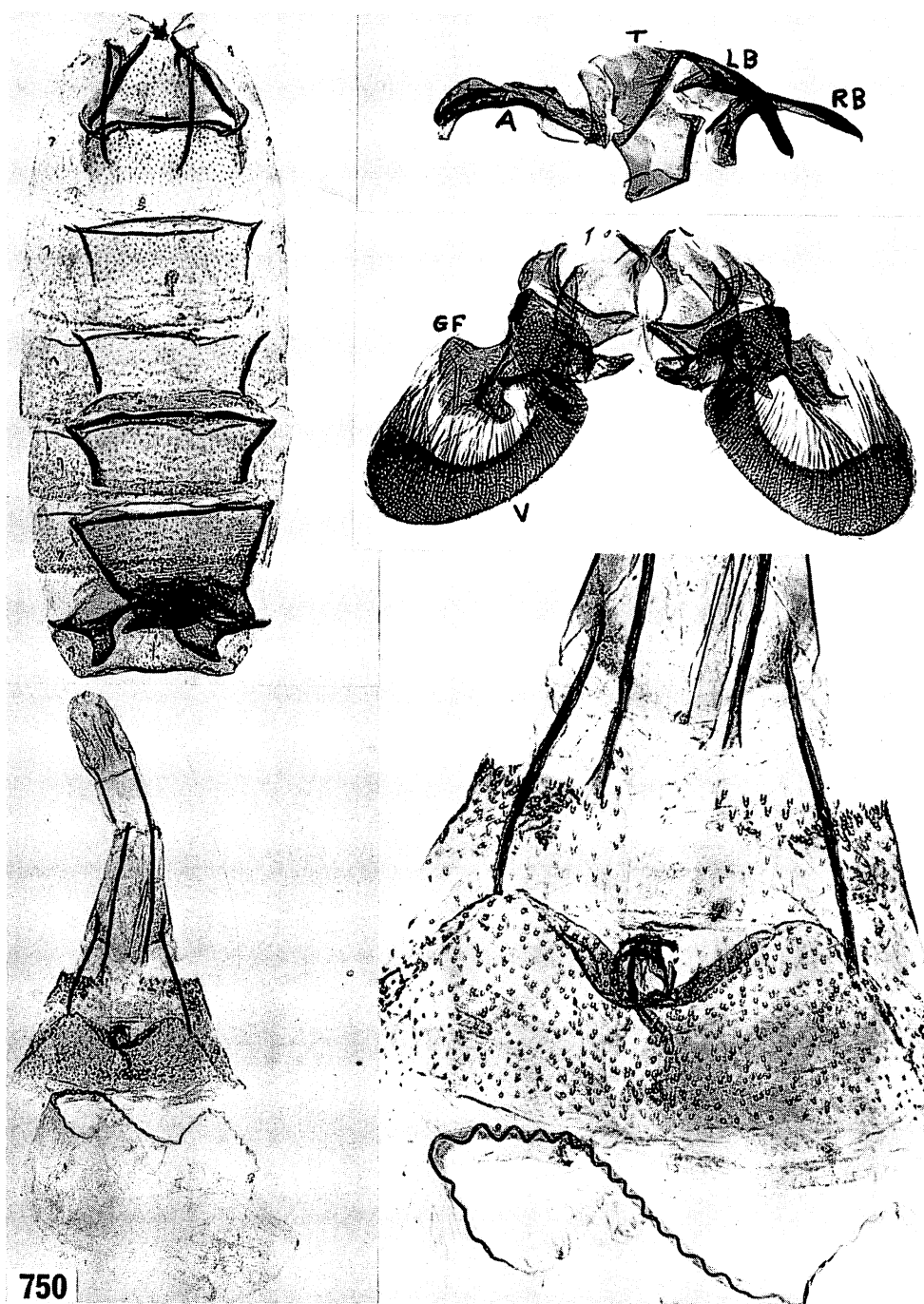


Figure 750—*Asymphorodes dimorpha* (Busck). Top left, male abdominal pelt; note the heavy sclerotizations. Top right, dorsal and ventral parts of the male genitalia (slide Z-V-23-61); Waipio, Oahu. Bottom two figures are of the female genitalia of a specimen from Kaimuki, Honolulu (slide Z-V-31-61). *A*, aedeagus and anellus lobe; *GF*, heavily sclerotized, highly modified genital "flap"; *LB*, left brachium; *RB*, right brachium; *T*, tegumen; *V*, valva. Compare figure 749.

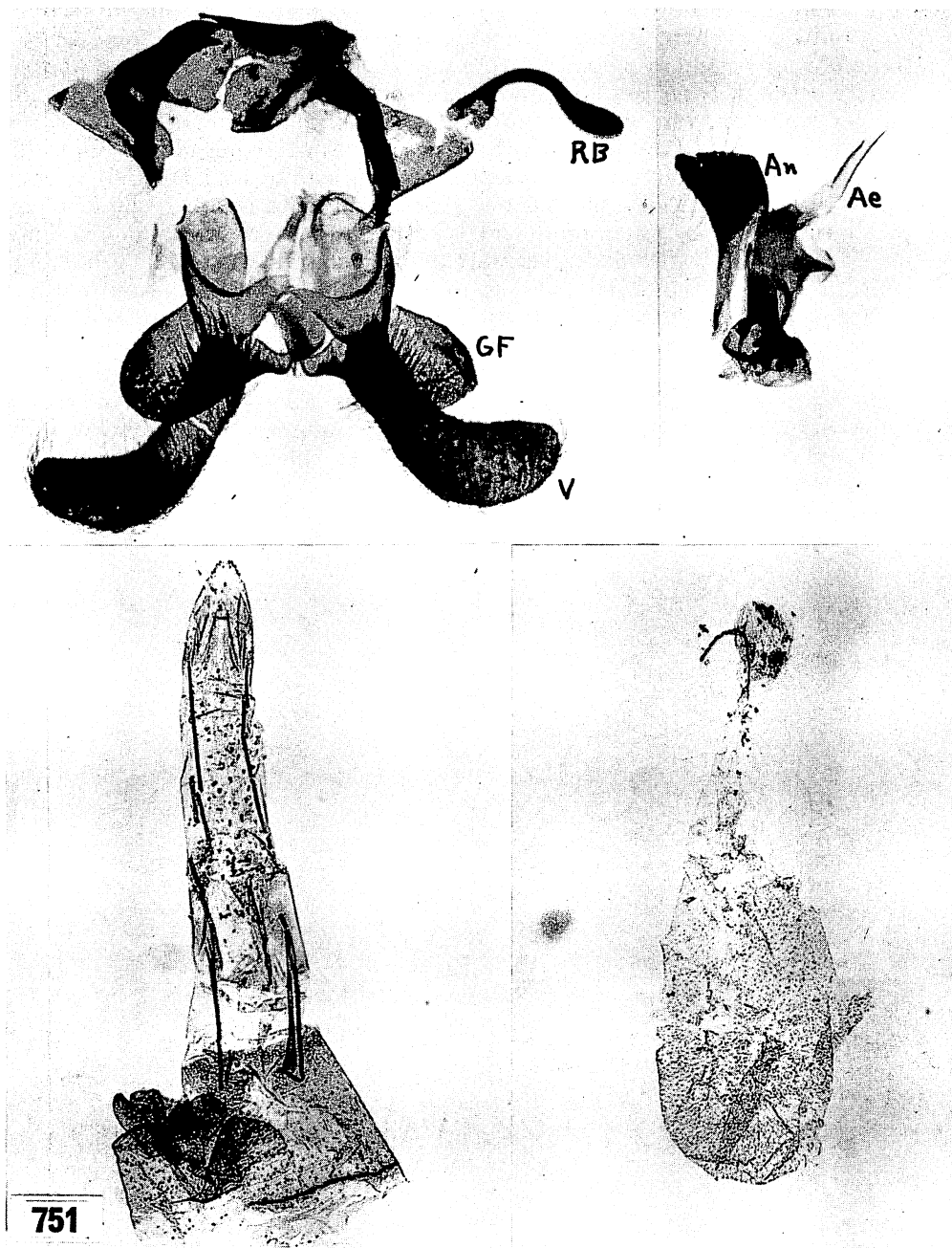


Figure 751—*Asymphorodes triaula* (Meyrick). Top, male genitalia, with the aedeagus and the closely adherent anellar lobe at right; Wailupe Valley, Oahu (slide Z-V-20-61-2). Bottom, female genitalia with the bursa copulatrix separated; Ewa, Oahu (slide Z-V-20-61-1); this abdomen appeared to be partly decomposed, and the preparation is not altogether satisfactory. *Ae*, aedeagus; *An*, anellar lobe; *GF*, genital "flap"; *V*, valva. Compare figure 752.

is, however, much more widely distributed in the Pacific than the published record indicates. There are new species to be described, and some species now assigned to other genera belong to *Asymphorodes*.

Both species of *Asymphorodes* now known to occur in Hawaii have been found in the lowlands, and one of these is also widely distributed through the Leeward Hawaiian Islands and out to various low islands in the northern Pacific outside of Hawaii. The distribution of *dimorpha* may appear to indicate that it is a lowland Hawaiian species that has been carried by man to other islands near Hawaii, but it may be much more widely distributed than is now known. The other species in Hawaii, *triaula*, has more definite characteristics of a relatively recent immigrant species. It is known thus far only from Hawaii and Oahu, where it has been collected commonly around Pearl Harbor in Honolulu and other lowland communities, but it is probably much more widely dispersed in Hawaii. Neither of the species was collected by Dr. Perkins, and this may indicate that both species became established in Hawaii after Perkins' intensive surveys were completed. *Asymphorodes dimorpha* is such a common and widely distributed species in Hawaii that it is difficult to believe that it could have

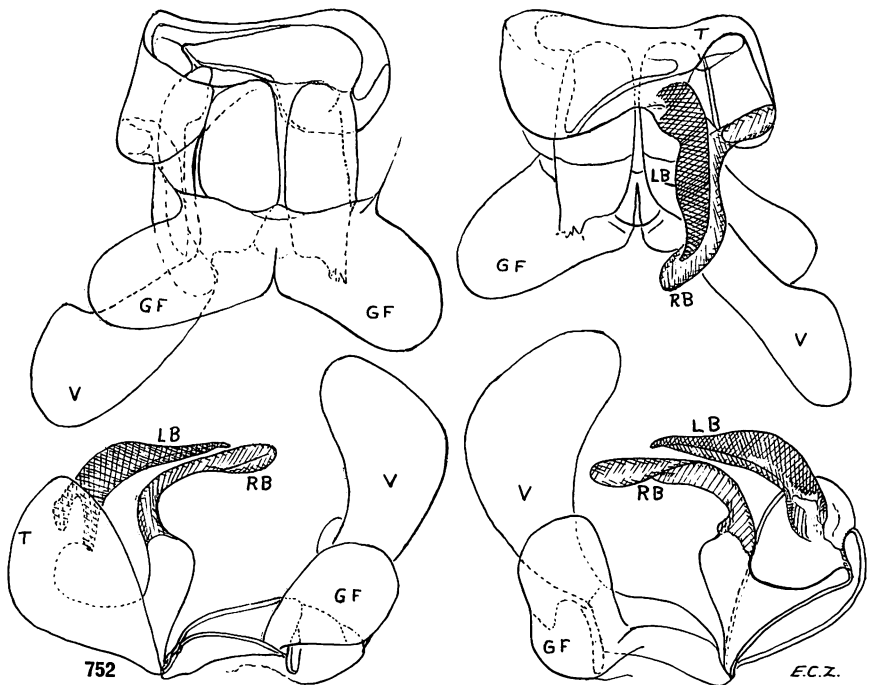


Figure 752—Diagrams of the male genitalia of *Asymphorodes triaula* (Meyrick). Part of the left valva and the aedeagus and anellus lobe have been removed. Top left, ventral aspect. Top right, dorsal aspect. Bottom left, viewed from the left side. Bottom right, viewed from the right side. Note, in the dorsal view, how the brachia are shifted toward the right side. Wailupe Valley, Oahu. GF, genital "flap" (epitygma); LB, left brachium; RB, right brachium; T, tegumen; V, valva. Compare figure 751.

been overlooked by Dr. Perkins if it were as common during his time as it is now. Similarly, had *triaula* been long established in Hawaii, it, too, surely would have been taken earlier by Dr. Swezey. Hence, I consider both of these species to be immigrants. (Dr. Sattler has recently looked further into the matter, and he has been unable to discover either *dimorpha* or *triaula* resting under any other name in the collections at the British Museum.)

### KEY TO THE SPECIES OF ASYMPHORODES IN HAWAII

1. Pronotum concolorous white or creamy; dark scaling mostly fuscous brown, figure 748; metascutum of male with a pair of extraordinary thornlike processes, as in figures 755–757; hindwing of male with greatly reduced venation and with an unusual, small, bladderlike protuberance at about middle of posterior margin of cell which projects distinctly beneath the wing, as in figure 745 ..... **dimorpha** (Busck).
2. Pronotum with a brown medial vitta, figure 748; dark scaling on forewings mostly much paler, more yellow brown; metascutum and hindwing of male normal ..... **triaula** (Meyrick).

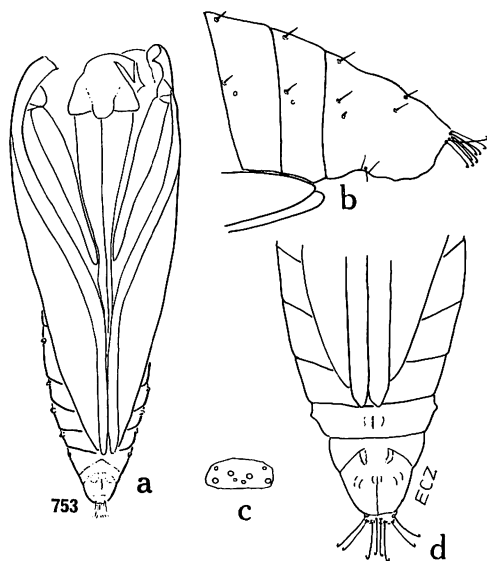


Figure 753—Details of the pupa of *Asymphorodes dimorpha* (Busck). *a*, ventral aspect of the cast skin of a male; length 4.25 mm.; *b*, lateral aspect of the caudal part of the abdomen of a cast skin of a female, with same shown in ventral aspect at *d*; at *c* is shown the pattern of the eight setal sockets of the cremaster in direct caudal aspect. Abdominal segments 5, 6, and 7 are mobile. Both specimens are from *Pandanus* at Honolulu.

***Asymphorodes dimorpha*** (Busck), **new combination** (figs. 745, head, wing venation; 747, 748, moth; 749, male genitalia; 750, male, female genitalia; 753, pupa; 754–757, metascutum and its processes).

*Petrochroa dimorpha* Busck, 1914b: 105. Williams, 1931: 157, fig. 55.

Niihau, Kauai (probable, but I have no record), Oahu (type locality: Honolulu), Molokai, Maui, Lanai, Hawaii, Nihoa, Necker, Pearl and Hermes Reef, Midway, Kure (Ocean), Wake, Canton, Jarvis.

Immigrant. Probably much more widely distributed in the Pacific than our present knowledge indicates.

Hostplants: dead leaves, dead grass, dead plant materials in turf, long eggplant (presumably in dead stems or leaf tissue), in bunch grass.

Parasites: *Chelonus* (*Microchelonus*) *blackburni* (Cameron), *Trathala flavo-orbitalis* (Cameron).

The whitish larvae do not make cases. It is a common and widespread moth of the lowlands, and the adults are often attracted to lights in large numbers. Van Zwaluwenburg (1943:309) found the species to be abundant on Canton Island where he found the larvae feeding in "the dead trash about bunchgrass clumps." The holotype is number 18431 in the U.S. National Museum. The



Figure 754—The denuded metascutum and metascutellum of an adult female of *Asymphorodes dimorpha* (Busck) for comparison with the male as illustrated in figures 755–757. Note that the wing-locking setose areas are not drawn out into thornlike processes in the female as they are in the male. See the text for discussion. Magnification:  $\times 150$ . [Scanning electron microscope photograph by Klaus Sattler, B.M. (N.H.)]

forewings of this small moth (overall length with wings folded at rest is about 5 mm.) are dark brown on about the costal two-thirds from base to apex whereas the area posterior to the brown scaling is pale creamy or whitish. Thus, when the wings are folded at rest, the moth appears brown on the sides with a broad, pale, longitudinal stripe down the middle of the back. On some examples the costal area may also have a pale vitta. Busck evidently called it *dimorpha* because, as he noted, the antennae are "in the females annulated with dark brown through their entire length, in the males annulated with dark brown only on outer two-thirds".

The hindwing of the male is most unusual. Not only is the venation much reduced, but there is a singular, bladderlike, thorn-bearing protuberance near the middle of the hind margin of the cell near the wing margin. Part of this peculiar organ projects above the dorsal wing surface, but the greatest protuberance is from the ventral surface, as shown by the accompanying illustrations. Neither Busck nor anyone else to my knowledge has commented upon the peculiar venation or the unusual process on the hindwing of the male.

The tergites of the five caudal segments of the male are heavily sclerotized. The two caudal tergites are especially distinctive and have unusual sclerotized plates. In life, the terminal segment is telescoped beneath the penultimate, and the genitalia are partially withdrawn beneath these more heavily sclerotized tergites. The structure of the abdomen is demonstrated in figure 750.

Upon first examination, the male genitalia may cause some confusion because the genital "flaps" (epiptygmata) are unique in the Hawaiian fauna. They are heavily sclerotized, irregular, angulate structures that may appear to be the valvae. I have not seen even a tendency toward such modification in any of the other Hawaiian Cosmopteriginae. The valvae are attached to the vinculum by narrow bases and are easily broken off. I was considerably confused by one of the first specimens I studied, because it had lost its valvae, and the sclerotized "flaps" appeared to be the valvae. The illustrations demonstrate the features of the genitalia.

The most extraordinary structural development of this species is, however, the astonishing thornlike processes on the metascutum of the male, as illustrated in figures 755–757. The minutely denticulate wing-locking areas on the metascutum are drawn out to form a pair of caudally directed, prominent, thornlike structures in the male, but these areas are normal in the female. This appears to be a heretofore unreported development in the Lepidoptera, and it appears to have escaped the notice of lepidopterists. I cannot offer an explanation for this remarkable structural modification being confined to the males. Observation of living moths may reveal its function. A study of the accompanying illustrations will be more instructive than additional words here.

When Klaus Sattler discovered that I was about to create a synonym by proposing a new name for this genus in Hawaii, he was led to an examination of the *Asymphorodes* material in the Meyrick collection in the British Museum. He found that the male of *valligera*, the type-species, has a metascutum formed as in *triaula* (that is, without thoracic thorns on the male), and it has a strong

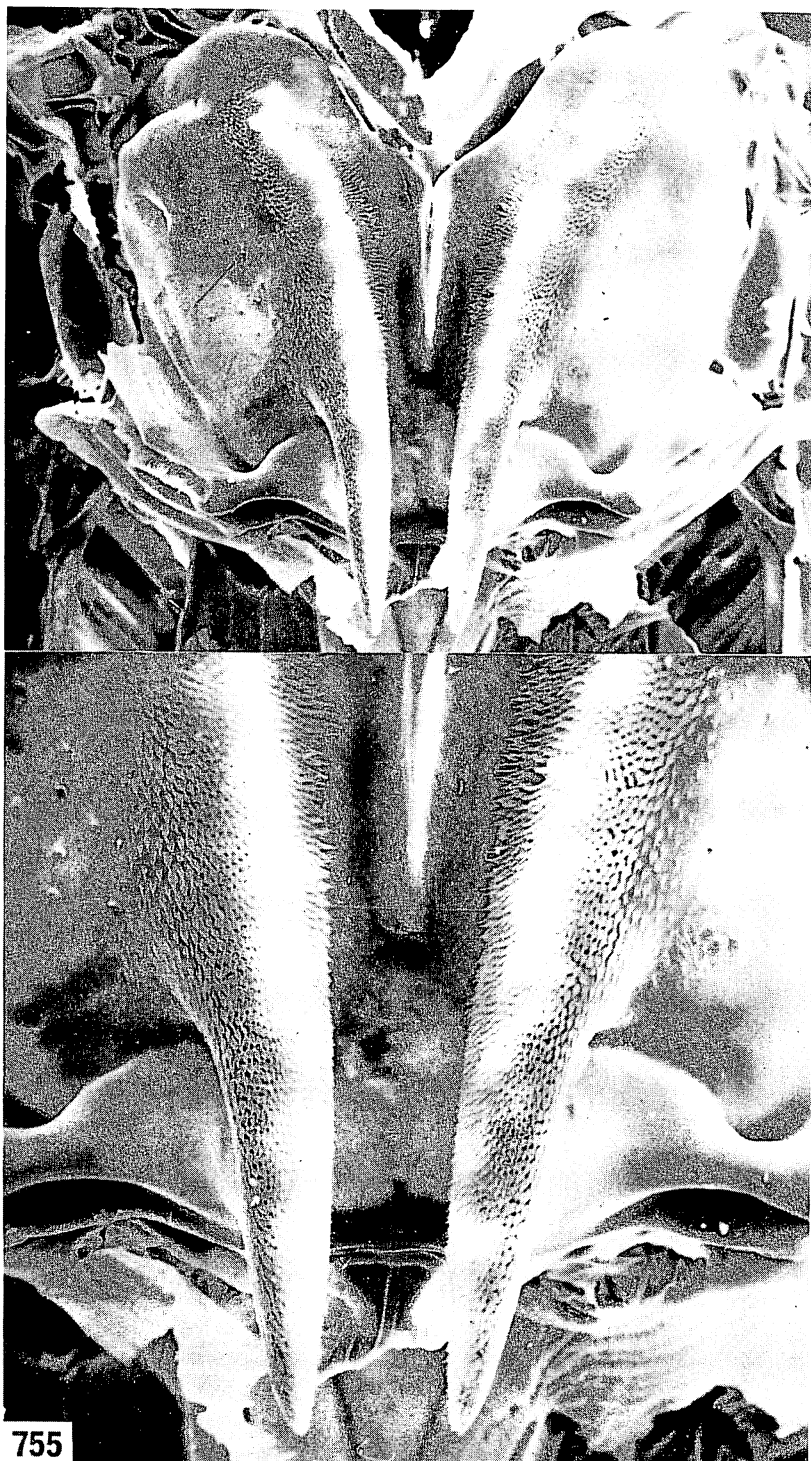


Figure 755—Two different enlargements of the unusual processes on the metascutum of the male of *Asymphorodes dimorpha* (Busck). Note that these thornlike processes are elongations of the wing-holding areas of the metascutum, and compare the different structure of the female as illustrated in figure 754. See the text for discussion. Magnification: top,  $\times 145$ ; bottom,  $\times 290$ . [Scanning electron microscope photographs by Klaus Sattler, B.M. (N.H.).]



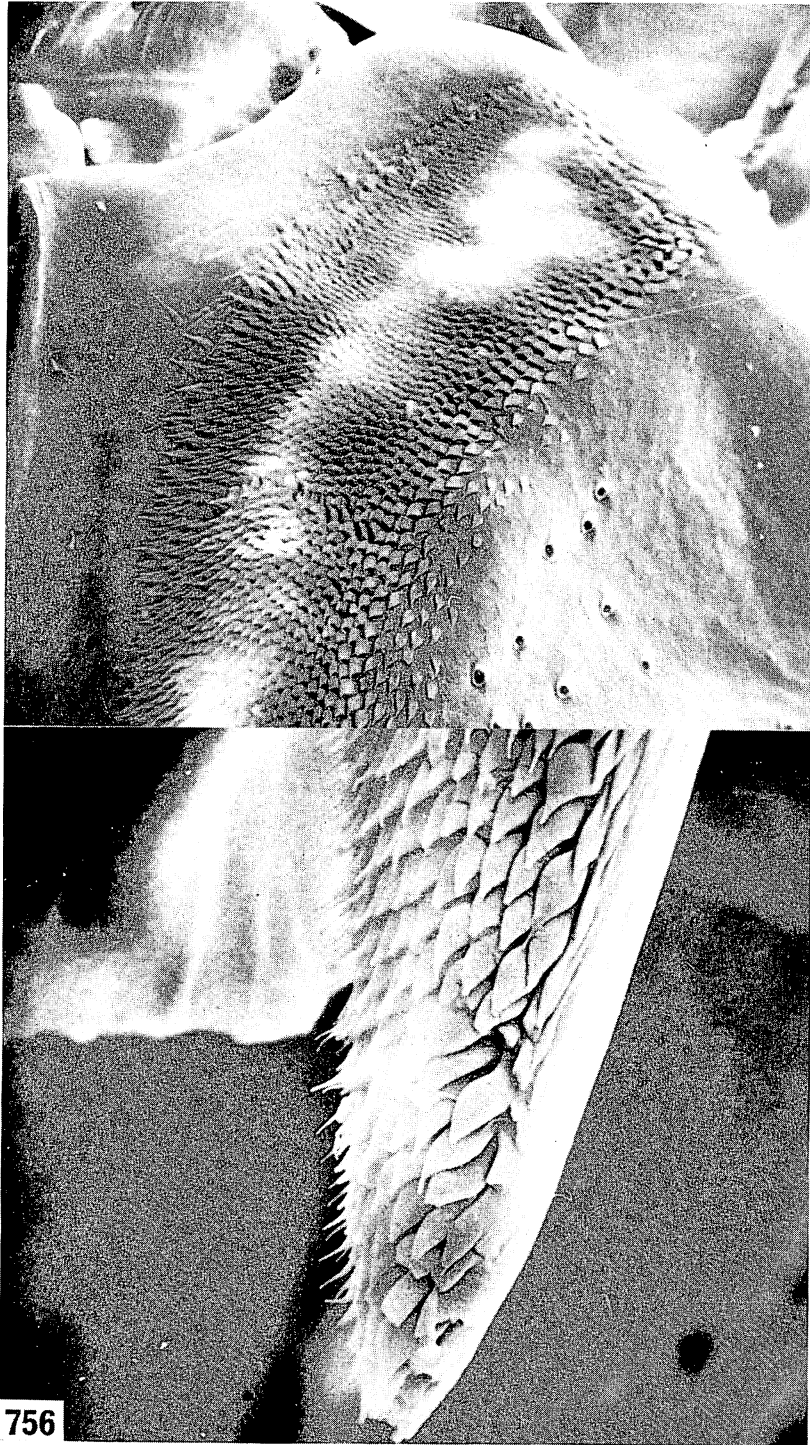


Figure 756—Enlargements of the base and apex of the right thornlike process of the metascutum of the male of *Asymphorodes dimorpha* (Busck) as shown in figure 755. Magnification: top,  $\times 500$ ; bottom,  $\times 1,450$ . [Scanning electron microscope photographs by Klaus Sattler, B.M. (N.H.).]



tuft on the underside of the hindwing as does *dimorpha*. The males of *porphyra*, *cirsodes* and *plectographa* have the strange thorn-like processes on the metascutum as does *dimorpha*, and they also have the "strange tuft" or process on the underside of the hindwing. The male of *circopis* has the thoracic thorns but lacks the hindwing structure. Neither thoracic thorns nor hindwing structures occur on *monoxesta*. Hence, Sattler has rightly concluded that it is possible to demonstrate the development of the thoracic thorns from species that show no sexual dimorphism in this regard to those that have the strange thoracic thorns developed strongly in the males only.

***Asymphorodes triaula* (Meyrick), new combination** (figs. 746, wing venation; 748, moth; 751, male, female genitalia; 752, male genitalia).  
*Aphthonetus triaula* Meyrick, 1935a:63.

Oahu, Hawaii (type locality: Kona).

Immigrant. I believe that this species is an immigrant although it appears not to be known elsewhere. The first examples were collected by Prof. S. Issiki, at Kona, in January, 1923. It was not found by Dr. Perkins, and Dr. Swezey did not collect it until his later years. In recent years it has been collected in

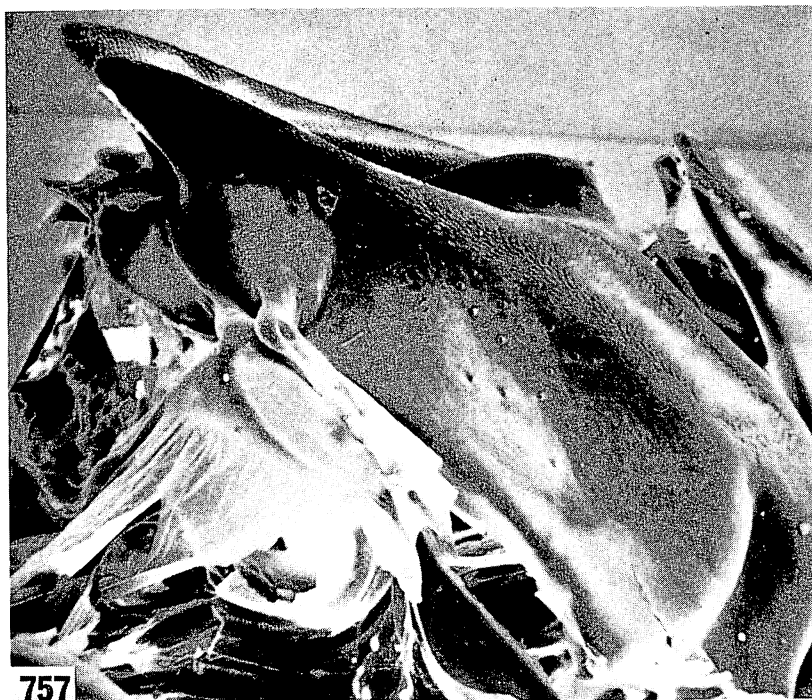


Figure 757—The thornlike processes on the metascutum of the male of *Asymphorodes dimorpha* (Busck) shown on figures 755 and 756 in right lateral aspect. Magnification:  $\times 200$ . [Scanning electron microscope photograph by Klaus Sattler (B.M. (N.H.).)]

numbers at lights in Honolulu, Pearl Harbor, Kaneohe, and elsewhere near the seashore on Oahu. J.W. Beardsley kindly examined collections in Honolulu for me, and he reported that the earliest record he has seen for Oahu is January, 1942.

Hostplant: unknown.

Meyrick failed to note the strong subcostal brush on the hindwing of the male nor did he mention the strong antennal pecten (about five setae). There is also a small brush on the posterior margin of the forewing of the male.

The abdomen of the male of this species lacks the peculiar sclerotizations which are found on *dimorpha*, and the genital flaps are not highly modified. The ostium of the female, however, is more heavily sclerotized and complicated than it is in *dimorpha*. There are no thornlike processes on the metascutum of the males as there are on *dimorpha*. The illustrations demonstrate these features.

### Genus **HYPOSMOCOMA** Butler

*Hyposmochoma* Butler, 1881:399. Type-species: *Hyposmochoma Blackburnii* Butler, 1881:400, monotypic. Walsingham, 1907b:549.

*Hyposmocoma*: Walsingham, 1907b:549, emendation (see p. 1079 below).

For synonymy, see the details under *Hyposmocoma* (*Hyposmocoma*) and *Hyposmocoma* (*Euperissus*) below.

See color plates 5, figures 5–8; 6, figures 1–8; 7, figures 1–8; 8, figures 1–4.

We now come to the greatest assemblage of Hawaiian Lepidoptera—the extraordinary endemic *Hyposmocoma* complex. It is one of the most fascinating and challenging groups of insects I know. It is truly remarkable. It is unusually rich in material for the study of evolution, and the extent of its astonishing developments cannot be adequately appreciated without detailed study. The more one studies the complex the more overwhelming appears the extent of its diversity and the trends and products of its evolution. Most unfortunately,

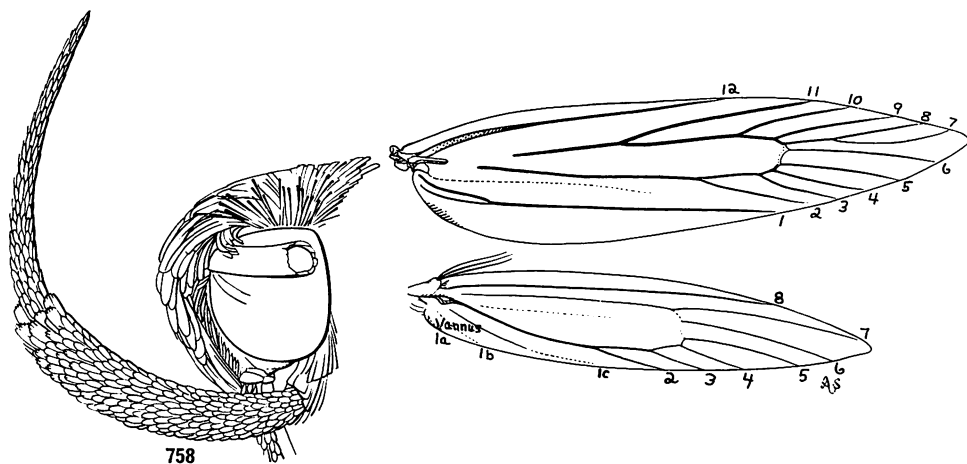


Figure 758—Head and wing venation of *Hyposmocoma* (*Hyposmocoma*) *blackburnii* Butler, female (BM slide 1190); Olinda, 4,000 feet, Maui. This is the type-species of *Hyposmocoma*.

what I have to record here is mostly the result of inadequate observation. I have not been allowed the time nor given the support necessary properly to study and to analyze this group. I should have liked to have had the opportunity to spend several years in the field and laboratory to prepare this chapter. An entire lifetime of profitable and exciting research could be devoted to the study of *Hypsmocoma* without exhausting the possibilities of revealing new and interesting facts. If I could only find a way of doing the work, I would gladly devote the remainder of my life to the study of *Hypsmocoma* alone.

The *Hypsmocoma* complex has not been understood because previous authors have failed to study the all-important and astonishingly varied genitalia. I have, therefore, found it necessary to combine 13 "generic" names under *Hypsmocoma*. This will no doubt appear to be drastic action, but it has not been



Figure 759—Head and wing venation of *Hypsmocoma* (*Euperissus*) *semifuscata* Walsingham, holotype male (BM slide 4140); Kona, 3,000 feet, Hawaii.

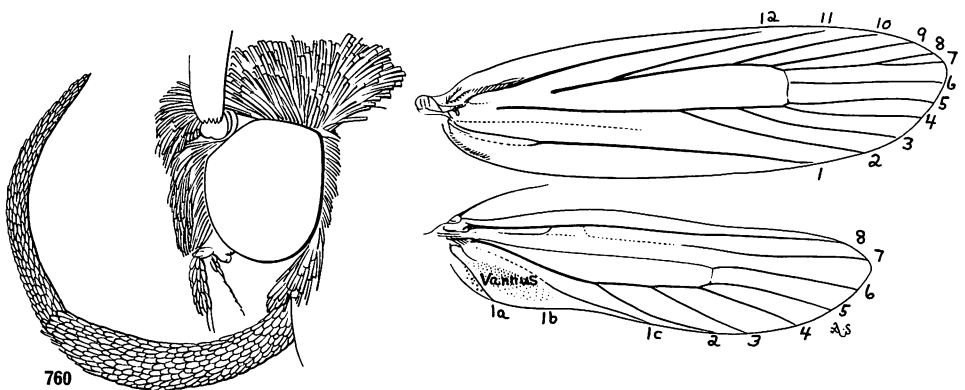


Figure 760—Head and wing venation of *Hypsmocoma* (*E.*) *cristata* (Butler), holotype (BM slide 4390). This is the type-species of *Euperissus*. The dotted area on the vannus of the hindwing indicates the sockets of the hairs of the vannal tuft.

done lightly or quickly. I have reached this conclusion only after study which has convinced me that *Hypsmocoma* is an enormous cluster of species in a remarkable state of explosive speciation and radiation which is diverging in many directions. Its extremes may at first sight appear to represent distinct genera. However, the links which tie the extremes to the center remain, and the blends from one extreme to the other can be demonstrated. Extinction of intermediate forms has not taken place to any noticeable degree.

If one were to select extreme species, or groups of extreme species, it would perhaps be possible to use many of the generic names which I have synonymized. Other new groups could be named, provided that superficial characters were used to separate them and that the intermediate species were ignored or unknown. I have, however, been unable to recognize the groups of other authors as genera. I have been equally unsuccessful in characterizing most of the groups as subgenera because there are intermediate forms which blend most groups into others and interlink the huge number of species in a manner which seems to defy such segregation.

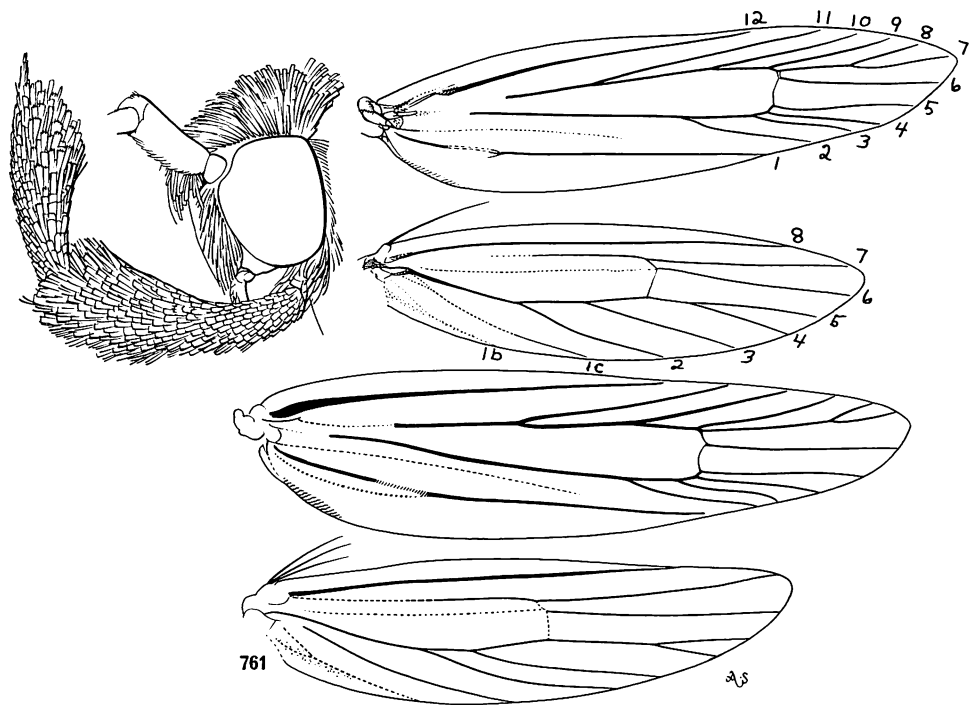


Figure 761—Head and male and female wing venation of *Hypsmocoma* (*H.*) *lignivora* (Butler). This is the type-species of *Diplosara*. Head from the allotype female, Oahu. Male wings from the holotype male (BM slide 9609), Oahu. Female wings from a specimen from Lanihuli, Oahu (slide Z-XII-62-3). This is the only species group of *Hypsmocoma* known to have palpi whose terminal segments are so expanded by the vestiture. Compare the many other palpi illustrated in figures 778 to 787. In the hindwings, veins 4 and 5 vary from being separate to connate, to short stalked, to long stalked. As noted in the main text, this species combines characters of *Euperissus* and *Hypsmocoma*.

Walsingham, who described most of the "genera" and species of the complex, did not prepare any keys. He may have tried to do so but found it impossible. Meyrick, who described one "genus" and a number of species, wrote no keys. Swezey, who described one "genus" and several species and wrote most of what is known about the biology, wrote a key to the "genera" known in 1909 (abstracting details regarding "key characters" from literature), but his key is unworkable. Busck described a "genus", which actually contained representatives of two genera, which cannot be maintained. He tried to make a key to the "genera", based upon Swezey's attempt and augmented by some brief studies of his own, but Busck's key failed in manuscript.

The task confronting Walsingham and his very able and faithful assistant Durrant when they undertook to prepare the *Fauna Hawaiiensis* report on Perkins' wonderful and extensive collections was formidable. It is remarkable that their difficult task was completed. (Durrant should be given great credit for his contribution—it may be that it was largely because of his work that the task was completed. He should have been named coauthor of the *Fauna Hawaiiensis* report on the Microlepidoptera.) Walsingham said (1907b: 743):

It will be recognized by all practical workers that the examination of so large a collection has been no easy task. The specimens, although for the most part in good condition, were merely pinned on blocks of cork with a dated locality label beneath. On each block were insects of various sizes, thus every specimen had to be provisionally registered before they could be relaxed in groups selected according to size, and therefore according to the amount of moisture required, the provisional labels being of course rendered useless after damping, and serving only to preserve a reference to the details in MS. All were repinned and set. The amount of mere manual labour which this involved has been a severe tax upon the time and industry of my assistant Mr. Durrant, but that was after all only the lighter part of his work. He has also undertaken for me a detailed examination of structural characters, and the sorting-out of species and genera preparatory to final arrangement and description.

If anything could have damped the enthusiasm of a specialist devoted to his subject the genera *Hypomocoma*, *Aphthonetus*, *Neelysia*, and *Heterocrossa* [*Carposina*] would assuredly have done so, but in verifying his work I have found scarcely any errors and these only such as were absolutely unavoidable in dealing with such a mass of material. He examined the neurulation and other minute structural characters of every specimen in the collection. Many which were almost absolutely similar in colour and markings were found

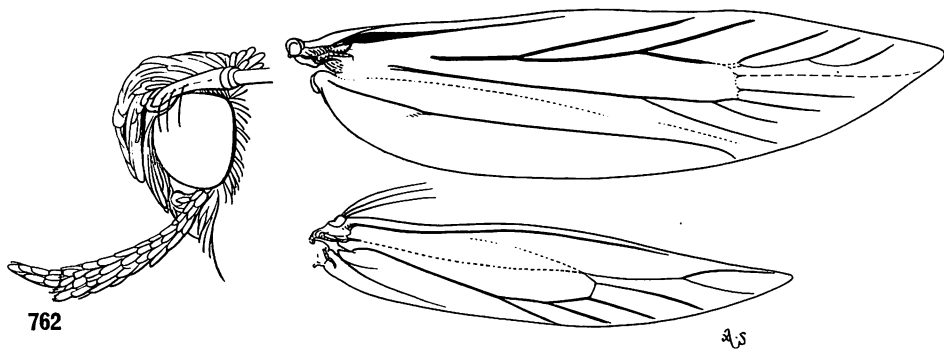


Figure 762—Head and wing venation of *Hypomocoma* (*H.*) *flavipalpis* (Walsingham), holotype (BM slide 4309); Haleakala, 4,000 feet, Maui. The palpi are normally upturned. This is the type-species of *Agonismus* Walsingham.

to differ in more important respects, and the discovery of one difference invariably led to the recognition of others which had at first sight been overlooked. Generic separation, which at first seemed obvious, had frequently to be discarded as valueless, and the work had thus to be done three or four times over before a satisfactory conclusion could be reached. I cannot sufficiently commend, or acknowledge, the patience and perseverance with which he has relieved me of by far the greater part of this labour and made my task, if not actually easy, yet far less painfully exhausting than his own.

Walsingham stated further (1907*b*: 741):

Mr. Perkins informs me that a very large proportion of the species dealt with in this paper were obtained by searching upon trunks of trees and among dead leaves under forest growth. As might be expected under such circumstances many of them were proved to be case-bearers, and without doubt this habit is characteristic, especially of such genera as are found rich in species. The most commonly known European case-bearing Tineina are those of the genus *Coleophora*, Hb., and it is at least a coincidence that in the perfect state these are also extremely difficult to distinguish from each other without some knowledge of their preliminary stages. Many attempts have been made to recognize characters of generic value among the numerous species of this genus, but *Coleophora*, as now generally accepted, presents a gradation of structure which not only fails to afford satisfactory lines for higher classification, but sometimes increases the difficulty of determining the limits of rightly accepted species. This applies specially to the more or less fugitive hair-scales at the base of the antennae, sometimes well-developed, sometimes weak, and often absent. If all the known species of Holarctic *Coleophorae* (many of them represented by a single specimen) were mixed together in a series of store-boxes it would not be more difficult to identify the species correctly, without any clue to their life-histories, than it has been to work through a correspondingly numerous collection of

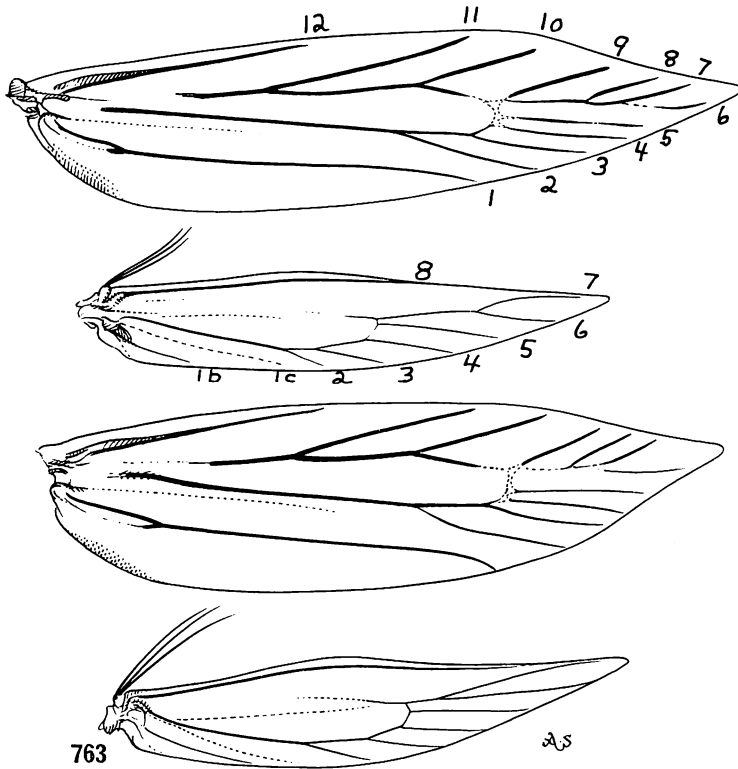


Figure 763—Head and wing venation of *Hyposmocoma* (*H.*) ('*Agonismus*') species. Top, *argentifera* (Walsingham), paratype (BM slide 5434); Kilauea, Hawaii. Bottom, *coruscans* (Walsingham), paratype (BM slide 5433); Kona, 4,000 feet, Hawaii.

the genus *Hypsmocoma*, Btl., consisting of at least 170 species, and to determine the limits of special variation. Yet it will be obvious to anyone acquainted with the subject that a series of *Coleophorae* selected at random would almost certainly include several consistently distinct species.

If the above illustration may convey some idea of the interminable series of mutations by which the differentiation of species has progressed, a study of generic characters is almost equally confusing.

And on pages 738–739, Walsingham said:

One thing certainly strikes us very forcibly in regard to the close affinity of species and the extreme difficulty of finding reliable and persistent generic characters, viz. that the Hawaiian *Microlepidoptera* are in a condition of progressive, and at present imperfect, differentiation. For, whereas in all other continental collections we find an abundance of distinct and easily recognisable species and genera, intermixed with some few only difficult to identify, the Hawaiian *Microlepidoptera* are in the great majority of instances so closely allied, or so confusingly similar, as to present the utmost difficulty in any attempt at classification and description. Each prevalent form seems to possess representatives in the various islands, but these are scarcely ever absolutely inseparable *in series*, and possess in each case some distinctive peculiarity of colour, or markings, or secondary sexual characters, which seems to entitle them to recognition as at least geographical species. It is not uncommon to find in a long series of specimens, apparently similar at first sight, that a certain proportion of the males possess an expansible subcostal hair-pencil at the base of the hindwings which is wanting in others, and a minute examination usually discloses persistent differences, however slight, which enable the species to be distinguished from each other in either sex. I was at first disposed to regard this sexual character as of generic value, but the idea was ultimately abandoned in view of the varying degree in which it was represented, and of the precise similarity, in all other structural details, of the very numerous specimens under observation. The same plasticity extends to other structural characters, such as the pecten on the basal joint of the antennae, the clothing of the tibiae, the comparative breadth of the fore and hindwings, and the relative length of the palpal joints; the neuration also is occasionally unstable. . . .

In their final arrangement in *Fauna Hawaïiensis*, Walsingham and Durrant placed 177 species in *Hypsmocoma*, but previously, in the manuscript, they had divided these species into other generic groups. This can be seen from Walsingham's statement in his 1908*b*:109 note renaming one of his species: "When combining tentative MS. genera, abandoned through the occurrence of intermediate forms, the idionym *nebulifera* was inadvertently used twice in the genus *Hypsmocoma*." It is of interest that, except for this lapse, Walsingham never used the same trivial name for more than one species in the entire complex

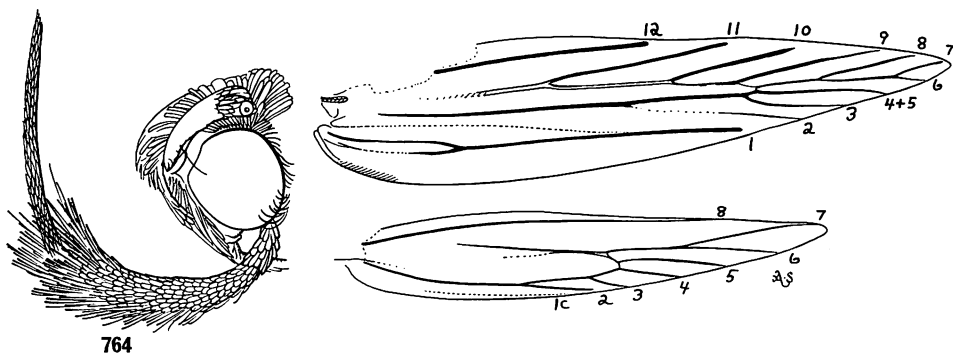
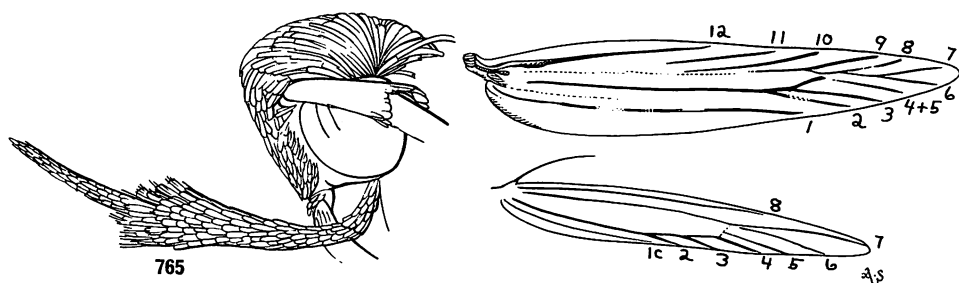


Figure 764—Head and wing venation of *Hypsmocoma* (*E.*) *diffusa* (Walsingham), holotype (BM slide 4423); Olinda, 4,000 feet, Maui. This is the type-species of *Aphthonetus*. There is a great range of variation in the form and vestiture of the labial palpi in the *Aphthonetus* group. The form of this species is characteristic of many, but not all, of the species in this group. For example, the palpi of *kauaiensis* have shorter terminal palpal segments, and there are four spines in the antennal pecten. The labial palpi of *fluctuosa* have widened second palpal segments which appear shorter and broader and which are not hairy.

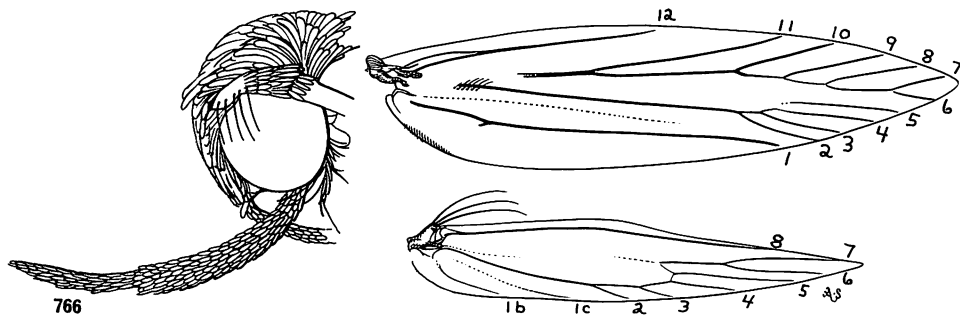
of about 250 species in the 11 generic names he used. It is possible he anticipated that some of his "genera" might eventually be merged.

As further evidence of Walsingham and Durrant's failure in their attempts to divide *Hypsmocoma*, we find that a number of the types of *Hypsmocoma* bear the unpublished name "*Eccomotria*" instead of *Hypsmocoma*. These species are scattered through the series of *Hypsmocoma* as they were finally arranged and published. I do not know what character or characters Walsingham and Durrant tried to use to separate this supposed group. In any event, such an arrangement is untenable because the list includes unrelated species in both *Hypsmocoma sensu stricto* and subgenus *Euperissus*. The following is a list of the species which I have noted as bearing the "*Eccomotria*" label (the question marks are as used by Walsingham and Durrant):



765

Figure 765—Head and wing venation of *Hypsmocoma (E.) rutilella* (Walsingham), holotype male (BM slide 4422); Kauai, 3,000 to 4,000 feet. This is the type-species of *Rhinomactrum*. Note that the forewing has only 11 veins; 4 and 5 appear fused, a not unusual feature. The hindwing was damaged, and it is not spread flat on the mount. I believe that the drawing may be too narrow from the base to near the middle so that the contour may be incorrect. Compare figure 766.



766

Figure 766—*Hypsmocoma (H.) scapulella* (Walsingham), head and wing venation of the female holotype (BM slide 5290); Oloa, Hawaii. Compare figure 765.



<i>argentea</i>	<i>leporella</i>	? <i>punctiplicata</i>
<i>auroargentea</i>	<i>lineata</i>	<i>quadristriata</i>
<i>commensella</i>	? <i>lucifer</i>	<i>rhabdophora</i>
<i>exornata exornata</i>	<i>maestella</i>	<i>scandens</i>
<i>exornata flavicosta</i>	<i>ocellata</i>	<i>subargentea</i>
<i>fulvocervina</i>	<i>oculifera</i>	<i>tenuipalpis</i>
<i>lacertella</i>	<i>persimilis</i>	? <i>trilunella</i>
<i>lebetella</i>	<i>picticornis</i>	<i>unistriata</i>

In his generic redescription of *Hyposmocoma*, Walsingham (1907b:549) said that it is "a variable genus containing many species in a plastic state of development". He then stated: "Distinctions founded on the relative lengths of the joints of the palpi, the comparative breadths of the wings, the presence or absence of raised scales, and the possession or lack of secondary sexual characters, which at first seemed of morphic value, and to indicate the possibility of subdividing the long series included in this genus, had to be abandoned for intermediate forms rendered it impossible to maintain any subdivision however distinct the subdivision appeared to be when founded on a single species." My figures 778 to 787 of the range of variation in the labial palpi illustrate the futility of any attempt to segregate *Hyposmocoma* into generic groups based upon the labial palpi.

Walsingham and Durrant, furthermore, had difficulty in limiting *Neelysia*. We find that several of the species which they finally described in *Fauna*

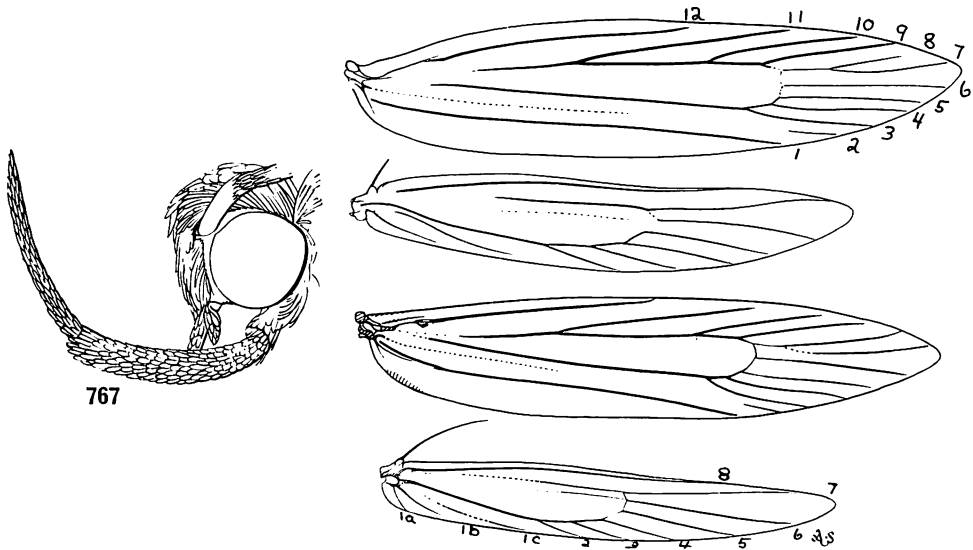


Figure 767—Head and wing venation of *Hyposmocoma* (*Euperissus*) species. Head and upper wings are from the holotype male (BM slide 4392) of ("Neelysia") *lignicolor* (Walsingham); Haleakala, 5,000 feet, Maui. This is the type-species of *Neelysia*. Bottom wings are of ("Neelysia") *tigrina* (Butler); Haleakala, Maui (BM slide 5446).

*Hawaiiensis* as *Neelysia* were included in manuscript as *Hyposmocoma*, and they bear that generic label in the type collection today. The species of *Neelysia* that I have noted that were originally labeled as *Hyposmocoma* are: *argyresthiella*, *nemoricola*, *ningorella*, *poeciloceras*, and *rediviva*.

When Butler (1879, 1881, 1882) described the first members of this group, he was so confused by them that he placed the 12 original species he described from the Reverend Blackburn's collections in six genera (*Scardia*, *Gracillaria*, *Laverna*, *Chrysoclista*, *Hyposmocoma*, and *Euperissus*) which he assigned to four families (Tineidae, Elachistidae, Gracillariidae, and Gelechiidae)! Thus, he described *Hyposmocoma* for *blackburnii* only, and he then incorrectly placed it in the Gelechiidae (instead of in the Cosmopterigidae) and wrongly allied it to the American *Holcocera*, which American lists now include in the Blastobasidae. He also placed *Euperissus* with its then single species *cristatus* in the Gelechiidae and wrongly associated it with the foreign *Taruda* and *Cryptotelechia*, a xyloryctid. He wrongly described *auripennis* as a *Gracillaria* in the Gracillariidae. In

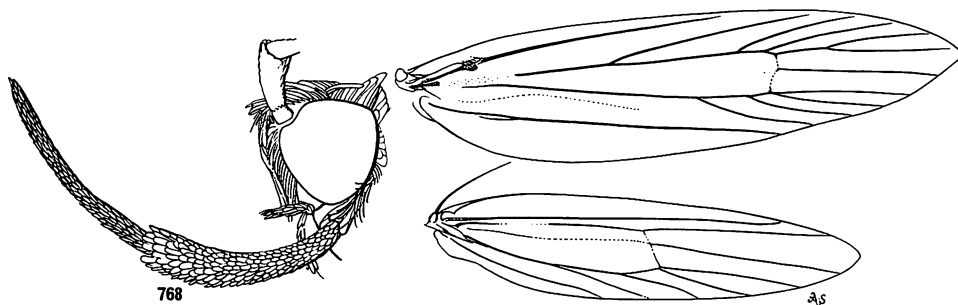


Figure 768—Head and wing venation of *Hyposmocoma* (*H.*) *semicolon* (Walsingham), holotype male (BM slide 4395); Kaholuamano, 4,000 feet, Kauai. Note the connate veins 4 and 5 in both wings. They are stalked in some specimens, and this character is variable. Note also the short cell in the hindwing. This is the type-species of *Dysphoria*.

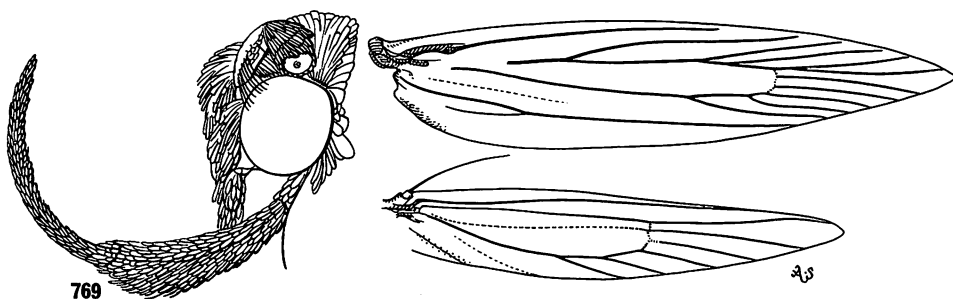


Figure 769—*Hyposmocoma* (*E.*) *subburnea* (Walsingham), head and wing venation of the holotype male (BM slide 4394); Molokai, about 4,000 feet. This is the type-species of *Bubaloceras*. Compare the short stalk of veins 7 and 8 in the forewing with the longer stalk shown in figure 768 and the much longer stalks in figure 770.

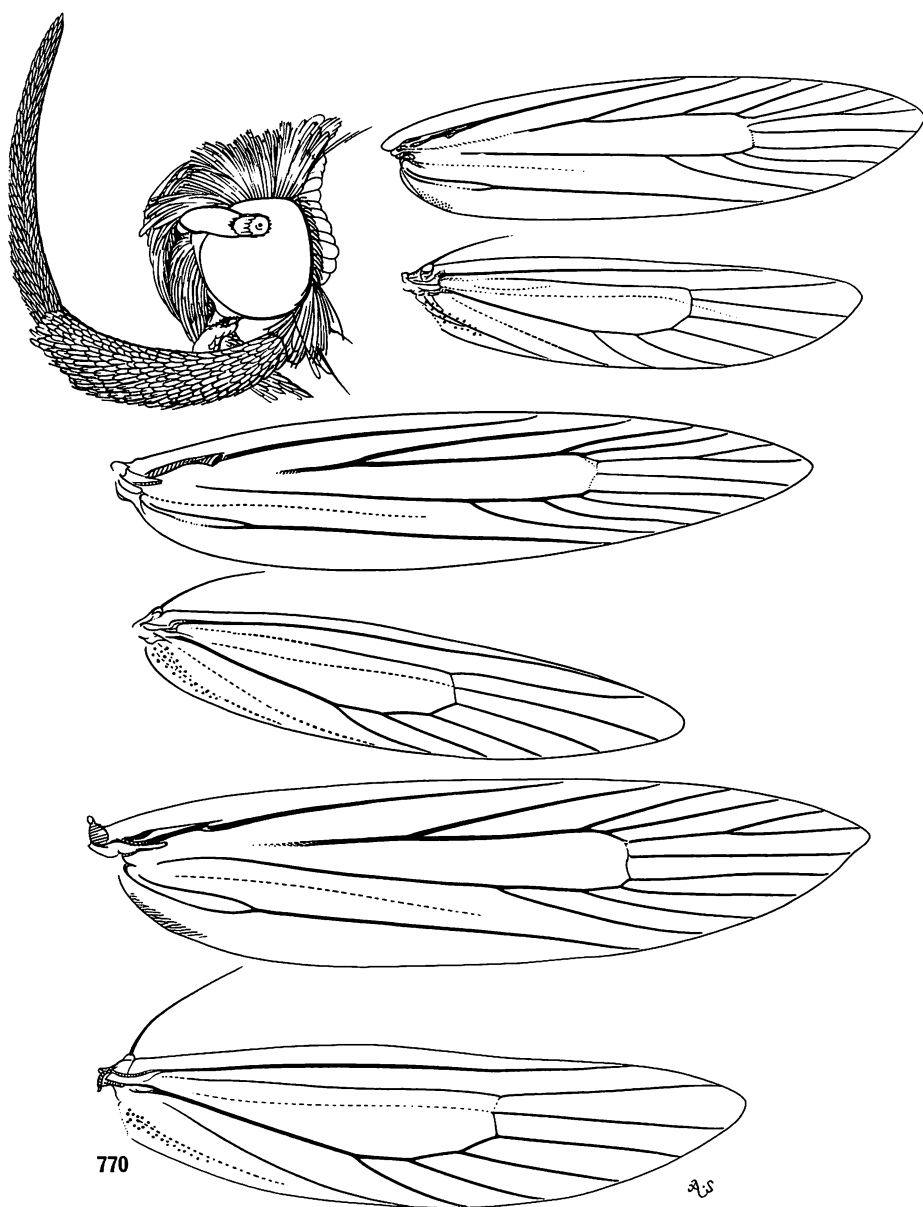


Figure 770—Details of *Hypsoscoma* (E.) species originally described in "*Hyperdasyella*". Top, *cryptogamiellus* (Walsingham), holotype male (BM slide 4428); Oloa, Hawaii. The type-species of *Hyperdasyella*. Note that the forewing has an abnormal 13 veins; an extra vein is between veins 10 and 11. Middle, *arundinicolor* (Walsingham), paratype (BM slide 2006; Walsingham 27282); Kauai, 3,000 to 4,000 feet. Bottom, *semiustus* (Walsingham), paratype (BM slide 2005; Walsingham 26741); Kauai, 3,000 to 4,000 feet.

*Laverna*, which he placed in the Elachistidae, he described *abjecta*, *aspersa*, *corvina*, *domicolens*, *montivolans*, and *parda*, and he also placed *tigrina* and *haleakalae* in the Elachistidae. He described *lignivora* in *Scardia* in the Tineidae.

The foregoing discussion demonstrates the difficulties others have encountered when trying to classify *Hypsmocoma*. All previous workers on the group have attempted to subdivide the group into genera, and they all have failed. It is obvious that the reason that such subdivision has failed is because *Hypsmocoma* is a blend from one extreme to another. It has not divided into genera in nature, although incipient subdivision is clearly evident. There

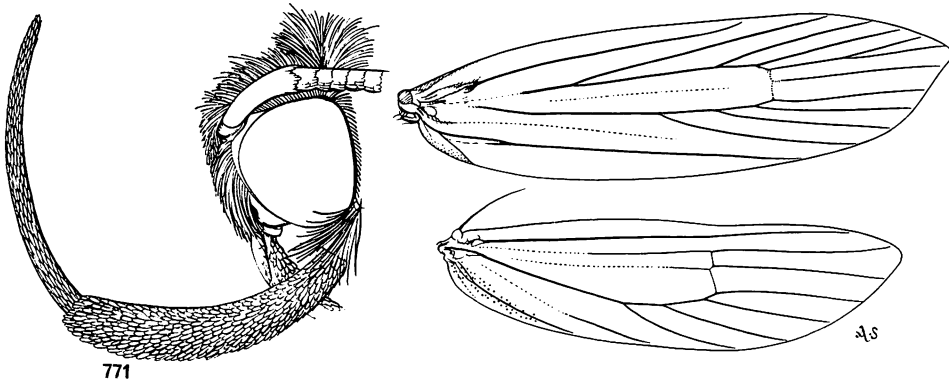


Figure 771—*Hypsmocoma* (*E.*) *fulvogrisea* (Walsingham), head and wing venation of the holotype male (BM slide 4429); Kauai, 3,000 to 4,000 feet. This is the type-species of *Semnoprepia*. Compare these broad wings with the narrow wings on figure 772, and note the differences in the palpal vestiture in the two species.

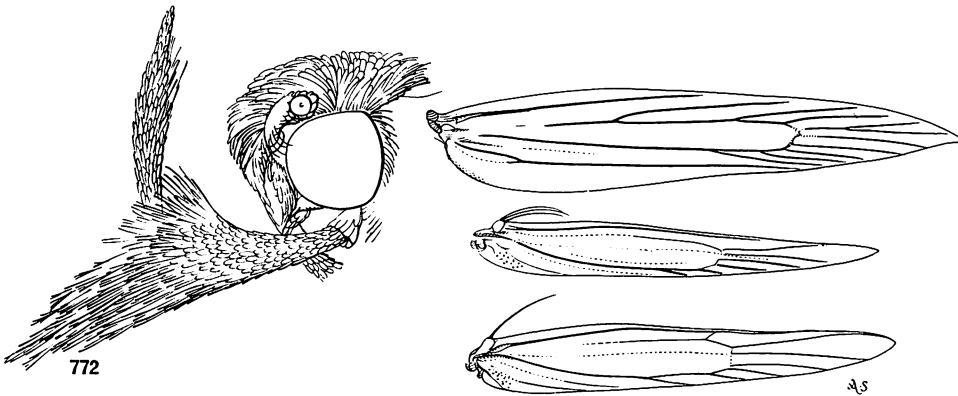


Figure 772—*Hypsmocoma* (*E.*) *ekaha* (Swezey), head and wing venation. The head is from a female, and the female wings are on BM slide 4405; Oahu. The male wings are on Busck slide 162. This is the type-species of *Euhypsmocoma*. The cross-vein between the cell and vein 8 in the hindwing of the male is evidently an abnormality; the forewing is essentially similar to that of the female.

appears to be little doubt that a number of genera could be formed from this complex if accidents of time such as rigorous extinction of intermediate forms or transference of isolated groups to other lands had occurred.

After much study, I have concluded that 13 of the 14 generic names heretofore used in this complex should be suppressed under *Hypsmocoma*. I shall now outline briefly my reasons for not recognizing these supposed genera. I shall not comment upon each detail of the generic descriptions, because when one is familiar with the great specific variability it becomes apparent that much of what has been written before is generically meaningless. An examination of my illustrations of the wing venation and palpi, for example, will clearly demonstrate the great range of specific variation, the intergradation from one extreme to another, and the impossibility of separating the complex into discrete generic units on such characters.

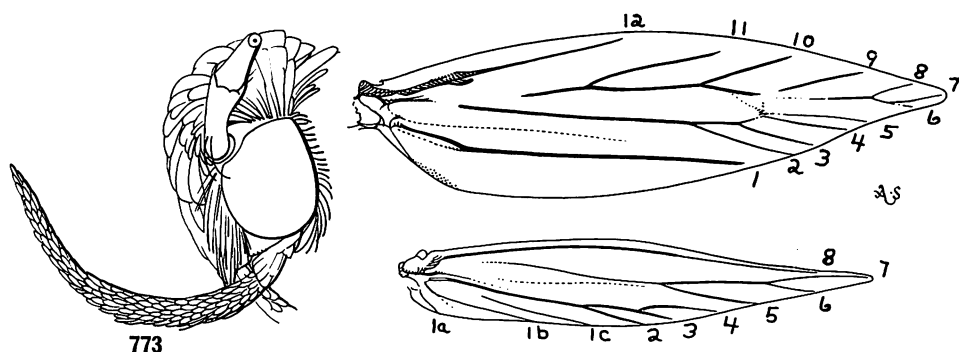


Figure 773—*Hypsmocoma* (*H.*) new species 32. Head and wing venation of a specimen formerly confused with *Petrochroa swezeyi* Busck. Note the unusual venation in which vein 6 comes out of 7 and is subobsolete in the forewing, and 4 and 5 are connate; in the hindwing 5 and 6 come out of 7 and the cell is open. There is probably considerable variation in the venation of this species. Kaimuki, Honolulu (BM slide 5212).

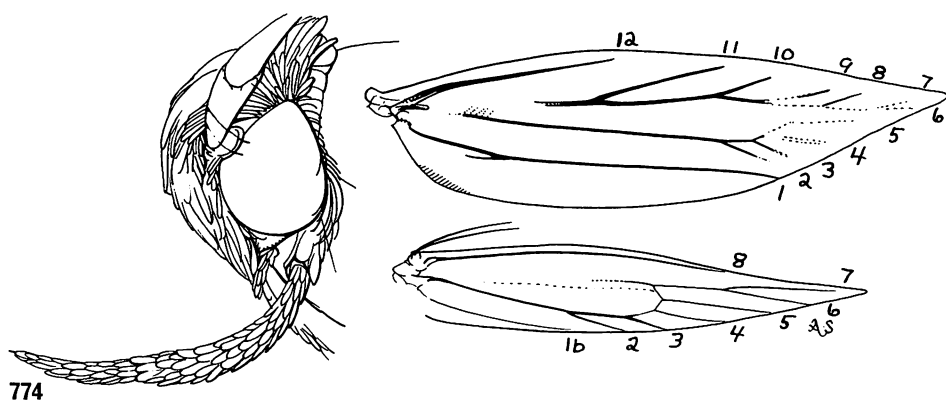


Figure 774—*Hypsmocoma* (*H.*) *longisquamella* (Walsingham), a species originally incorrectly assigned to *Elachista* by Walsingham. Head and wing venation of the female holotype (BM slide 2029); Kona, Hawaii.

**Hyposmochoma** Butler, 1881:399. In *Fauna Hawaiiensis* (1907b:550) Walsingham emended the name to *Hyposmocoma*, and he said, "The generic name was obviously given in reference to the subcostal hair-pencil, 'presumably a scent-fan' (Btl. *l.c.*). *Hyposmochoma* (χωμα = a heap) would be neuter, and it seems advisable to make the slight correction to *Hyposmocoma* (κομη = hair), feminine, which was doubtless intended." I agree with Walsingham regarding the desirability of emending the name to *Hyposmocoma*. The resurrection of the long-forgotten, and possibly erroneous, spelling *Hyposmochoma* would serve no useful purpose, and it would contribute to confusion. I appealed to the International Commission on Zoological Nomenclature to have *Hyposmocoma* placed on the Official List of Generic Names in Zoology (Zimmerman, 1969; Cowan, 1969, 1970). The Commission has now rendered "Opinion 965" which validates the emendation to *Hyposmocoma*. See Melville, 1971:78.

Butler proposed the name *Hyposmochoma* for a single species, and no author has used that spelling for any of the species since 1881. When Walsingham emended the name to *Hyposmocoma* in 1907b, he included 187 speciesgroup names in combination with it. All authors since 1907 have consistently used the emended form. Butler specifically mentioned the subcostal brush of the hindwing in his original description, and it is obvious that he compounded the generic name to refer to it. As Butler spelled the name, Hyp = under + osmo = scent + choma = heap, mound, promontory, it would appear rather meaningless, but Hyp – osmo – coma = under – scent – hair would be meaningful in this instance. It is possible that Butler's *Hyposmochoma* was an erroneous spelling or typographical error for "Hyposmotrichoma", which would have been an appropriate Greek compound. I am indebted to Jasper Griffin, Oxford University, for advice on the Greek.

**Euperissus** Butler, 1881:401, was described in the same paper in which Butler described *Hyposmocoma*, but he did not relate it to *Hyposmocoma*. Butler was impressed principally by a specifically variable feature of the hindwing of the male, and we now know that this is not of generic importance. Butler (1881:402) stated that "the singular development of bristles from the median vein of the secondaries, in order to hold down a long hair-pencil which proceeds from the marginal abdominal furrow, is one of the most singular contrivances which I have ever observed in a Lepidopterous insect." Butler was mistaken when he stated that the hair-pencil came from the "marginal abdominal furrow" because it is what Walsingham referred to as the "limbal hair-pencil". As indicated in my illustration of the wing venation, the "hair-pencil" arises from the wing between veins 1a and 1c. It might better be called the vannal brush.

On *cristatus*, the type-species of *Euperissus*, the conspicuous bristlelike setae along the posterior margin of the cell (along cubitus) of the hindwing of the male extend from near the base to near the origin of vein 2. The setae are represented by a small cluster on the female (although Walsingham said that they were absent on the female), and the vannal brush of the female is much smaller than that of the male. *Euperissus* Butler, in its most restricted sense, represents a cluster of forms which includes the *Semnoprepia* and *Hyperdasyella* groups. Several of these are large species. The members of this section do not

have specialized spurs on the male genital valvae. If *Euperissus* could stand as a distinct genus, then *Semnoprepia* and *Hyperdasylella* would have to be merged with it. This cluster of species represents one of the many divergent lines of *Hypsochomoma*. It cannot be maintained as a genus limited by the characters defined by Walsingham because it blends into other groups of the *Hypsochomoma* complex. *Euperissus* can, however, be separated from *Hypsochomoma sensu stricto* by other characters which I shall discuss below. I have chosen to treat *Euperissus* as a subgenus of *Hypsochomoma*.

**Hyperdasylella** T. B. Fletcher, 1940: 18 (a replacement name for *Hyperdasys* Walsingham, 1907b:640, a homonym) was separated from *Euperissus* by Walsingham on specifically variable or secondary sexual characters of no

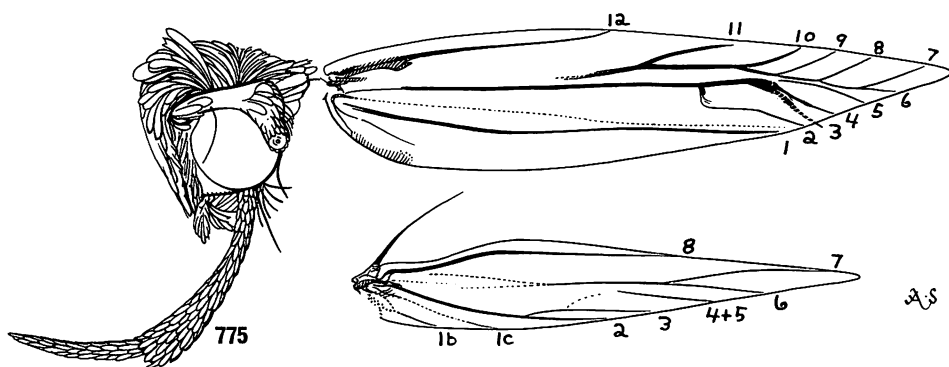


Figure 775—Head and wing venation of *Hypsochomoma* (*E.*) *sordidella* (Walsingham), holotype male (BM slide 5232). Note the extraordinary process on the underside of the forewing which is the modified vein 3 (see figure 777 for enlargement). The labial palpi are probably carried erect in life. Compare figure 776 of (*E.*) *mystodoxa*.

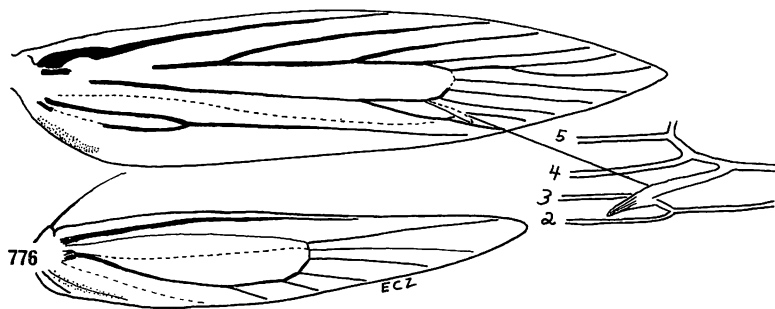


Figure 776—Wing venation of *Hypsochomoma* (*E.*) *mystodoxa* Meyrick, paralectotype male (BM slide 16344); Honolulu, Perkins, 1908. At right is an enlarged section of the ventral wing surface to show the development of the third vein into an unusual spur indicating a development parallel to the extreme form found in the remarkable (*E.*) *sordidella* (see figures 775 and 777). It is noteworthy that these extraordinary developments occur on two species which belong to different subgroups and are not closely allied forms.

generic importance, and it cannot be retained. It falls as a synonym of *Euperissus*. Walsingham said, "The generic character of the bold fringe of hair-scales arising from the edge of the costa [of the forewing] beneath is always apparent in the male [of *cryptogamiellus*, the type-species]". He noted that these hairs are shorter on his *semiustus*.

**Semnoprepia** Walsingham, 1907b:644, was separated from *Euperissus* by "the absence of the fringe of hair-scales along the lower edge of the cell in the hind wing of the [male]." The name falls as a synonym of *Euperissus*.

Walsingham considered the above three "genera" to be allied to *Orthotaelia* Stephens, but, of course, that was an error. The females lack his "generic" characters, and he had difficulty assigning the females of these "genera" to their proper places. This can be seen from his statements that the female of *Semnoprepia petroptilota* "is at present unknown unless it has been wrongly referred to *Hyperdasys cryptogamiellus*", and that the females of *Euperissus cristatus* "can be distinguished from those of the very similar *Semnoprepia fulvogrisea*, Wlsm. by the grooved appearance of the palpi and by the possession of two spots before the discoidal on the forewings." These are specific, not generic, characters.

**Diplosara** Meyrick, 1883a:35. This is the type-genus of the supposed family Diplosaridae. When he described the "genus", Meyrick (1883a:35) said, "A remarkable and distinct genus, certainly belonging to the *Gelechidae*. . . ." In 1915, however, he erected his family Diplosaridae upon it. The type-species of *Diplosara*, *Scardia lignivora* Butler, 1879b:273, was described in the

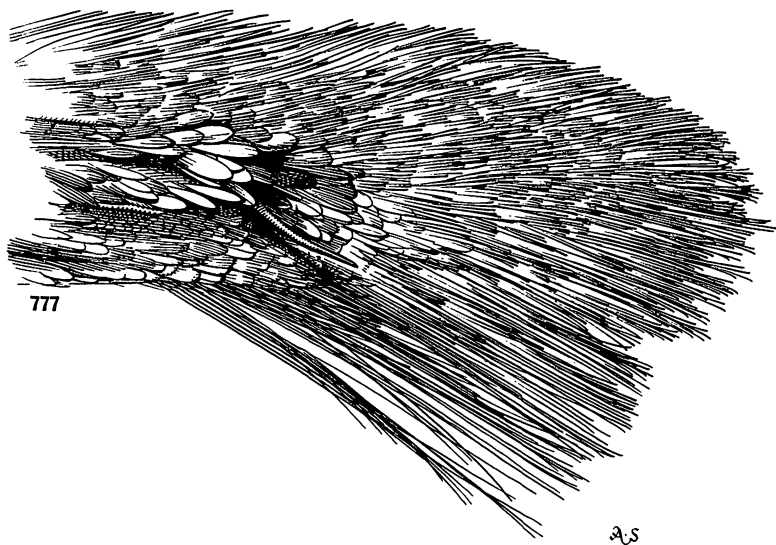


Figure 777—*Hypsomocoma* (*E.*) *sordidella* (Walsingham), underside of the distal part of the forewing of the male holotype to show the extraordinary spinelike process developed from the free and highly modified vein 3. Compare figure 775.



Tineidae. It represents one of the extreme species groups of *Hyposmocoma*. It was thought by all previous authors that *Diplosara* contained only one variable species, but I have discovered that this supposed one variable species is really a cluster of species. The characters used to maintain *Diplosara* are not of generic value, and each breaks down and blends with those of other *Hyposmocoma* groups as one examines series of *Hyposmocoma* species. The labial palpi are expanded by scales in a distinctive manner. There is a wide, dense brush of long, specialized, spinelike scales across the posterior part of the seventh abdominal segment that overhangs the base of the genitalia and is found only in this group. The clusters of erect or raised scales on the forewings are more obvious on these species than on many other species. These features are not, however, of generic value, and the genitalia and other features demonstrate that *Diplosara* is only one of the more distinctive species groups of *Hyposmocoma*. As will be explained below, it has characters of both *Hyposmocoma sensu stricto* and *Euperissus*. It thus, strangely, bridges the gap between the two major subdivisions of *Hyposmocoma*.

**Agonismus** Walsingham, 1907b:512, was said to be "intermediate between *Hyposmocoma* and *Batrachedra* Stn."—which is a meaningless statement—and he placed it adjacent to *Batrachedra* in *Fauna Hawaiiensis*. It has, of course, nothing to do with *Batrachedra*. Three unrelated species were assembled under this "generic" name, and there are no characters by which to

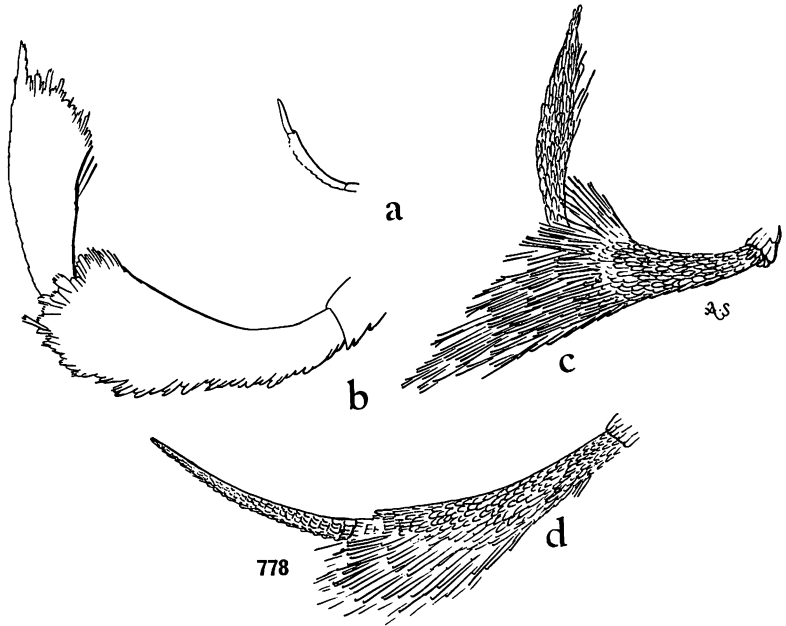


Figure 778—Examples of extremes in the development of the labial palpi in various species of *Hyposmocoma*. a, ("Agonismus") (*H.*) *argentifera* (Walsingham), holotype female; b, ("Diplosara") (*H.*) *lignivora* (Butler), holotype female; c, ("Euhypsomodomy") (*E.*) *ekaha* (Swezey), female; d, (*E.*) *barbata* Walsingham, holotype female.

maintain any of them as a genus distinct from *Hypsmocoma*. The generic description is meaningless, and the name must fall as a synonym of *Hypsmocoma*. The genitalia are typical of *Hypsmocoma sensu stricto*, and the only male I have seen (*coruscans*) has large spurs on the valvae.

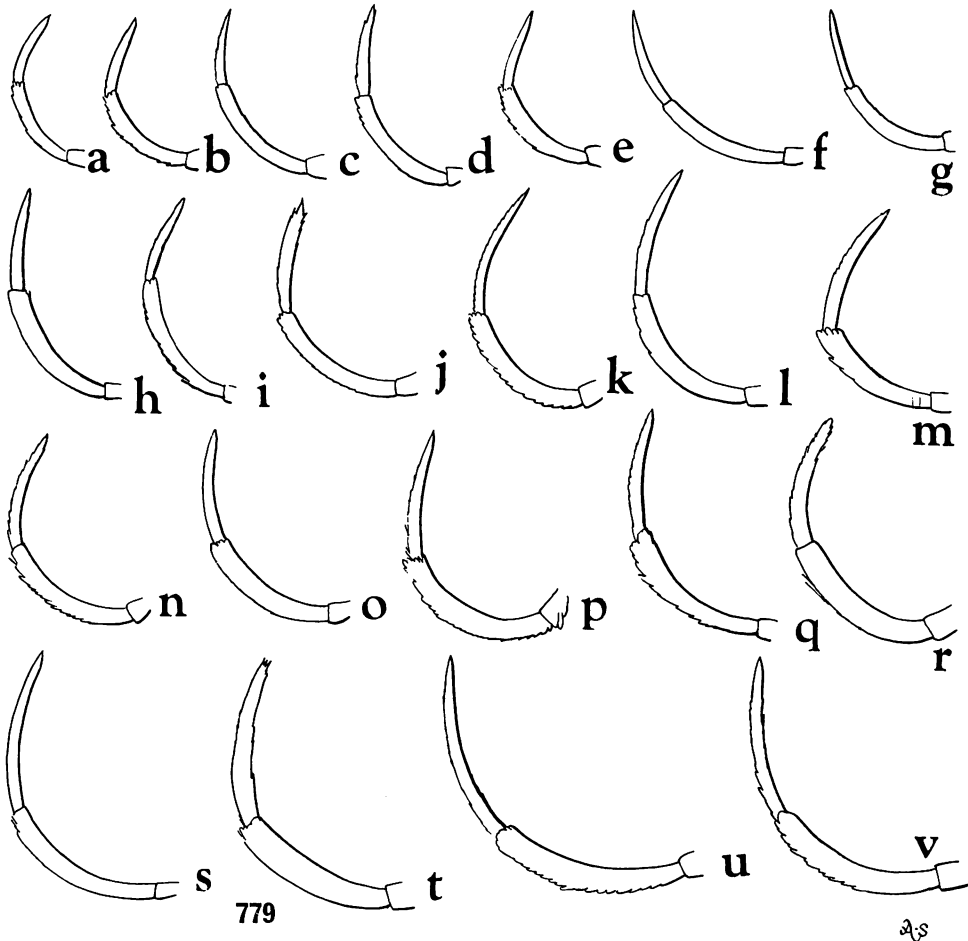


Figure 779—Sketches of *Hypsmocoma* labial palpi, drawn to same scale. *a*, (*H.*) *saccophora* Walsingham, holotype male; *b*, (*H.*) *triptila* Meyrick, lectotype male; *c*, (*H.*) *auropurpurea* Walsingham, holotype male; *d*, (*H.*) *mimema* Walsingham, holotype male; *e*, (*H.*) *phalacra* Walsingham, holotype male; *f*, (*H.*) *inversella* Walsingham, holotype female; *g*, (*H.*) *pseudolita* Walsingham, holotype male; *h*, (*H.*) *metallica* Walsingham, holotype male; *i*, (*H.*) *trimaculata* Walsingham, holotype male; *j*, (*H.*) *syrrhaptus* Walsingham, holotype male; *k*, (*H.*) *rusius* Walsingham, holotype male; *l*, (*H.*) *subflavidella* Walsingham, holotype male; *m*, (*H.*) *paradoxa* Walsingham, holotype male; *n*, (*H.*) *petrosia* Meyrick, lectotype male; *o*, (*H.*) *lixiviella* Walsingham, holotype male; *p*, (*H.*) *montivolans* (Butler), holotype male; *q*, (*E.*) *inflexa* Walsingham, holotype male; *r*, (*H.*) *ochreocervina* Walsingham, holotype male; *s*, (*E.*) *obliterata* Walsingham, holotype male; *t*, (*H.*) *schismatica* Walsingham, holotype female; *u*, (*H.*) *mesorectis* Meyrick, holotype male; *v*, (*H.*) *parda* (Butler), holotype female.

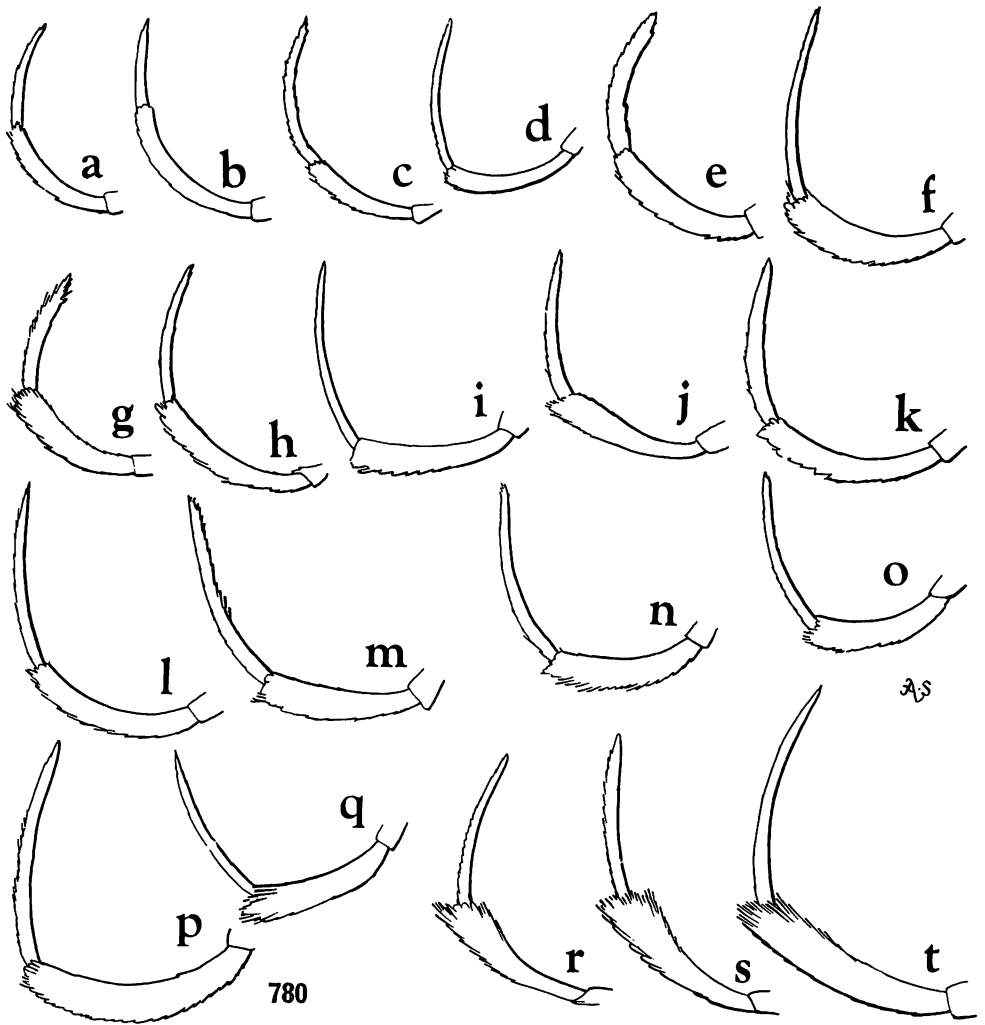


Figure 780—*Hyposmocoma* labial palpi, sketched to the same scale. *a*, (*H.*) *semifusa* (Walsingham), holotype female; *b*, (*H.*) *alveata* (Meyrick), lectotype male; *c*, (*E.*) *tischeriella* (Walsingham), holotype male; *d*, (*E.*) *psaroderma* (Walsingham), holotype male; *e*, (*E.*) *cuprea* (Walsingham), holotype male; *f*, (*E.*) *fuscodentata* (Walsingham), holotype female; *g*, (*E.*) *complanella* (Walsingham), holotype male; *h*, (*E.*) *incongrua* (Walsingham), holotype male; *i*, (*E.*) *pluviella* (Walsingham), holotype female; *j*, (*E.*) *terminella* (Walsingham), holotype male; *k*, (*E.*) *fuscofusa* (*E.*) (Walsingham), holotype male; *l*, (*E.*) *basivittata* (Walsingham), holotype male; *m*, (*E.*) *cleodorella* (Walsingham), holotype male; *n*, (*E.*) *anthinella* (Walsingham), holotype male; *o*, (*E.*) *tigrina* (Butler), holotype male; *p*, (*E.*) *agnetella* (Walsingham), holotype male; *q*, (*E.*) *rotifer* (Walsingham), holotype female; *r*, (*E.*) *mactella* (Walsingham), holotype male; *s*, (*E.*) *exaltata* (Walsingham), holotype male; *t*, (*E.*) *municeps* (Walsingham), holotype female. All of these species were described originally in *Neelysia*.

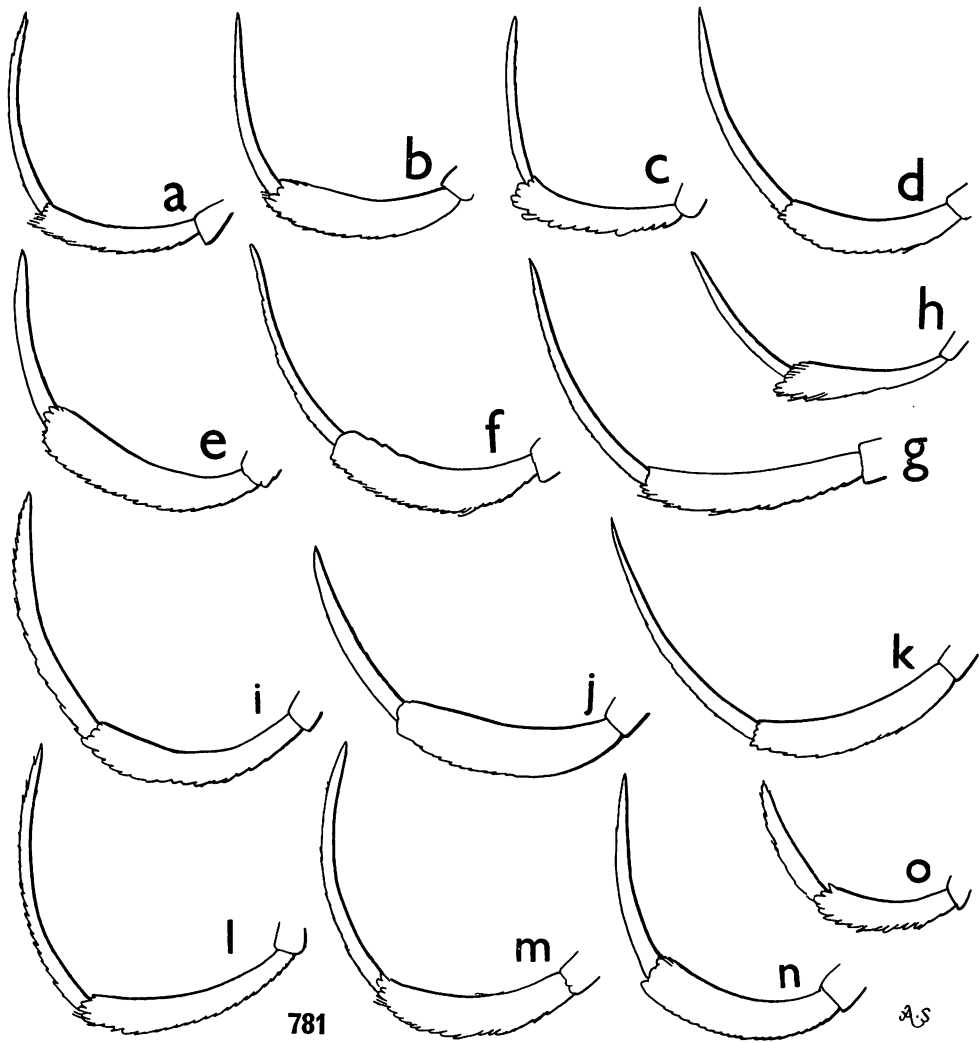


Figure 781—*Hyposmocoma* labial palpi, sketched to the same scale. *a*, (*E.*) *nemoricola* Walsingham, holotype female; *b*, (*H.*) *prophantis* Meyrick, lectotype female; *c*, (*E.*) *discolor* Walsingham, holotype female; *d*, (*E.*) *latistlua* Meyrick, holotype male; *e*, (*H.*) *ochreociliata* Walsingham, holotype male; *f*, (*H.*) *quinquemaculata* Walsingham, holotype male; *g*, (*E.*) *scepticella* Walsingham (from the male holotype of *scepticella dubia*); *h*, (*E.*) *argyresthiella* Walsingham, holotype female; *i*, (*E.*) *malacopa* Meyrick, lectotype male; *j*, (*H.*) *corvina* (Butler), holotype male; *k*, (*E.*) *fulvida* Walsingham, holotype male; *l*, (*E.*) *mystodoxa* Meyrick, lectotype male; *m*, (*E.*) *ochreovittella* Walsingham, holotype male; *n*, (*H.*) *empedota* Meyrick, lectotype male; *o*, (*H.*) *turdella* Walsingham, holotype male.

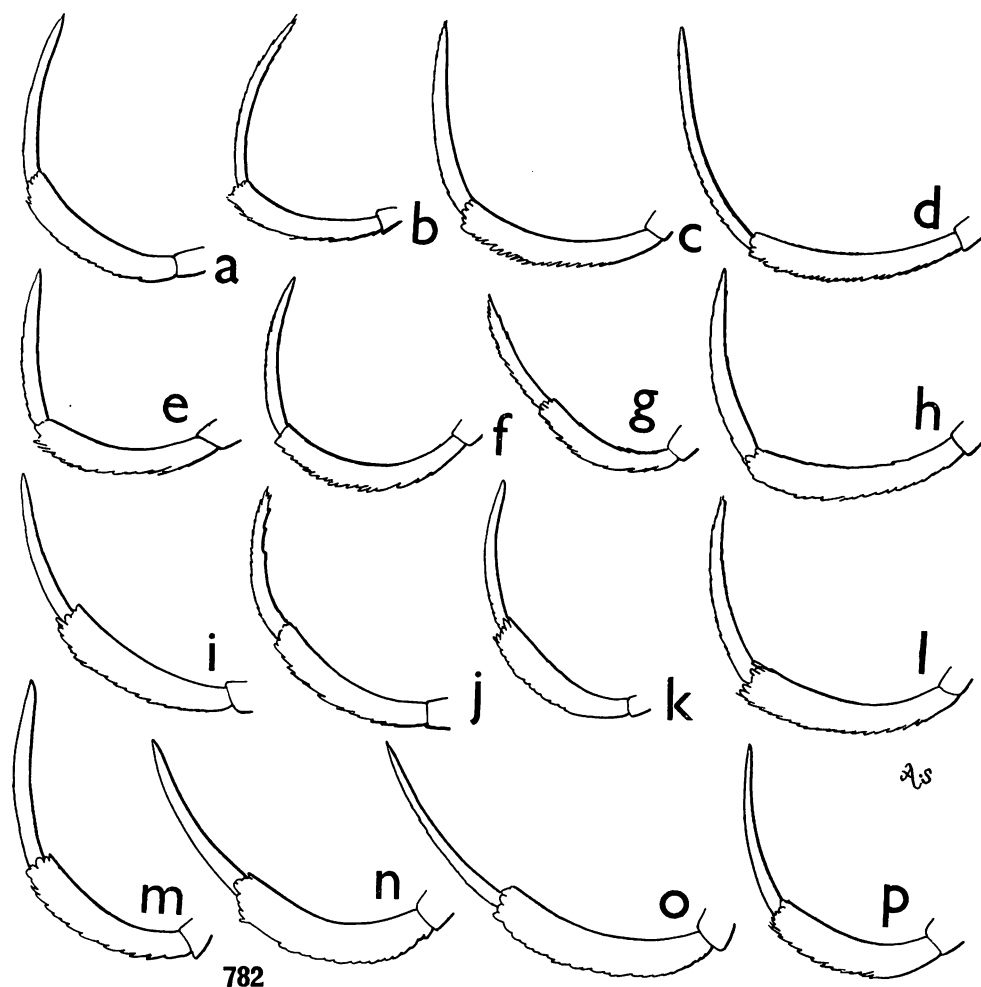


Figure 782—*Hypsozoma* labial palpi, sketched to the same scale. *a*, (*H.*) *endryas* Meyrick, holotype male; *b*, (*E.*) *ningorella* (Walsingham), holotype male; *c*, (*H.*) *thoracella* Walsingham, holotype male; *d*, (*H.*) *geminella* Walsingham, holotype male; *e*, (*H.*) *rubescens* Walsingham, holotype male; *f*, (*H.*) *evanescens* Walsingham, holotype male; *g*, (*H.*) *saliaris* Walsingham, holotype male; *h*, (*H.*) *nephelodes* Walsingham, holotype male; *i*, (*H.*) *servida* Walsingham, holotype female; *j*, (*H.*) *arenella* Walsingham, holotype male; *k*, (*H.*) *liturata* Walsingham, holotype male; *l*, (*H.*) *lupella* Walsingham, holotype male; *m*, (*H.*) *irregularis* Walsingham, holotype male; *n*, (*H.*) *conditella* Walsingham, holotype male; *o*, (*H.*) *iodes* Walsingham, holotype male; *p*, (*H.*) *vinicolor* Walsingham, holotype female.

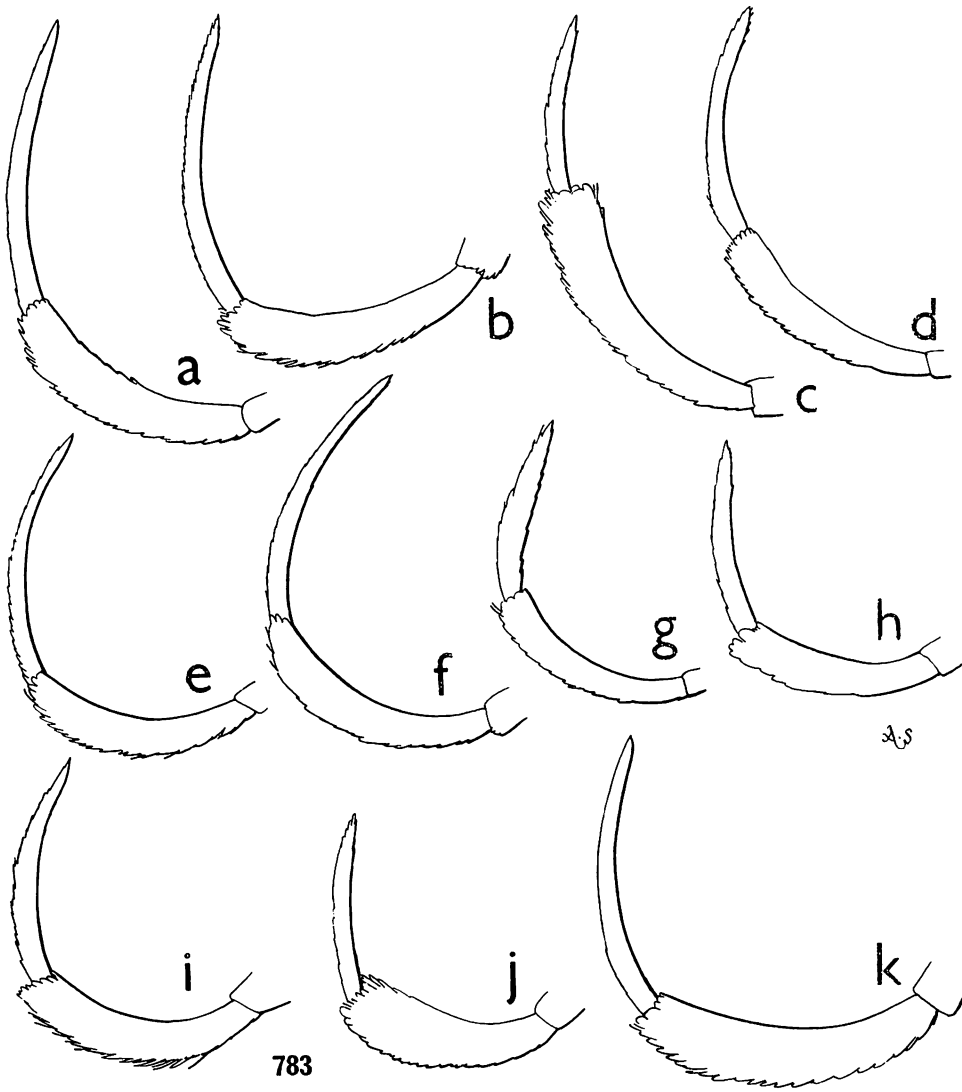


Figure 783—*Hyposmocoma* labial palpi, sketched to the same scale. a, (*E.*) *subsericea* Walsingham, holotype male; b, (*E.*) *argentea* Walsingham, holotype male; c, (*E.*) *dorsella* Walsingham, holotype male; d, (*H.*) *sabulella* Walsingham, holotype male; e, (*E.*) *philocharis* Meyrick, holotype male; f, (*E.*) *arundinicolor* Walsingham, holotype male; g, (*E.*) *brevistrigata* Walsingham, holotype male; h, (*H.*) *carnea* Walsingham, holotype male; i, (*E.*) *thermoxyla* Meyrick, lectotype male; j, (*H.*) *divisa* Walsingham, holotype male; k, (*E.*) *fulvocervina* Walsingham, holotype male.

**Aphthonetus** Walsingham, 1907b:517, in the strict sense, is among the most divergent of *Hypsmocoma*, but I have been unable to find characters to maintain it as a genus. One might be able to separate the males, but the females are less distinctive. Not all of the species assigned to *Aphthonetus* belong to it, as will be demonstrated below.

It is a cluster of mostly small, slender species. Because the wings are slender, there is a consequent alteration of venation which is more extreme in some forms than in others. Walsingham said that the forewings have only 11 veins with "4 and 5 probably coincident". Vein 2 is variable, and it appears to be

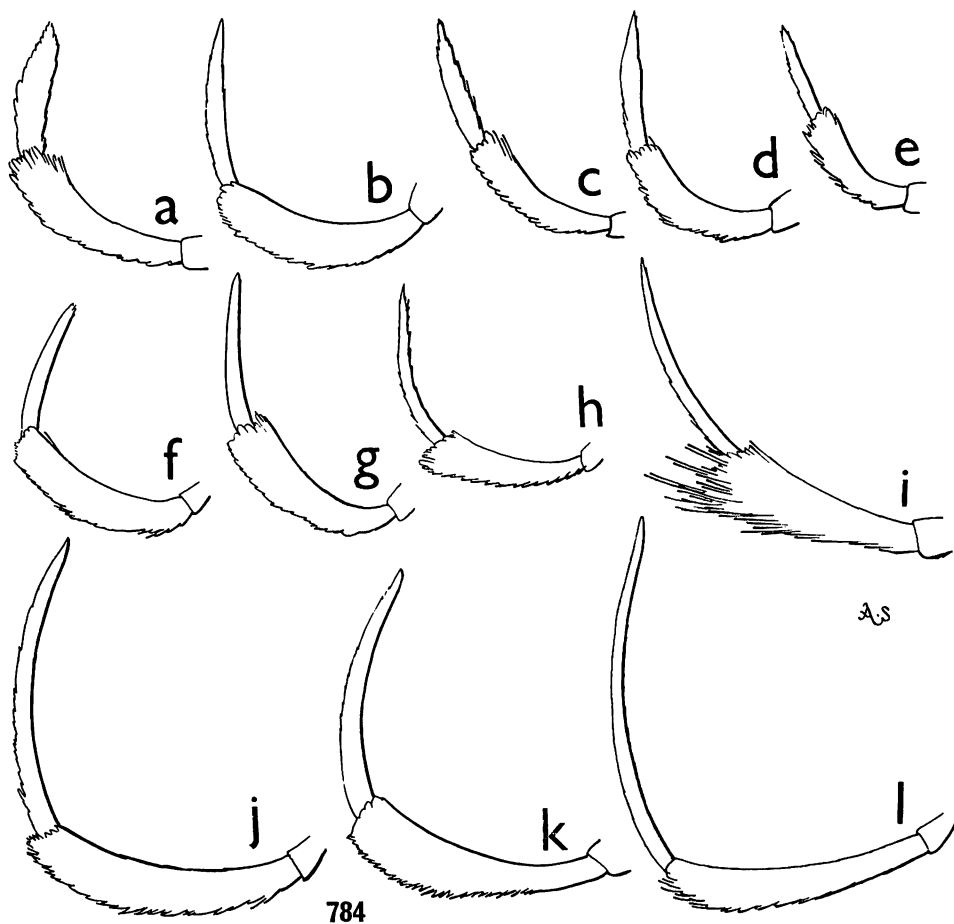


Figure 784—*Hypsmocoma* labial palpi, sketched to the same scale. a, (*E.*) *fluctuosa* Walsingham, holotype male; b, (*H.*) *tarsimaculata* Walsingham, holotype male; c, (*H.*) *torella* Walsingham, holotype male; d, (*H.*) *subscolopax* Walsingham, holotype male; e, (*H.*) *tetraonella* Walsingham, holotype male; f, (*H.*) *metrosiderella* Walsingham, holotype male; g, (*H.*) *nebulifera* Walsingham, holotype male; h, (*E.*) *poeciloceras* Walsingham, holotype male; i, (*E.*) *barbata* Walsingham, j, (*E.*) *marginella* Walsingham, holotype male; k, (*H.*) *fractistriata* Walsingham, holotype male; l, (*E.*) *roseofulva* Walsingham, holotype male.

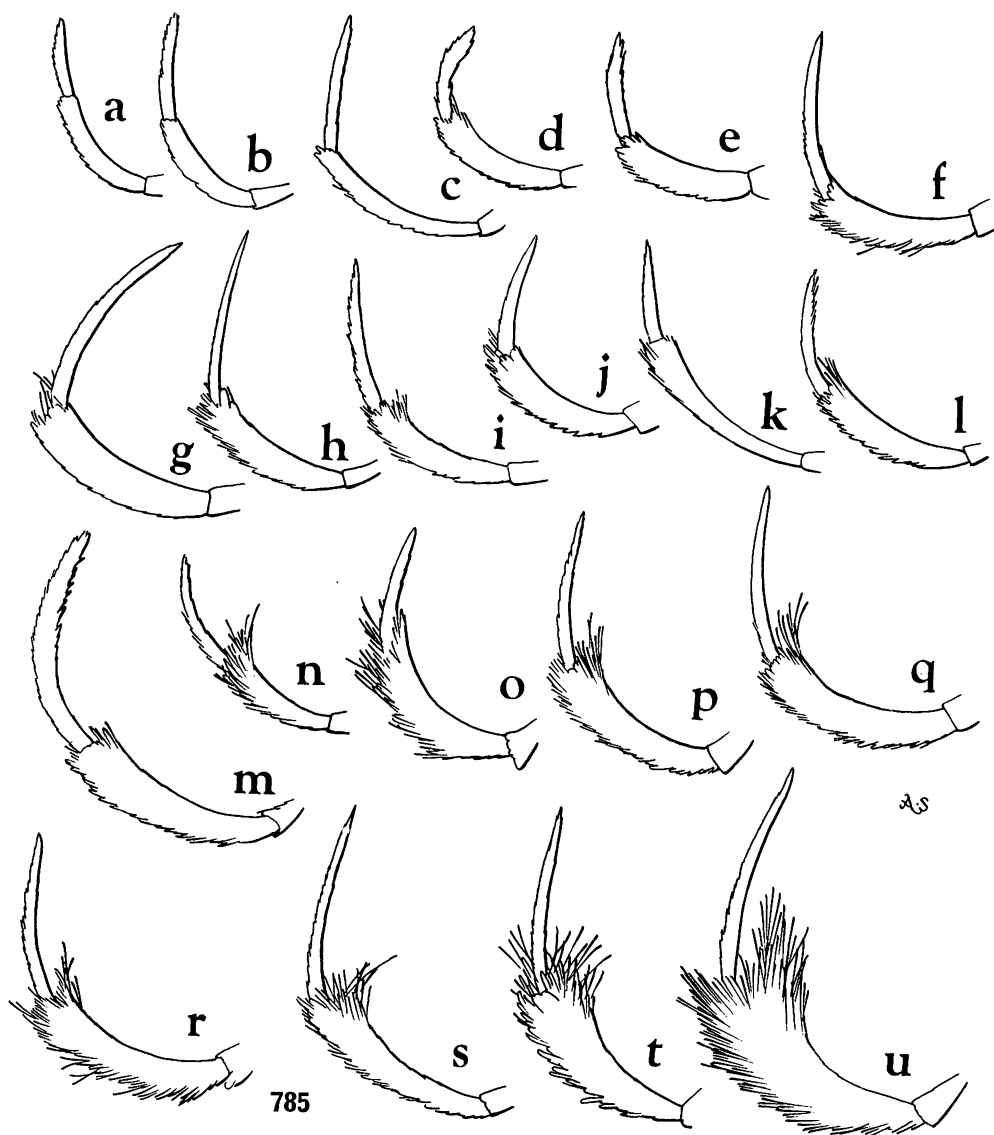


Figure 785—*Hyposmocoma* (*Euperissus*) labial palpi, sketched to the same scale. *a*, *passerella* (Walsingham), holotype male; *b*, *nemo* (Walsingham), holotype male; *c*, *humerella* (Walsingham), holotype male; *d*, *veterella* (Walsingham), holotype female; *e*, *kauaiensis* (Walsingham), holotype male; *f*, *polia* (Walsingham), holotype male; *g*, *punctililiata* (Walsingham), holotype male; *h*, *spurcata* (Walsingham), holotype male; *i*, *exsul* (Walsingham), holotype female; *j*, *empetra* (Meyrick), lectotype male; *k*, *plumbifer* (Walsingham), holotype male; *l*, *trichophora* (Walsingham), holotype male; *m*, *sagittata* (Walsingham), holotype male; *n*, *eleuthera* (Walsingham), holotype female; *o*, *divergens* (Walsingham), holotype male; *p*, *bitincta* (Walsingham), holotype male; *q*, *aspera* (Walsingham), holotype female; *r*, *subocellata* (Walsingham), holotype male; *s*, *albocinerea* (Walsingham), holotype male; *t*, *lichenalis* (Walsingham), holotype female; *u*, *hirsuta* (Walsingham), holotype female. All of these species were originally described in *Aphthonetus*.



nearly lost in some examples, weak or abbreviated in others, and fully formed in others. Some examples, therefore, may appear to have only 10 veins in the forewings. In the forewings, vein 6 comes out of 7 and 7 out of 8. These would appear to be usable characters, but they intergrade, as an examination of narrow winged forms that Walsingham himself assigned to *Hyposcymoma* will demonstrate [compare figure 841 of *Hyposcymoma* (*Hyposcymoma*) *lixiviella*, for example]. Similarly, the stalking of veins 6 and 7 in the hindwings, although characteristic of most of the species assigned to *Aphthonetus*, is not constant—the veins may be separate (*exsul*, for example), connate (*columbella*, for example), or variably stalked as figures 816 to 822 demonstrate. On a paratype of *Aphthonetus sideroxyloni* (Busck slide 153 in Bishop Museum), the hindwing

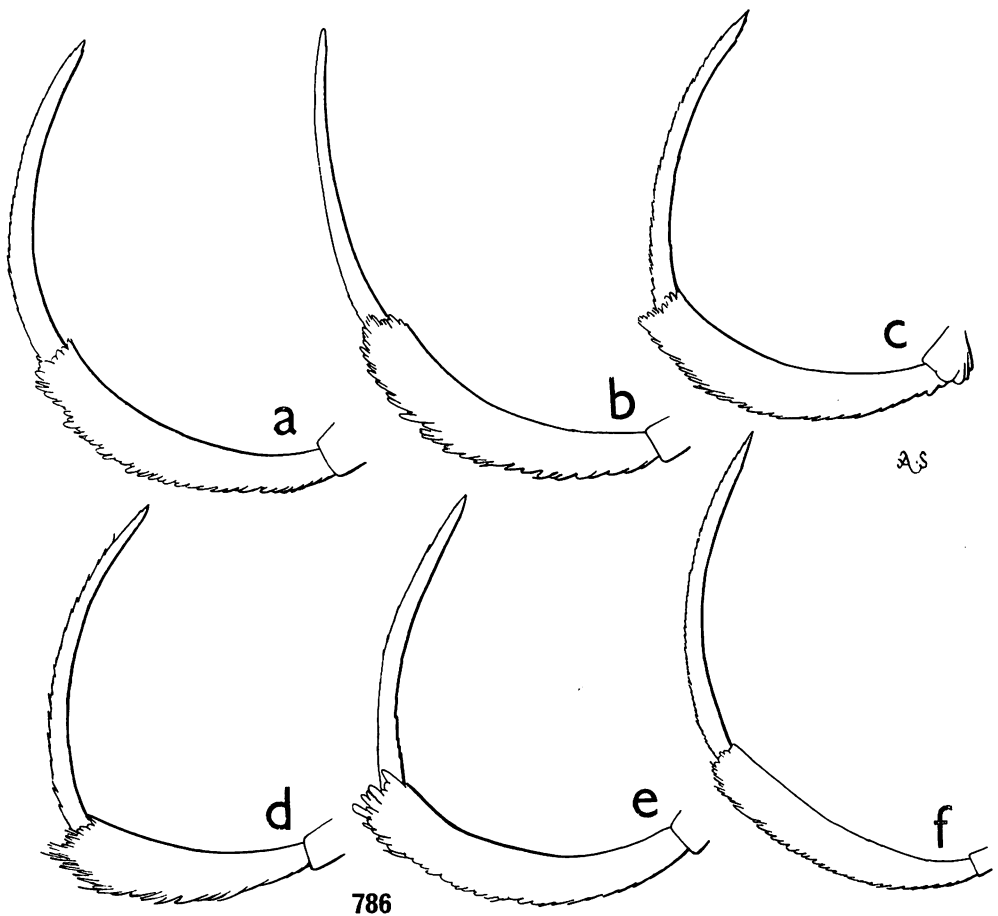


Figure 786—*Hyposcymoma* labial palpi, sketched to the same scale. *a*, (*H.*) *notabilis* Walsingham, holotype male; *b*, (*E.*) *maestella* Walsingham, holotype male; *c*, (*E.*) *petroptilota* (Walsingham), holotype male; *d*, (*E.*) *longitudinalis* Walsingham, holotype male; *e*, (*E.*) *semiusta* (Walsingham), holotype male; *f*, (*H.*) *picticornis* Walsingham, holotype male.

has only seven veins (5 is absent) instead of the usual eight veins, and the cell is partly open (figure 822). A rather similar condition is found in *sordidella* (figure 775).

*Aphthonetus* belongs to subgenus *Euperissus* of *Hypsmocoma*, as will be defined below. Surprisingly and confusingly, however, a number of species of *Hypsmocoma sensu stricto*, have forewing veins 6, 7, and 8 similarly arranged to that of

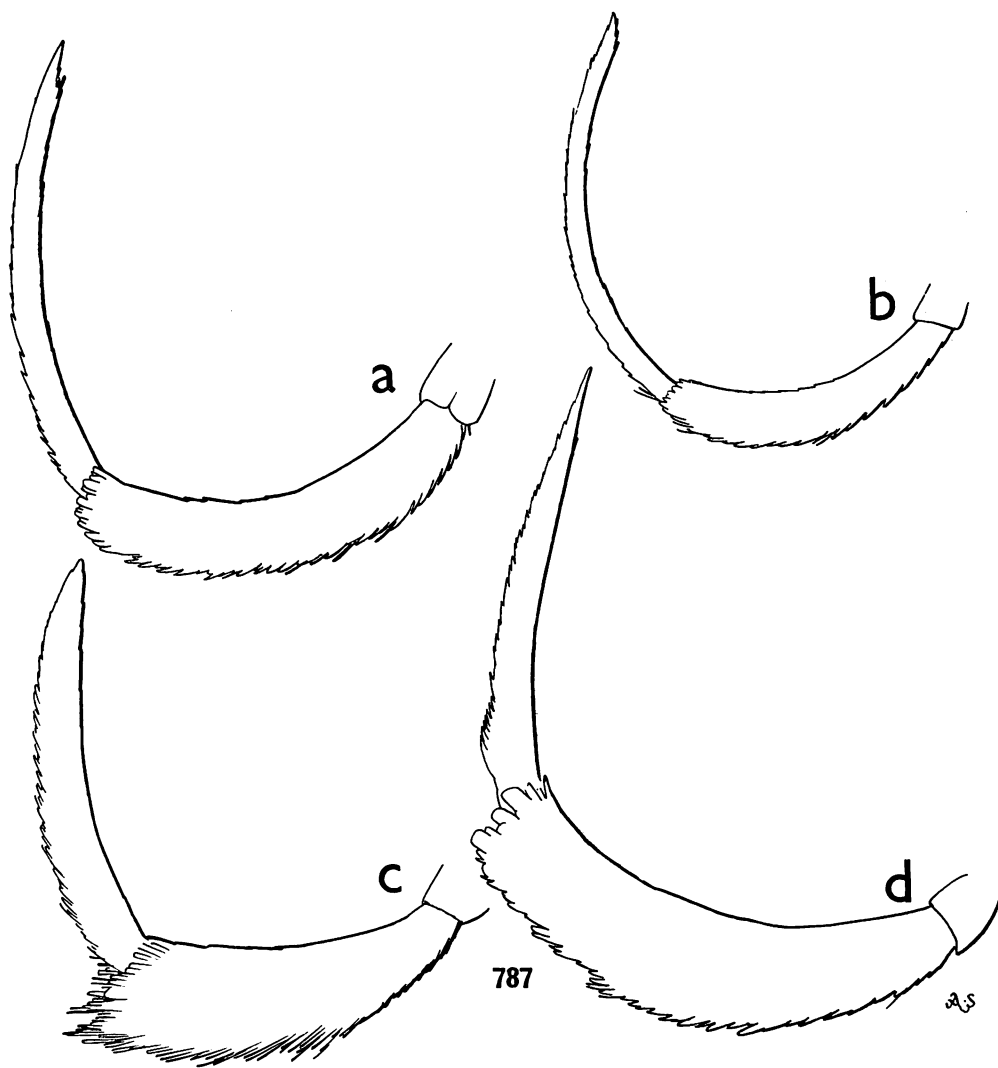


Figure 787—*Hypsmocoma* labial palpi, sketched to the same scale. *a*, (*E.*) *centralis* Walsingham, holotype male; *b*, (*E.*) *subnitida* Walsingham, holotype male; *c*, (*E.*) *chilonella triocellata* Walsingham, holotype male; *d*, (*E.*) *epicharis* Walsingham, holotype female.

*Aphthonetus*. As previously noted, in the forewings of *Aphthonetus* vein 6 arises from 7 and 7 arises from 8. This condition is distinctly different from the majority of the species of this great genus in which most species have vein 6 arising free from the cell. In such species of *Hypsmocoma* (*Hypsmocoma*) as *lixiviella* (figure 841), new species 19 (figure 841), *phalacra* (figure 852), and *pseudolita* (figure 853), the forewing venation is similar to that of *Aphthonetus* with vein 6 arising from 7 and 7 arising from 8. On *canella* (figure 829), *mimema* (figure 845), *mimica* (figure 845), and *petroscia* (figure 852), vein 6 arises from 8 basad of the origin of 7. On *schismatica* (figure 856), vein 6 emerges from the base of 8.

On none of these *Hypsmocoma sensu stricto* species, however, are veins 4 and 5 fused into one vein in the forewings as they are on *Aphthonetus*. If we would use the combination of veins 4 and 5 fused and vein 6 out of 7 and 7 out of 8 in the forewing for maintaining *Aphthonetus* as a group name, then we would have to use it only for the species that are closely associated with the type-species *diffusa*. Another group name would have to be applied to *exsul* and its allies which represent a species group distinct from true *Aphthonetus* although until now they have wrongly been placed in *Aphthonetus*. *Aphthonetus* can only be applied to those species having the venational arrangements as described above in combination with the male caudal abdominal structures as described below.

The male genital valvae appear to be in a process of simplification in certain atypical members of *Aphthonetus* (in the wide sense of Walsingham), and none, of course, have spurs on the valvae (that is a character confined to *Hypsmocoma sensu stricto*). The simplification of the valvae is, however, not a unique feature of the species heretofore placed in *Aphthonetus*, but it is shared with other



Figure 788—Sketch of the anterior edge of the metapleuron of a possible subspecies of *Hypsmocoma* (*H. picticornis* Walsingham (Olinda, 4,000 feet, Maui) to show the spinose sensory organ which is conspicuously developed on some species of *Hypsmocoma* (including the *Aphthonetus* and *Neelysia* groups). It is often obscured or damaged by pinning or abrasion. A similar organ has also been seen in Hawaii on *Choropleca* (Tineidae), *Carposina* (Carposinidae), *Cryptophlebia*, and *Crociosema* of the Tortricidae, and it may occur on other genera. I have not made a general survey to search for the organ on many species. On some species of *Hypsmocoma* a long brush or cluster of long squamae arises from the area just beneath the organ. A modest cluster of squamae is shown here. (WB = wing base.)

species groups such as various atypical *Neelysia*. Strangely, there is not much diversity in the genitalia of the true *Aphthonetus* group. True *Aphthonetus* is only one species cluster within *Euperissus*. As indicated above, there are two subgroups confused within Walsingham's *Aphthonetus*, as an examination of the genitalia will reveal. More will be said regarding these subgroups in the discussion below.

The discs of the tergites of the three basal abdominal segments of both sexes of the *Aphthonetus* group are clothed with peculiar, modified, depressed, dense, sharply lanceolate or bilanceolate, almost spinelike, golden squamae (see figure 1015). A somewhat similar-appearing vestiture is found on *Trisodoris*, but there it is much more extensive. Walsingham described these areas as "naked patches", but they are definitely densely squamose. Although these areas have more or less modified squamae in other species groups of *Hypsmocoma*, in none of them is it similar to *Aphthonetus*. This feature can be used to separate this group from all others. The squamae on some of the other species groups that I have examined have denticulate apices.

Perhaps the most distinctive structures of true *Aphthonetus* that I have noted are the unusual sclerotizations and processes of the seventh abdominal tergites of the males (figure 1017, for example). I have not seen such developments elsewhere in the *Hypsmocoma* complex. I presume that they are scent-dispersing organs. They are normally hidden from view by the usual scaling of the abdomen. There is normally no conspicuous surface indication of this structure although one would expect to find some unusual differentiation in the arrangement of the squamae over the area. They can be exposed by denuding the squamae from the tergite, and they are, of course, conspicuous in slide preparations.

There are long, persistent, modified scales forming brushes at the apices of the two longer mesal arms of the structures (see figure 1024, of *mediocris*, for example). When well developed, the inner arms extend over the base of the genitalia (see also figure 1019 of *diffusa*, for example). The development of these structures varies in the species thus far assigned to *Aphthonetus*—they are absent in some and strongly developed in others. I have not seen the abdomens of the males of *aspersa*, *eleuthera*, *hirsuta*, *lichenalis*, *prae fracta*, or *veterella*, and I cannot give a complete report on these peculiar caudal appendages. I have, however, examined males of most of the species, and I can say that the structures are absent from *corticicolar*, *empetra*, *exsul*, *fluctuosa*, *humerella*, *kauaiensis*, *nemo*, *passerella*, *plumbifer*, and *sideroxyloni*. They are present, and sometimes strongly developed, on *albocinerea*, *bitincta*, *columbella*, *confusa*, *diffusa* (the type-species of *Aphthonetus*), *digressa*, *divergens*, *elegans*, *fugitiva*, *mediocris*, *polia*, *puncticiliata*, *sagittata*, *spurcata*, *subocellata*, and *trichophora*. This is one of the most peculiar divergent features of the *Hypsmocoma* complex, and it deserves further detailed investigation. It is noteworthy that such an unusual structure is present or absent in what may appear to be rather closely similar forms. With the apparent exception of *corticicolar*, the genital valvae of the members of the subgroup which lack the caudal processes appear to be more subtriangular and have shorter, broader basal "stalks" than the valvae of the species which have the caudal processes. If *Aphthonetus* were to be retained as a subgenus of *Hypsmocoma*,

then the members of this *exsul* subgroup would have to be separated from *Aphthonetus*, and the name *Rhinomactrum* (Walsingham) might be applied to them.

If one examined the hindwing venation of only one of the typical members of the *Aphthonetus* group such as *digressa*, which has caudal abdominal processes, and compared it with only one of the subgroup which lacks caudal processes, such as *exsul*, one would note that veins 6 and 7 are not stalked in *exsul* but are long-stalked in *digressa* (see figure 819). This might appear to be a character that could be used to segregate the subgroups, but when one examined *corticicolor* (see also figure 819), which also lacks abdominal caudal processes, it would be seen that these veins are stalked. Also, the veins are not stalked in the figured specimen of *columbella* (figure 818) which has caudal processes. Such features are confusing, and they serve further to demonstrate the complex, variable nature of *Hypsmocoma*.

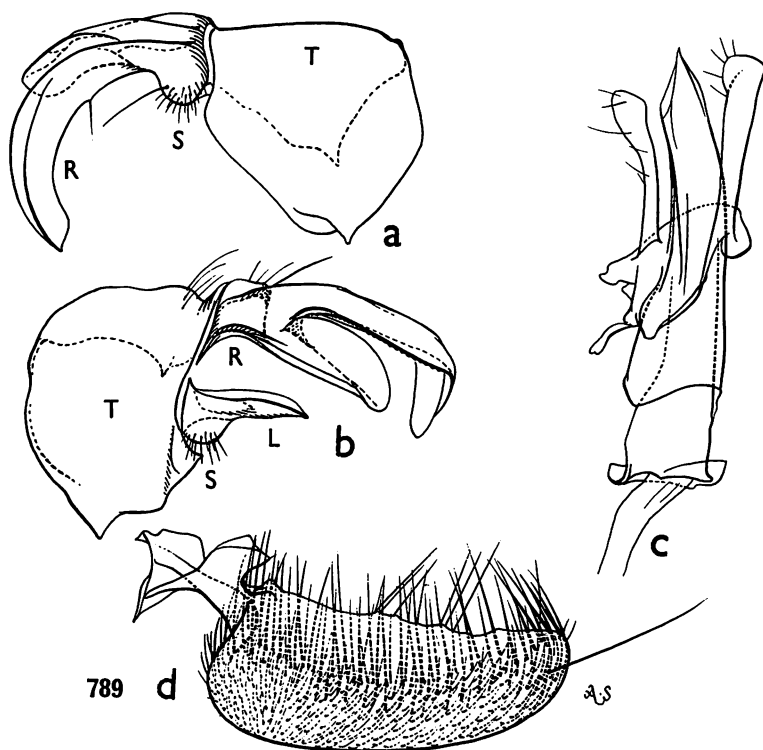


Figure 789—Male genitalia of *Hypsmocoma* (E.), new species 21 (BM slide 5436), formerly confused as a paratype of *longitudinalis* Walsingham; Molokai, above 3,000 feet. This is a member of subgenus *Euperissus* in which group the right and left valvae are similar on each specimen. *a* and *b*, right lateral and left dorso-lateral aspects of the tegumen and the uncuslike brachia; note the socii-like setose areas and the strong sutures between the tegumen and the brachia. *c*, the aedeagus with the anellus torn free and adhering to it and bearing the two processes or lobes of the anellus. *d*, the right valva. *L*, left brachium; *R*, right brachium; *S*, sociuslike structure; *T*, tegumen. Compare figures 790 and 791.

The metapleura of neither the typical nor the atypical *Aphthonetus* (or *Rhinomactrum* group) have the long brushes of hairs which are conspicuously developed on the atypical *Neelysia*.

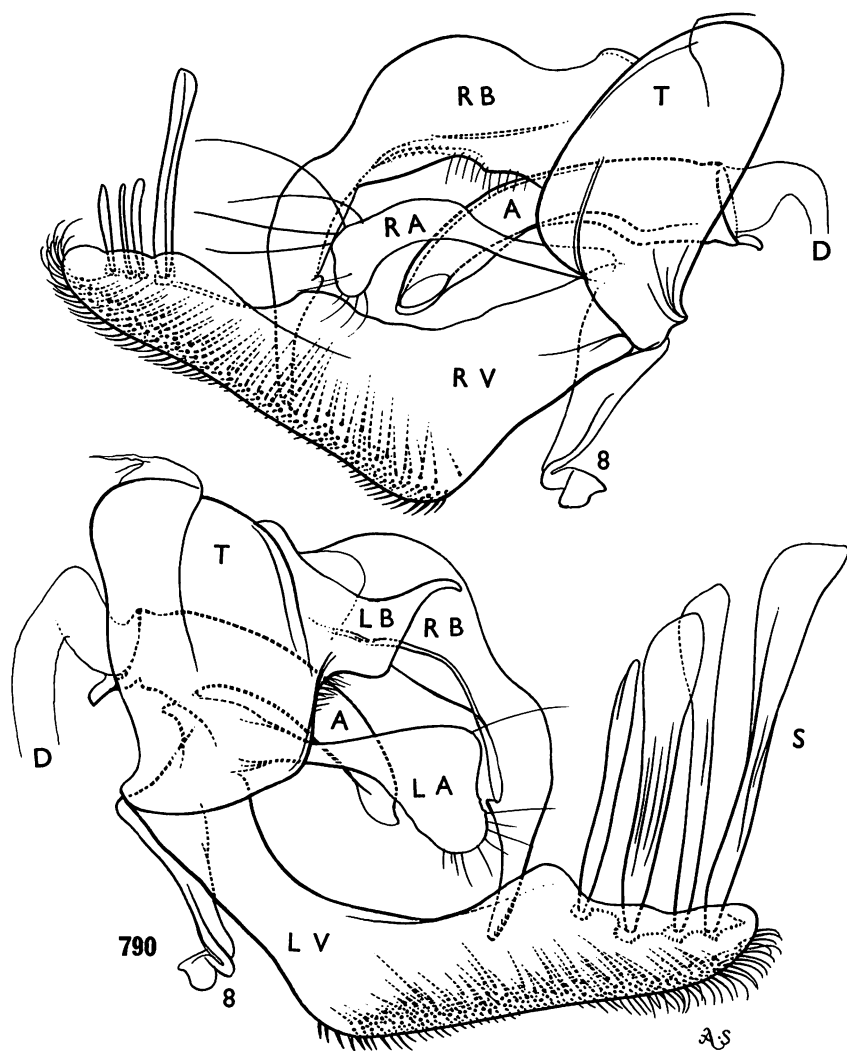


Figure 790—Male genitalia of *Hyposmocoma* (*H.*) new species 20 (BM slide 5437), formerly confused as a paratype of *longitudinalis* Walsingham; "Waialua (beach)", Oahu; eighth abdominal sternum and genital "flaps" removed. Top, right lateral aspect. Bottom, left lateral aspect. *A*, aedeagus; *D*, ductus ejaculatorius; *LA*, left anellus lobe; *LB*, left brachium; *LV*, left valva; *RA*, right anellus lobe; *RB*, right brachium; *S*, spurlike specialized setae of the valva; *T*, tegumen; *8*, torn part of the eighth sternum. Compare figures 789 and 791.

**Rhinomactrum** Walsingham, 1907b:531, was erected for two specimens representing two species. Walsingham said that the genus was "intermediate between *Neelysia* and *Aphthonetus*." The two included species are not closely allied, and they belong to the two major sections or subgenera of *Hyposmocoma*. Walsingham considered that the discovery of a male of his *scapulellum* "would probably justify the description of a new genus" to separate it from *rutilellum*, the type-species of *Rhinomactrum*. There are some discrepancies in the original generic description, as my figures of *rutilellum* and *scapulellum* will demonstrate if they are compared with the descriptions. There is nothing to justify the name *Rhinomactrum* as a full genus. *Rhinomactrum* was based upon a confused concept to include species representing two distinct groups. It falls as a synonym of *Hyposmocoma* subgenus *Euperissus*. It might in the future be applied to the group of "atypical" *Aphthonetus* species mentioned above which is typified by *exsul* should more species-group names be found convenient. Having seen only the female holotype of *scapulellum*, which has lost its abdomen, I cannot place it within a species group of subgenus *Hyposmocoma* to which it belongs.

**Neelysia** Walsingham, 1907b:533, is quite similar to *Aphthonetus* in general appearance and consists mostly of narrow-winged forms, although the wings of most species are not as narrow as those of *Aphthonetus*. It, also, is a confused assemblage. Walsingham said that the forewings have only 11 veins with 4 and 5 fused as in *Aphthonetus*. But, in fact, veins 4 and 5 are developed, and it is vein 2 which is weak or absent. Thus, the forewings may have either 11 or 12 veins depending upon whether vein 2 is or is not distinguishable. It is not always possible to ascertain the nature of the development of vein 2 unless a

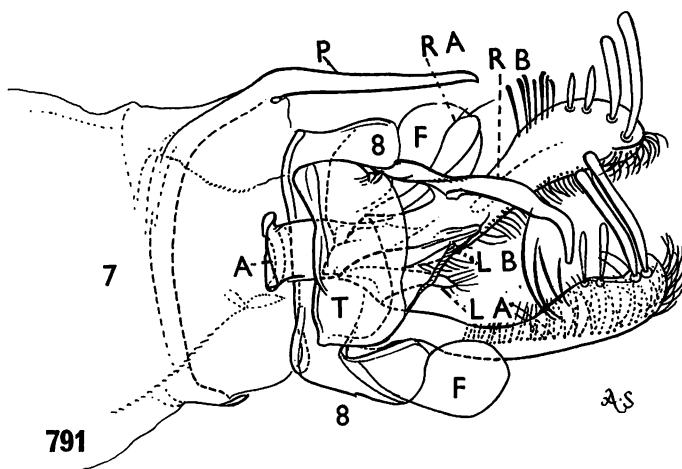


Figure 791—*Hyposmocoma* (*H.*) *tetraonella* Walsingham; holotype (BM slide 5489); Kona, Hawaii; left dorso-lateral aspect of the male genitalia. A, aedeagus; F, genital "flaps" (epitygmata); LA, left anellus lobe; LB, left brachium; P, pseuduncus; RA, right anellus lobe; RB, right brachium; T, tegumen; 7, seventh abdominal segment; 8, eighth abdominal sternum. Note the strongly developed pseuduncus. Compare figures 789 and 790.

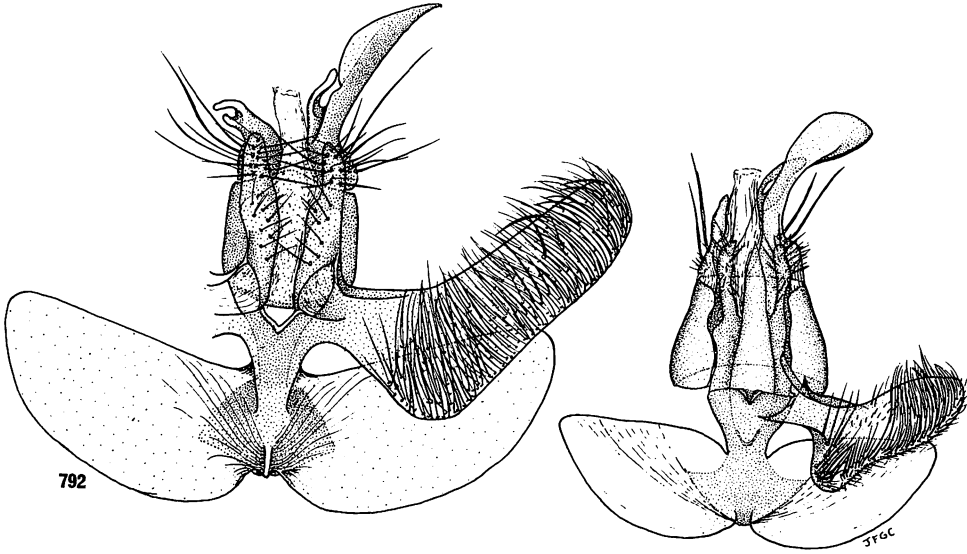


Figure 792—Male genitalia of two species of *Hyposmocoma* (*Euperissus*) originally placed in two different "genera". Left, ("*Hyperdasyella*") *cryptogamiella* (Walsingham) (Busck slide 60). Right, (*Euperissus*) *cristata* (Butler). Left valvae not drawn.

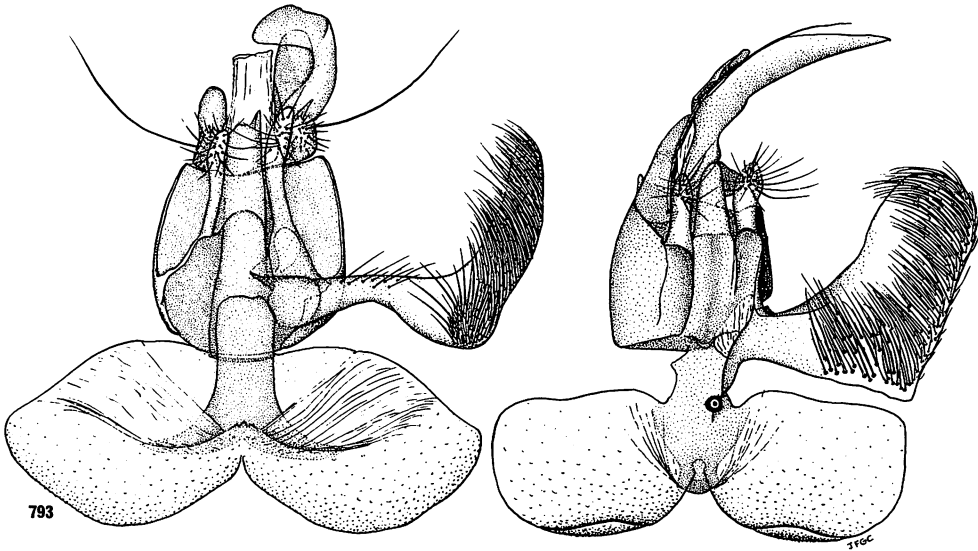


Figure 793—Male genitalia of two species of *Hyposmocoma* (*Euperissus*) heretofore placed in two different genera. Left, ("*Neelysia*") *lignicolor* (Walsingham) (USNM slide 3772, Clarke). Right, ("*Sennoprepia*") *fulvogrisea* (Walsingham) (Busck slide 57). Left valvae not drawn.





Figure 793A—See legend on page 1099.

descaled wing preparation is made. For example, in figure 809, vein 2 is complete on *alveata*, a species which does not belong to *Neelysia*, whereas only the distal ends are distinct on *agnatella* and *anthinella*, both of which are typical *Neelysia*. On *argyresthiella*, a member of a different species group, vein 2 is absent (figure 810). On *alveata*, vein 6 is so weak that Meyrick could not see it on the uncleared wing. Believing that there were only 11 veins in the forewing, he placed that species in *Neelysia* in spite of the fact that its male genitalia (which he never studied, of course) show that it is a typical "strong" member of *Hypsmocoma sensu stricto* with long spurs on the valvae. *Neelysia*, on the other hand, belongs to subgenus *Euperissus*. In the hindwing of *Neelysia*, veins 6 and 7 are usually separate, sometimes connate, but I have seen no specimens with these veins stalked as they are in *Aphthonetus*.

Walsingham at first described some *Neelysia* in his manuscript as *Hypsmocoma*, but he transferred them to *Neelysia* in his published text. The original "*Hypsmocoma*" labels remain on his types of these species; see the list of these species in the text above (p. 1075). Some atypical *Neelysia* of the *exaltata* group show a "degenerating" tendency in the male genitalia, as do the atypical *Aphthonetus* of the *nemo* group (see figures 1004, 1009, 1013 for example). The valvae lack heavy setae or spurs in *Neelysia*. The characteristic form of *Neelysia* male genitalia is exemplified by figures 1006 of *complanella*, *cuprea*, and *fuscofusa* and 1008 of *incongrua* and *lignicolor* (the type-species of *Neelysia*). A comparison of these figures with figure 1003 of *alveata*, *agnatella*, and *anthinella* and 1012 of *rediviva*, for example, will demonstrate quickly the compound nature of *Neelysia* as it has heretofore been constituted.

I cannot find any characters to maintain *Neelysia* as a distinct genus. When the group is reduced to those species which agree in basic characters with its

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Figure 793A—Evolutionary sequence of armature development of the male genital valvae of *Hypsmocoma*. The varied development of the setae is a reflection of the extraordinary sexual selection active in *Hypsmocoma*. The processes are intimately coupled with copulation.

Only the distal parts of the valvae are shown in the sketches, and the fine vestiture has been omitted from most of the drawings. On figures *a* and *b* a small area of vestiture is shown to indicate the types of coverings that clothe most of the internal surfaces of the valvae on those species and their associates. On *a* there is a fine fur-like covering. On *b* there is a mixture of fine and coarser hairs. On *c* and *d* there is marked differentiation of a few marginal setae. On *e*, *f* and *g* the specialized setae have become thickened, further modified and with modifications of articulations. *g* through *l* show marked development of the digitate setae. On *m* another form of modification, that of reduction in number, is shown, and here only an extraordinary, long, single dactyl is developed. At *n* is displayed an early tendency toward broadening of the modified hairs to form paddle-like dactyls that is carried to the known extremes of development on *o* and *p*. Also on *o* and *p* there are modifications of the dorsal margins of the valvae to produce protuberant bases for the dactyls.

If one knew only the remarkable palmate process of *p* it might be difficult to understand what the organ represents or how, or from what, it was developed. When a series of examples of the extraordinary species swarm is examined, however, it becomes clearly evident that the evolutionary modification of simple hairs on the valvae has led to the development of an astounding array of male genital embellishment.

Most of the species with strong dactyl formation display asymmetrical development with the strongest, or only, armature on the left valva. One wonders why it should be that the emphasis has been placed upon the left valvae.

All of the sketches are drawn to the same scale.

*a*, *b*, *c* and *d* are species of the subgenus *Euperissus*, and all of the other species belong to *Hypsmocoma sensu stricto*.

*a*, *ossea* Walsingham; *b*, *subsericea* Walsingham; *c*, *punctifumella* Walsingham; *d*, *niveiceps* Walsingham; *e*, *illuminata* Walsingham; *f*, a species of the *malornata* group; *g*, *persimilis* Walsingham; *h*, *leporella* Walsingham; *i*, *literata* Walsingham; *j*, *ludificata* Walsingham; *k*, *humero vittella* Walsingham; *l*, *genitalis* Walsingham; *m*, *bacillella* Walsingham; *n*, *phalacra* Walsingham; *o*, new species 23; *p*, *triptila* Meyrick.

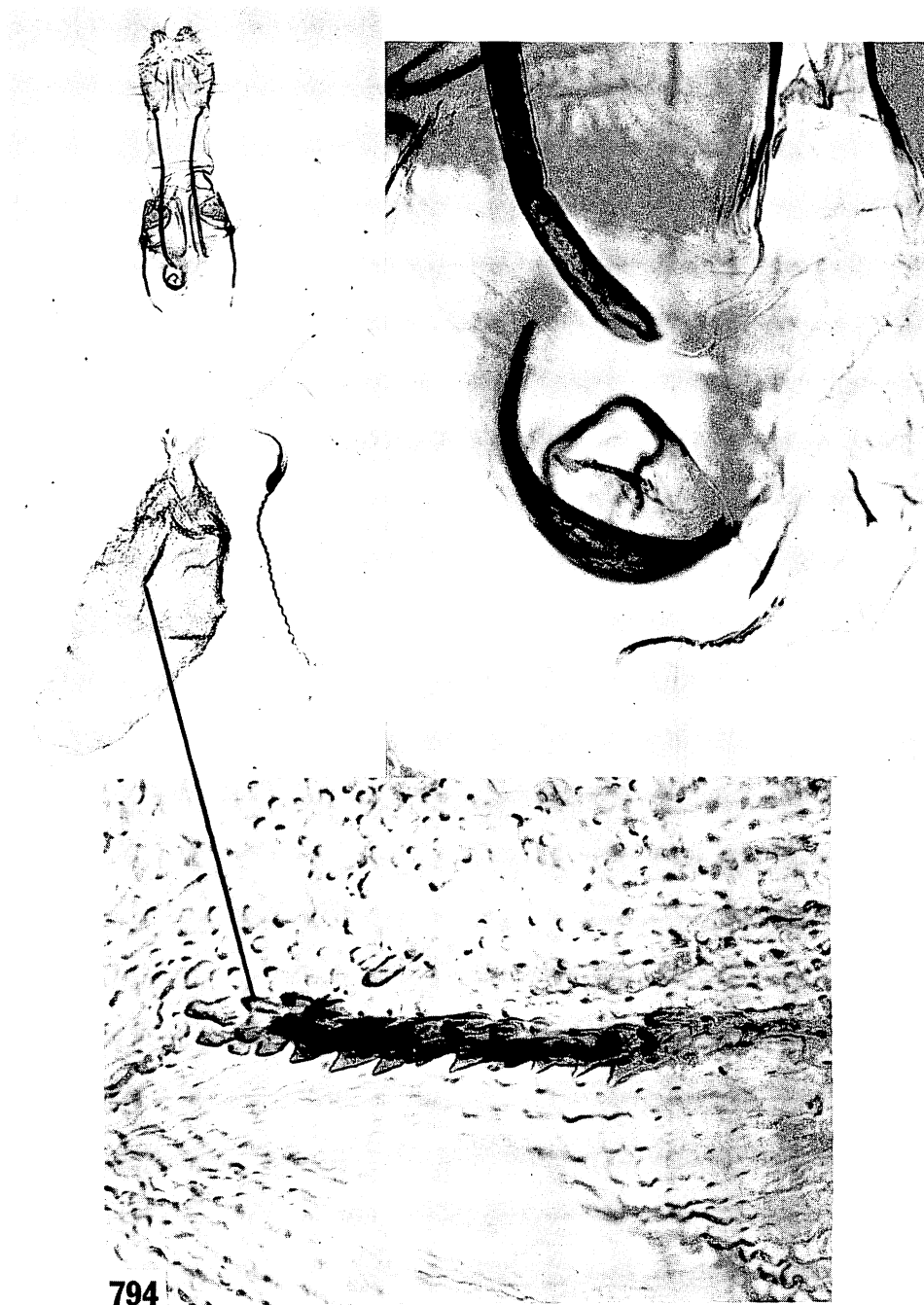


Figure 794—Female genitalia of *Hypsmocoma* (*Euperissus*) *centronoma* Meyrick; Kawaihapai, Oahu; holotype (slide Z-70-5). Compare the elongate signum of this species with the double signa of *hemicasis* in figure 795.



Figure 795—Female genitalia of *Hypsoscocoma* (*Hypsoscocoma*) *hemicasis* Meyrick; Mt. Kaala, Oahu; paratype (slide Z-70-10). Compare the double signa of this species with the single elongate signum of *centronoma* in figure 794. Compare the elongate ovipositor of this species with the short ovipositor of *persimilis* in figure 798.

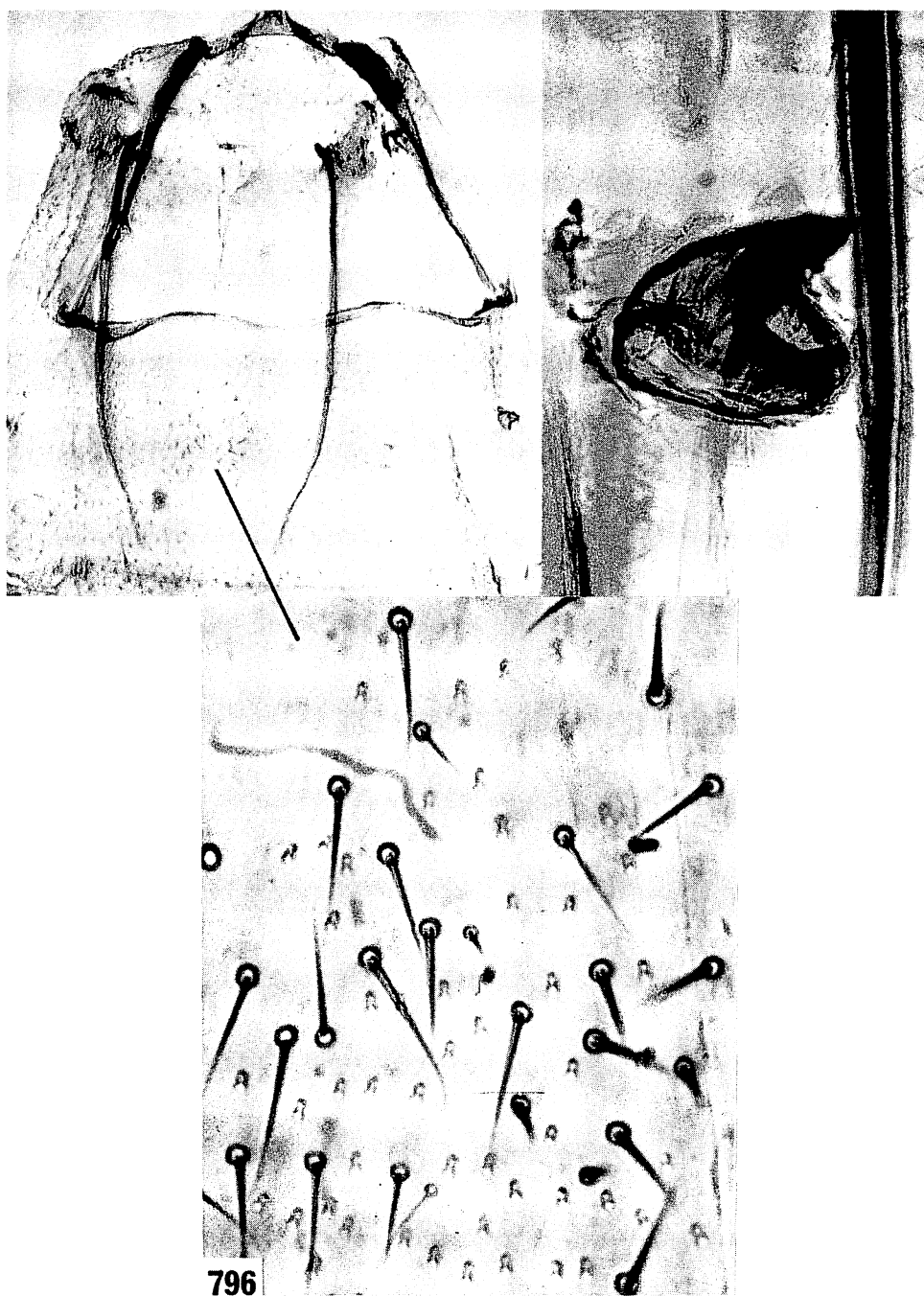


Figure 796—Details of the female abdomen of *Hyposmocoma (Euperissus) argomacha* (Meyrick). Top left, base of abdomen. Top right, ostium. Bottom, sensory setae at the middle of the second abdominal sternite. Kilauea, Hawaii; holotype (slide Z-70-4).

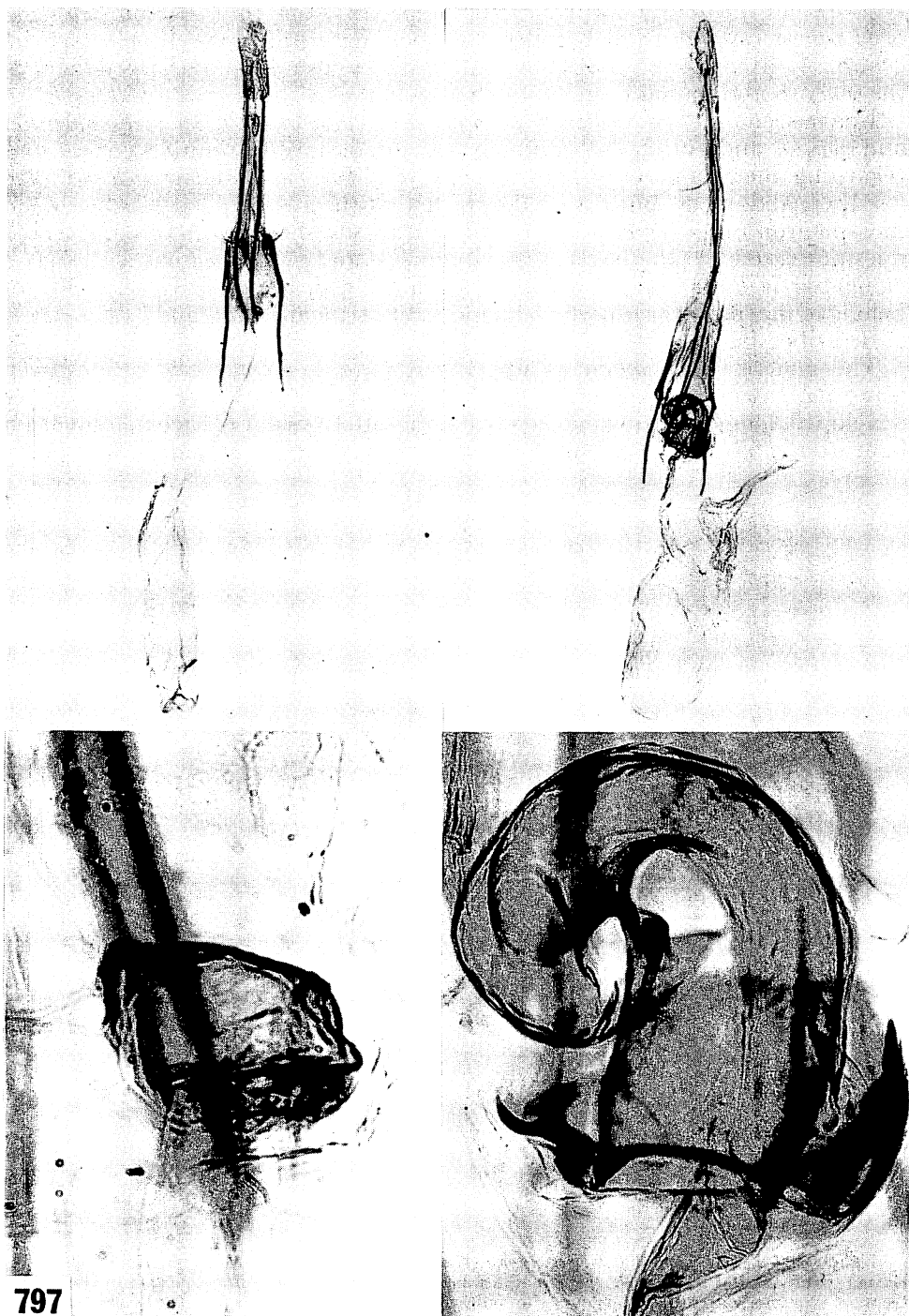


Figure 797—Female genitalia representing the two subgenera of *Hyposmocoma*. Left figures, (*Euperissus*) *caecinervis* Meyrick; Mt. Kaala, Oahu; paratype (slide Z-70-13). Right figures, (*Hyposmocoma*) *calva* Walsingham; Kona, 4,000 feet, Hawaii; from the *Fauna Hawaiiensis* collection and named by Durrant but not designated as a paratype (BM slide 15849). Note especially the different developments of the ostia in these representatives of the two subgenera of *Hyposmocoma*.

type-species, *lignicolor*, it forms a cluster of species within the subgenus *Euperissus* of *Hypsmocoma*. They might collectively be referred to as the *lignicolor* species group. *Neelysia* does not, of course, have the unusual caudal appendages of the seventh abdominal tergites which are characteristic of true *Aphthonetus*.

I have seen only females of *Neelysia fuscodentata*, *mormopica*, *municeps*, *pluviella*, and *rotifer*, and, most unfortunately, I cannot form definitive conclusions regarding them. The only known males of *erebogramma* and *psaroderma* have lost their abdomens, but it would appear that they are typical *Neelysia*. Each metapleuron on *erebogramma* has a comparatively short brush of hairs which does not extend to the back of the abdomen, and *psaroderma* has a cluster of elongated squamae on each metapleuron. Hence, these two species do not belong to the species group which includes the atypical *exaltata* and its associates, as described below.

The males of the *exaltata* group (*argyresthiella*, *exaltata*, *mactella*, *nemoricola*, *ningorella*, *poeciloceras*, *rediviva*, *subaurata*, *tischeriella*, *terminella*) all have strongly developed, long brushes which arise from the anterior edge of each metapleuron beneath the hindwing base and extend back over the dorsum of the abdomen.

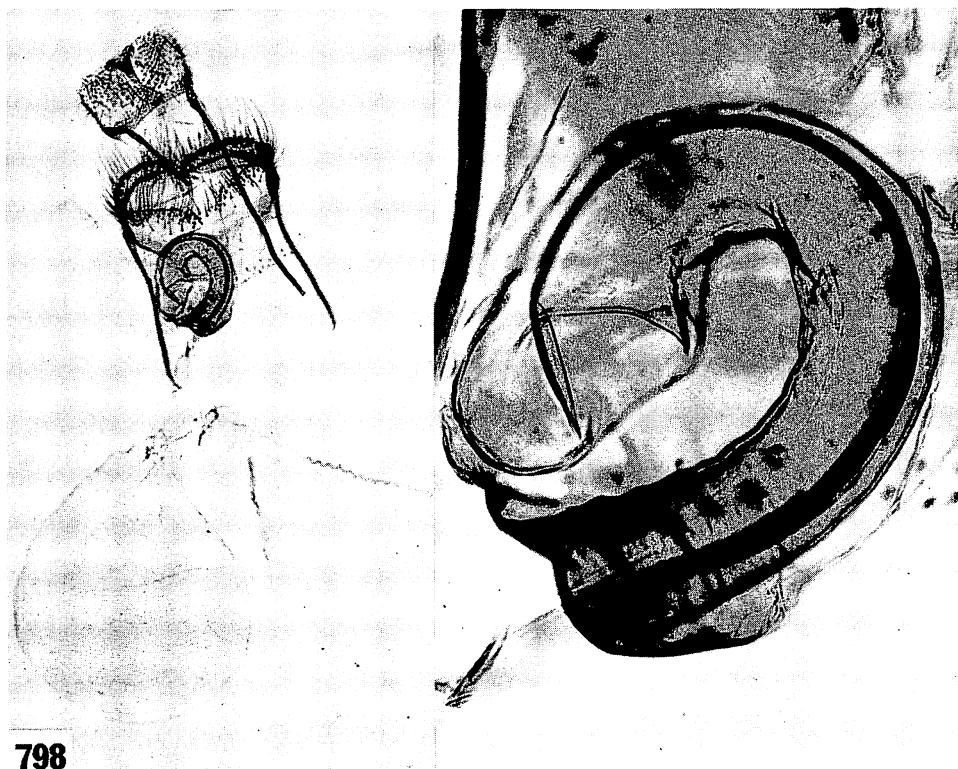


Figure 798—Female genitalia of *Hypsmocoma* (*Hypsmocoma*) *persimilis* Walsingham; Kona, 3,500 feet, Hawaii; paratype (BM slide 15880). Note that this species lacks signa in the bursa copulatrix, and compare the short ovipositor with the elongate ovipositor of *hemicasis* (figure 795), for example. The ovipositor lengths reflect differences in the egg-laying habits of the species. Compare the intermediate length of the ovipositor of *centronoma* (figure 794).

When at rest, these conspicuous masses of hair are held in place on the top of the middle of the abdomen by a number of comparatively huge squamae which arise on each side of the medial line of the abdomen. Because of the way the ends of the hairs in the brushes are enclosed by these large squamae, it may appear that the hairs end in enormously expanded tips. The females of these species all appear to have different ostia from typical *Neelysia* (on which the ostia are *not* protuberant). I have not seen the female genitalia of *terminella*, but the ostia of *argyresthiella*, *exaltata*, *nemoricola*, *ningorella*, *rediviva*, and *tischeriella* are all protuberant and thus differ from typical *Neelysia*. The slide of the female genitalia of *mactella* (BM slide 7723) is not satisfactory, and I cannot be certain of the nature of the ostium, but it appears to be protuberant. Slide BM 7716 of the female genitalia of the aberrant *subaurata* is also unsatisfactory. I cannot ascertain its true condition, but it appears not to be protuberant.

If we were to use *Neelysia* as a subgenus for the *lignicolor* species group, then we would have to propose a new subgeneric name for the *exaltata* species group. Thus, it is demonstrated that *Neelysia* was proposed for a compound group, and it falls as a synonym of *Euperissus* within *Hypsmocoma*.

**Dysphoria** Walsingham, 1907b:547, was described to receive one species. Evidently Walsingham was led to establish this genus because veins 4 and 5 in the forewings are “connate or short-stalked”. This is a variable character, and it is also true of at least two other species, *fractivitella* and *nigralbida*, which he placed in *Hypsmocoma*. Walsingham’s statement that “6 approximated to 7” in the forewing is certainly not true of the type specimen of *Dysphoria semicolon* which I have illustrated. *Dysphoria* cannot be maintained. Its genitalia are clearly like those of *Hypsmocoma sensu stricto* with heavy spurs on the valvae, and there is a strong pseuduncus.

**Bubaloceras** Walsingham, 1907b:548, was described for one male example of a single species. Swezey later included a second species. The “genus” was based upon the shape of the basal antennal segment which was described as “strongly curved, flattened and dilated, with well-developed pecten”. This is only a specific character, because the size and shape of the first antennal segment and the development of the pecten are subjects of wide specific ranges of variation in *Hypsmocoma*. The name *Bubaloceras* falls to *Euperissus*.

**Euhypsmocoma** Swezey, 1913f:277, was erected for two species (after Swezey had described one of them in *Hypsmocoma*). His generic description reads: “Has the characters of *Hypsmocoma*, except that the labial palpi have a large spreading tuft extending from the median segment. The male has no subcostal hair-pencil on the hindwings.” The presence or absence of a subcostal brush on the hindwing is a specifically variable character of the males of *Hypsmocoma sensu stricto*, and I have not seen any member of subgenus *Euperissus*, to which *Euhypsmocoma* belongs, which has subcostal brushes on the hindwings. The most obvious character of this species group is the expansion of the second labial palpal segment by longer than usual scales and hairs. This is only an extreme form of a variable character, and the tendency to such development is found on other species such as *Aphthonetus diffusa*, *Hypsmocoma barbata*, and *exaltata*. The great range of variation in palpal structure can best be understood



by an examination of the accompanying illustrations (figures 778–787). In spite of the distinctive appearance of the two included species, *Euhypsmocoma* represents a subgroup of the subgenus *Euperissus* of *Hypsmocoma*, and it cannot be maintained as a genus. There are no indications of any *Aphthonetus*-like processes on the abdomens of the males.

**Petrochroa** Busck, 1914b:104, was established for two species, but I have found them to belong to two different genera. Busck incorrectly placed the “genus” in the family “Cygnodiidae” (properly Cynodiidae) and wrongly allied it to *Coelopoeta*. I have placed one of Busck’s species in *Asymphorodes*. The type-species of *Petrochroa*, *swezeyi* Busck, is a small *Hypsmocoma sensu stricto* with typical large spurs on the male genital valvae, and it also has a pseuduncus. Swezey added five additional small species to this “genus” to form a mixed assemblage of mostly unrelated forms. *Petrochroa* was a compound entity from the beginning, and there is nothing to support its continuance. It falls as a synonym of *Hypsmocoma sensu stricto*.

**Phthoraula** Meyrick, 1935a:65, was described from a single female specimen. Meyrick said that it was “a derivative of *Hypsmocoma*, from which it is distinguished by the absence of vein 8 in the forewings, and the exceptionally long terminal joint of the palpi.” The length of the palpi is, as stated before and as my illustrations plainly demonstrate, a highly variable feature and is only a specific character in this group. The forewing does lack a vein, but it may be that vein 7 is fused with 8 instead of 8 being absent. We do not know whether the venational abnormality is or is not a constant character of this species. But in the light of the variability of the venation in *Hypsmocoma*, I do not believe that *Phthoraula* can be maintained even if vein 7 and 8 are fused, and I have merged it with subgenus *Euperissus* of *Hypsmocoma*.

In addition to the foregoing “genera”, Walsingham (*Fauna Hawaiiensis*, pp. 514–515) included “*Elachista*” in the *Hypsmocoma* complex. In “*Elachista*” he described *longisquamella* and *spilota*, but neither of these species belongs to *Elachista*. His *longisquamella* is the same species that Swezey later described as *Petrochroa nigrella*, and it is here transferred to *Hypsmocoma*. His *spilota* belongs to *Philodoria* in the Gracillariidae!

Further collecting, study, and contemplation, following the examination of much more representative material, may eventually enable us to consider a few of the groups discussed above as subgenera. For the present, however, I believe that we know too little of the range of variability and intergradation of characters to enable an adequate evolutionary picture to be drawn, and I prefer to combine them all as a cluster of evolving species groups within the genus *Hypsmocoma*.

Farther in this text I have demonstrated that *Hypsmocoma* may be divided into two major groups which I have called subgenera. Any division of *Hypsmocoma* will have to recognize these groups. These divisions are based upon the nature of the vestiture of the vannal areas of the hindwings which correlates with two basic types of male genitalia. Moreover, these groups also appear to correlate with larval habits because all known case-bearing larvae

belong to *Hypsmocoma sensu stricto* and all known naked stemborers and certain other naked larvae belong to subgenus *Euperissus*. Our knowledge of the larvae is, however, fragmentary. See the additional discussion under the heading "Key to the Subgenera of *Hypsmocoma*" below. To subgenus *Hypsmocoma* belong the species previously assigned to *Diplosara*, *Agonismus*, *Petrochroa*, one of the *Rhinomactrum*, and *Dysphoria*. To subgenus *Euperissus* belong those species assigned to *Hyperdasyella*, *Semnoprepia*, *Aphthonetus*, the type-species of *Rhinomactrum*, *Neelysia* (with the exception of the erroneously included *alveata* Meyrick which is a true *Hypsmocoma*), *Bubaloceras*, *Euhypsmocoma*, and *Phthoraula*.

### RELATIONSHIPS OF HYPSMOCOMA

The foregoing discussion has shown that authors have had difficulty in assigning this great assemblage to a suprageneric category. The comments upon the relationships of this complex which I have read or heard are mostly incorrect and meaningless. What I wrote on the subject in my analysis of the Hawaiian insect fauna in the Introduction to *Insects of Hawaii* (1948:77, 91) was based upon gleanings from other workers; it is wrong and should be deleted. Butler incorrectly thought that *Hypsmocoma* might be similar to *Holcocera*. Walsingham placed it in his expanded idea of the "Hyponomeutidae" where he assigned numerous unrelated groups. Meyrick established the Diplosaridae for it. Brues and Melander called it the Hypsmocomidae. Swezey followed Walsingham, Meyrick, and Busck. Busck's opinion varied, but in the end he decided that it belonged to the Cosmopterigidae. Walsingham thought that *Hypsmocoma* was allied to *Mompha*, *Walshia*, *Limnaecia*, and possibly *Atrémaea*. Most of his remarks are conjecture. It has also been considered to be a possible ally of *Labdia*. It is certainly not allied to *Mompha* or *Walshia* which belong to different subfamilies. Of the genera just named, it most closely approaches *Labdia* and *Limnaecia*.

The genitalia of *Hypsmocoma* are basically similar to those of *Cosmopterix*, and there is no doubt that *Hypsmocoma* is correctly placed in the Cosmopteriginae. To determine the true position of *Hypsmocoma* within the Cosmopteriginae will require a general survey, if not a world revision of the subfamily. This, of course, should be done. I should like to do it, but, unhappily, such a study is impossible at the present time.

In so far as we know now, *Hypsmocoma* is an endemic Hawaiian genus. It does not appear to be represented by close relatives elsewhere in Polynesia. Nothing like it has been found in southern or central Polynesia or Melanesia. The Micronesian faunas remain unrecorded, but it appears that close relatives have not yet been found there. Based upon my present knowledge, I would assign *Hypsmocoma* to the ancient Hawaiian fauna which developed when the now degenerate leeward Hawaiian Islands were at their zenith. Its ancestors were probably Boreal. Related forms may yet be recognized in Japan or eastern Asia. I believe that this enormous complex of perhaps more than 500 species may have arisen from one or two ancestral females which were accidentally carried across the sea and established their race upon an ancient Hawaiian land now eroded away and submerged beneath the waves.

To my knowledge, only two genera outside of Hawaii have been assigned to the "Diplosaridae", as the allies of *Hyposmocoma* were called by Meyrick and some other workers. (Meyrick always referred to the Hawaiian cosmopterigines as Diplosaridae, and I cannot recall his ever using the family name Cosmopterigidae when he discussed the Hawaiian species.) The two extra-Hawaiian genera are *Irenicodes* Meyrick and *Aphanosara* Forbes.

**Irenicodes** Meyrick, 1919b:352; type-species: *Irenicodes eurychora* Meyrick, 1919b:352; monotypic. Zimmerman, 1971:53, figs. 1, 2.

This genus was described from one male specimen from Paekakariki, New Zealand, and to my knowledge nothing had been written about it until I published my 1971 report. Meyrick said (1919b:351-352):

In general characters it approaches the Cosmopterigidae, but is distinguished from that family by the absence of the pronounced costal shoulder with scale-projections at about  $\frac{1}{4}$  of hindwing, the costal edge being quite regularly arched. The family as hitherto known is entirely restricted to the Hawaiian Islands where it constitutes the mass of the Micro-Lepidopterous fauna, the known species approaching 300, and indicating a probable total of quite 500. The following species (quite certainly a characteristic member of the family) is the first discovered elsewhere, and is therefore of very great interest; but it must be observed that the *Tineina* of the Pacific islands are hardly at all known yet (I wish some one would explore them), and some may be found there. The new species would seem, however, to be an extreme straggler from the centre of development.

Meyrick was completely misled by this species. It has nothing to do with the Hawaiian fauna, it does not belong to the "Diplosaridae", and it is not a cosmopterigid. It belongs to the Cynodiidae (= Elachistidae *auctorum*)! If Meyrick had studied the genitalia he would have seen at once that they are so typically cynodiid that the species might have been taken for a possible member of the European fauna. Hence, the genus *Irenicodes* is eliminated from consideration as a possible relative of the Hawaiian cosmopterigines.

**Aphanosara** Forbes, 1931:361; type-species *Aphanosara planistes* Forbes, 1931:362, pl. 42, fig. 10, forewing in color; pl. 43, fig. 5, wing venation; pl. 46, fig. 37, male genitalia; monotypic. Zimmerman, 1972:315.

Forbes (1931:362) said that his species was "the only Diplosarid in the restricted sense known to me outside of Hawaii", but he overlooked *Irenicodes* Meyrick, as mentioned above. Forbes' species was described from an unique male from Puerto Rico. It is not represented in the British Museum, and I have not studied it. However, it is obvious from Forbes' good illustrations that this species is not closely allied to the Hawaiian group. It is an American cosmopterigid; it is not a member of the "Diplosaridae" in the Hawaiian sense. The wing venation and the male genitalia are unlike anything found in Hawaii, and the species is not related to the Hawaiian fauna.

Thus we have eliminated from association from the Hawaiian *Hyposmocoma* complex, or "Diplosaridae" of some authors, these two extra-Hawaiian genera which were supposed by their authors to be allied to it.

### THE NUMBER OF SPECIES OF HYPOSMOCOMA

Herein are included details concerning the more than 350 kinds of *Hyposmocoma* I have seen. This is an astonishing number to be assigned to one genus in an area of only about 6,000 square miles, or about  $\frac{4}{5}$  the size of the

small state of Massachusetts, or  $\frac{1}{5}$  the area of Ireland, or  $\frac{1}{470}$  part of the contiguous continental states of the United States. Yet, this is only a part of the species of this remarkable genus. An untold number of new species remain to be described. No species have been recorded from vast areas of the islands. I have not seen any species from all of wonderful West Maui—the equivalent of a large, separate, high, densely forested island—where there should be a large number of locally restricted and perhaps extraordinary species. This is a major gap in the record, and it is surprising that it exists. The lowland faunas are virtually unknown, but, alas, they are now decimated. A vast number of species surely has been exterminated since man has so drastically altered the environment. In spite of the large number of species described, the islands have only been “sampled” here and there for *Hyposmocoma*. No general collection of *Hyposmocoma* had been made since Perkins’ remarkable surveys 75 years and more ago until the Sattlers’ survey was made in 1973 after this text was written. Dr. Swezey collected many species. However, most of his work was devoted to the rearing of selected forms in an attempt to ascertain their hostplants, and he did not make light-trap surveys in the forests or extensive general collections of free adult moths. It is not unreasonable to suppose that as many as 500 or more species of *Hyposmocoma* now exist, and perhaps many more than even that large number may have existed within the past century before the islands were changed so drastically by man and by introduced parasites, predators, and diseases.

### CHARACTERIZATION OF HYPSMOCOMA

Without a detailed revision of the Cosmopteriginae, a task outside the scope of this monograph, it is impossible to formulate a description in succinct terms that will delimit characters to distinguish *Hyposmocoma* from all other genera. We shall have to accept a generalization for the present.

The specific variability of almost all features of *Hyposmocoma* is most bewildering, but it is intensely interesting and highly significant to the evolutionist. It is difficult to convey in words the astonishing morphological variation in *Hyposmocoma*. It must be seen and studied in detail to be appreciated fully. I have included a number of illustrations to demonstrate some of the variation, but these limited figures cannot tell the whole story. It would appear that almost all structures are subject to great specific differentiation and divergence. As the multitude of species is studied, one never knows what to expect when one examines species not seen before. It is impossible to foretell what unusual features may be displayed when new species are discovered.

The wing expanse of the moths ranges from less than 7 mm. to 35 mm. The head and thorax are smoothly scaled in most species, but on some the scales on the head may be somewhat raised. Ocelli are absent. The proboscis is well developed, variable, and squamose. Maxillary palpi are variable in length, although they are usually quite small.

The labial palpi are extraordinarily variable in size, shape, and vestiture, and the form and variation can best be appreciated by examining figures 778–787. Normally, they are carried upright and curve up in front of the head,

and on some species they are so long that they curve up far over the head. They may be long or short, smoothly scaled or hairy. The terminal (third) segment may be shorter or longer than the second, it may be slender to rather stout, and it may be variously expanded by hairs and scales. The second (penultimate) segment may be only a little broader or it may be much broader than the third and may be expanded by its vestiture to varying degrees; the expansion of the vestiture on the second segment reaches its maximum on *ekaha* and *trivitella* (*Euhyposmocoma*, figures 772, 778). Intermediate between the "normal" *Hyposmocoma* type and the extreme development of *Euhyposmocoma* is *Hyposmocoma barbata* (figures 778, 784), which Walsingham labeled "*Hyposmocoma* (?)". The greatest expansion of the third labial palpal segment is found on *lignivora* and its allies (*Diplosara*, figures 761, 778).

The *antennae* are shorter than the forewings. The basal segment is specifically variable in size and shape, and a *pecten* (a comb of setae) may or may not be present. When the antennal pecten is present, it may consist of one or two or more setae, or there may be an entire row of strongly developed setae. The structure of the antennal segments and their vestiture is subject to specific variation, and characters useful in separating some species may be found in the antennae.

Some species (and perhaps only the males in some species) have an *expansible hairbrush* on the metathorax beneath the anterior corner of the wing or in the posterior axil of the hindwing. This may vary from small to large and conspicuous, and, where it is present in both sexes, it may be larger on the male than on the female.

There is a well-developed *chaetosemalike organ* (see figure 788) on some species between the base of the anterior metathoracic brush and the insertion of the wing; this varies from being weakly to strongly developed.

The *legs* vary considerably in clothing, and there is also specific variation in the proportionate lengths of the *spurs*. These features are useful for the separation of some species.

The *wings* vary greatly in shape and comparative size; some are narrow and others are comparatively broad, as the many accompanying illustrations demonstrate. Some species, such as ("*Petrochroa*") *neckerensis* and ("*Rhinomacrum*") *scapulella*, have definite indications of wing reduction which, if carried further, might lead eventually to flightlessness. This is a significant evolutionary trend. Many species have patches of *raised squamae* on the forewings—"Diplosara" *lignivora*, many species of the "*Aphthonetus*" group, and various otherwise conservative species of *Hyposmocoma* display such raised patches, but others show no trace of raised squamae. The *vannal areas* of the forewings may be adorned with various arrangements of hairs and squamae and may have conspicuous brushes of long hairs. On the undersides of the forewings there may or may not be a fringe of specialized hairs or squamae on vein 12 in the males.

The hindwings of the males of the members of *Hyposmocoma sensu stricto* may or may not have an *expansible subcostal brush*, and, when present, it may vary from modest to large, long, and heavy. See the accompanying tabulation of the species according to the presence or absence of the subcostal brush. All members of subgenus *Euperissus* lack subcostal brushes. The clothing of the

posterior margin of the cell in the hindwings varies specifically.

The *vannal areas* of the hindwings call for special attention because differences in the vestiture divide the genus *Hyposmocoma* into two major divisions. On subgenus *Euperissus*, the dorsal surface of the vannal area along or between veins 1b and 1a bears some, and may have many, long hairs, and some species bear conspicuous brushes on these areas (when well developed, they were called "limbal hair-pencils" by Walsingham). On the other major division, subgenus *Hyposmocoma sensu stricto*, the dorsal surface of the vannal area of the hindwing is clothed entirely with squamae.

## **PRESENCE OR ABSENCE OF SUBCOSTAL BRUSHES ON THE HINDWINGS OF HYPSMOCOMA SENSU STRICTO MALES**

### **SUBCOSTAL BRUSH PRESENT**

<i>abjecta</i>	<i>fractistriata</i>	<i>nividorsella</i>
<i>admirationis</i>	new species 13	<i>notabilis</i>
<i>alliterata</i>	<i>geminella</i>	<i>ochreociliata</i>
<i>alveata</i>	<i>genitalis</i>	<i>partita</i>
<i>atrovittella</i>	<i>haleakalae</i>	<i>phalacra</i>
<i>bacillella</i>	<i>hygroscopa</i>	<i>propinqua</i>
<i>bella</i>	<i>impunctata</i>	<i>pseudolita</i>
<i>blackburnii</i>	<i>iodes</i>	<i>sabulella</i>
new species 1	<i>irregularis</i>	<i>saccophora</i>
new species 2	<i>lactea</i>	new species 27
new species 4	<i>lignivora</i>	<i>scolopax</i>
new species 5	new species 15	<i>semicolon</i>
new species 7	<i>liturata</i>	<i>sideritis</i>
<i>butalidella</i>	new species 18	<i>similis</i>
<i>calva</i>	<i>lixiviella</i>	<i>straminella</i>
<i>candidella</i>	new species 19	<i>subcitrella</i>
new species 8	<i>ludificata</i>	<i>subscolopax</i>
new species 9	<i>lupella</i>	<i>suffusa</i>
new species 10	<i>malornata</i>	<i>suffusella</i>
<i>conditella</i>	new species 22	new species 30
new species 11	<i>marginenotata</i>	new species 31
<i>corvina</i>	<i>mediella</i>	<i>tarsimaculata</i>
new species 12	<i>mediospurcata</i>	<i>tenuipalpis</i>
<i>discella</i>	<i>mesorectis</i>	<i>thoracella</i>
<i>divisa</i>	<i>metrosiderella</i>	<i>torella</i>
<i>domicolens</i>	<i>mimema</i>	<i>trimaculata</i>
<i>empedota</i>	new species 23	<i>tripartita</i>
<i>endryas</i>	<i>montivolans</i>	<i>triptila</i>
<i>fallacella</i>	<i>nebulifera</i>	<i>trossulella</i>
<i>fractinubella</i>	<i>nigralbida</i>	

**SUBCOSTAL BRUSH ABSENT**

new species 3	new species 20	<i>thiatma</i>
new species 16	<i>metallica</i>	new species 33
new species 17	<i>mimica</i>	new species 34
new species 26	<i>modesta</i>	<i>torquata</i>
<i>albifrontella</i>	<i>neckerensis</i>	<i>trimelanota</i>
<i>albonivea</i>	<i>nephelodes</i>	<i>turdella</i>
<i>anisoplecta</i>	<i>niger</i>	<i>unistriata</i>
<i>arenella</i>	<i>nigrescens</i>	<i>vermiculata</i>
<i>auripennis</i>	<i>numida</i>	<i>virgata</i>
<i>auropurpurea</i>	<i>ochreocervina</i>	
<i>belophora</i>	<i>paradoxa</i>	
<i>canella</i>	new species 24	
<i>carnea</i>	<i>parda</i>	
<i>cinereosparsa</i>	<i>patriciella</i>	
<i>commensella</i>	<i>persimilis</i>	
<i>communis</i>	<i>petroscia</i>	
<i>coruscans</i>	<i>pharsotoma</i>	
<i>costimaculata</i>	<i>picticornis</i>	
<i>elegantula</i>	<i>prophantis</i>	
<i>evanescens</i>	<i>quinquemaculata</i>	
<i>fervida</i>	<i>rhabdophora</i>	
<i>filicivora</i>	<i>rubescens</i>	
<i>fuscopurpurea</i>	<i>saliaris</i>	
<i>hemicasis</i>	<i>schismatica</i>	
<i>humero vittella</i>	<i>somatodes</i>	
<i>illuminata</i>	<i>subflavidella</i>	
<i>indicella</i>	new species 28	
<i>lacertella</i>	<i>swezeyi</i>	
<i>lebetella</i>	new species 32	
<i>leporella</i>	<i>syrrhaptēs</i>	
<i>lineata</i>	<i>tetraonella</i>	

**MALES NOT SEEN**

new species 6	<i>cupreomaculata</i>	<i>oxypetra</i>
new species 25	<i>ferricolor</i>	<i>progressa</i>
<i>adjacens</i>	<i>flavipalpis</i>	<i>punctiplicata</i>
<i>advena</i>	<i>fuscotogata</i>	<i>scapulella</i>
<i>argentifera</i>	<i>intermixta</i>	<i>semifusa</i>
<i>bilineata</i>	<i>inversella</i>	<i>tomentosa</i>
<i>cincta</i>	<i>lacticretella</i>	<i>trifasciata</i>
<i>continuella</i>	<i>longisquamella</i>	<i>vinicolor</i>
<i>crossotis</i>	<i>lucifer</i>	

The *wing venation* is subject to great and confusing specific variation. It may also vary between individuals of the same species, and it may differ in the wings of opposite sides of the same individual. Abnormalities occur on many specimens. The basic number of veins in the forewing is 12, but one vein—2, 4, 5, or some other vein—may be weak or absent, thus leaving only 11 veins. I have seen 13 veins in the forewings of a female paratype of *palmivora* and in the male holotype of *cryptogamiella* (see figure 770) where an extra vein occurs between veins 8 and 12. The basic, conservative, broad forewing has all 12 veins present; vein 2 strong and complete; 3 leaving cell before its apex; 4, 5, and 6 free and strong, the cell wide throughout its length; 7 normally arising as a branch from 8 and running to costa anterior to wing apex; 8 always free from 9; 9 to 12 all free and distinct.

From this basic and simple pattern of venation a multitude of variations have developed. Rarely, 7 may arise free from the cell, as it does in *commensella* (figure 830). [On an abnormal paratype of *vinicolor* (see figure 865) the course of 7 is unusual, because it is stalked with 6 from the cell (the stem is free from 8), and it runs to termen instead of anterior to apex. On the opposite side of this paratype, the vein is normal as it is on both sides of the type of the species.] In many species, vein 6 arises as a branch of the stem of 7 + 8. In most species the apical veins run strongly and boldly to the wing margins but are apically weak in some species, and in others they are weak near the cell. In species in which the wings are narrower the veins become closer together, 2 may become weak or lost, 3 migrates to the end of the cell, 4 and 5 may fuse, and 6 may become a branch of 7.

The shape of the *hindwing* is subject to much variation. Basically, there are 8 veins; the discocellular space may be wide or narrow; vein 6 may arise from the cell and be well separated from 7, or it may be connate or short-stalked with 7 (this condition exists in species which Walsingham placed in *Aphthonetus* as well as in *Hypsmocoma*); veins 4 and 5 may be widely separated at their origins, connate, short- or long-stalked (in *Diplosara lignivora* all of these conditions may be found in the one species, and the left wing may have a different arrangement from the right wing!). The wing may be broad or narrow, and some species that were originally assigned to *Hypsmocoma sensu stricto* have narrow hindwings similar to those narrow-winged species originally assigned to *Aphthonetus* and *Neelysia* (see figure 852 of *petroscia* and figure 855 of new species 26, formerly confused as a paratype of *saccophora*, for example).

The *color* and *pattern* spreads over an extraordinary range—there appears to be no end to the arrangements. Some species are dull and nondescript, but the colors and patterns range to highly colorful, bright, and strikingly marked species. Some species are nearly concolorous, others are extraordinarily maculated; some species are mostly white and others are black; some are yellow and others are orange, pinkish, brown, beautiful green, bluish, or iridescent; some are vittate and others are fasciate; some appear jewel studded. Many are truly beautiful organisms. I refer the reader to the many accompanying illustrations for further explanation of the wing patterns and their venation. We should not forget that there is a protective reason in nature for the colors and color patterns of the moths and what we see on a spread specimen



mounted on a pin in the museum bears little resemblance to the effect given by the moth when it sits with its wings closed in repose on its chosen substrate. Many species are so effectively camouflaged that they are extremely difficult to see when they are sitting quietly on vegetation. Even those whose markings appear in the laboratory to be bold and contrasting may in nature be beautifully camouflaged. Some species closely resemble the lichen-covered tree trunks or branches upon which they rest. Others have sharply defined markings which serve as disruptive camouflage.

The *genitalia*, especially those of the male, are truly astonishing. The *female genitalia* usually do not have signa on the bursa copulatrix, but in some there is a minute signum, some have a well-developed signum, and others have a pair of signa. I have illustrated the signa of some species on figures 1207 to 1210. Signa occur on species of both *Hypsmocoma sensu stricto* and subgenus *Euperissus*. In subgenus *Euperissus*, I have noted signa on such species as *argentea*, *arundinicolor*, *fulvida*, *longitudinalis*, *radiatella*, *roseofulva*, *vicina*, and *pritchardiae* (which species appears to have an unusual signum). In subgenus *Hypsmocoma*, there are signa on such species as *canella*, *indicella*, *lixiviella*, *mimica*, *parda*, *saliaris*, *schismatica*, and *subflavidella*. The most remarkable feature of the female genitalia is the *ostium*. In the "strong" *Hypsmocoma sensu stricto* types, the ostium is developed as a heavy, sclerotized, protruding, subhelicoid or more or less question-mark-shaped structure. From this extreme development there is a gradual merging to those species that have only a simple, faint, or even obscure, nonprotruding sclerotization (see the illustrations). One wonders how copulation is effected in those species with the extreme development of the heliciform, heavily sclerotized, externally protruding ostium, but we must remember that it is by use of the membranous internal sac, or endophallus, of the aedeagus that sperm transfer is accomplished. The sclerotized aedeagus itself could never be inserted, and it can only be used to bring its orifice in contact with the apex of the female's ostium. I have not had time to give adequate attention to the study of the female genitalia of *Hypsmocoma*, but, in addition to the differences in the details of the ostia as illustrated, I have noted differences in the comparative lengths, shapes, and textures of the bursae and their ducts; short and long ovipositors; differences in lengths of the segments of the ovipositors, their sclerotization, and their setae. Most species have very long ovipositors, but some species, such as *lacticretella*, *persimilis*, *tricincta*, and *trimaculata*, have very short ovipositors. These differences reflect the way in which the eggs are deposited and the kinds of places in which they are deposited. Some females have more heavily sclerotized seventh abdominal segments, and the shape of the seventh sternite is subject to variation.

The *male genitalia* of *Hypsmocoma* call for special comment. I have never found a more remarkable assemblage of astonishing morphological features in any group of insects that I have studied. The structural diversity is incredible; it must be seen to be believed. It is an exciting experience to dissect *Hypsmocoma* male genitalia because one cannot guess what remarkably different structural variation each different species may display. Most male genitalia cannot be adequately illustrated by photographs of slide-mounted dissections alone, although some very good photographs can be made of some species if great care is taken with dissections and their mounting. Models would be necessary properly to illustrate the genitalia.

The male genitalia of *Hypsmocoma* incorporate the following features: From the ventrolateral parts of the eighth abdominal sternum, which is variously developed and variously attached to the sides of the tegumen, with the strongest attachment usually mesad at the bases of the saccus or saccuslike sclerotization, there arise a pair of broad, thin, hinged, flaplike structures bearing dense, long vestiture (see figures 791, 792, for example). These structures vary greatly in size and shape, and with their long vestiture (on the outer surface, that is; the vestiture is fine and furlike internally) they enclose the genitalia proper. After treatment in potash they are revealed as hollow structures whose sclerotization appears similar to that of the abdominal segments. In want of a name, I call them simply the "*genital flaps*" and suggest that they be known by the new technical term *epiptygma* (plural epiptygmata). Kuroko, 1957, called similar structures on Japanese *Cosmopterix* "*lobed projections*". It may be thought that they have a scent-spreading function, and thus they may be analagous in function to coremata. However, they are not eversible sacs as are typical coremata, and I doubt that they are equivalent to coremata. It is the long hairs and scales on these flaps which conceal the main parts of the genitalia, and it is more probable that they act to protect the genitalia.

The *tegumen* is usually strongly developed, but it varies greatly in size, shape, and degree of sclerotization. The *vinculum* is reduced or obsolete.

The *valvae* assume so many shapes and are so variably developed and ornamented that a simple description is impossible, and the reader is referred to the illustrations. They present the most remarkable evolutionary sequences that I have witnessed (figure 793A). There seems no end to the variation because of the infinite combinations of characters possible. It would appear at first that there are two basic types of valvae, and this might lead one to consider that two genera were involved if he had only a limited representation of the species. At one extreme is the simple, smooth-contoured, finely haired valva. From this there is a complete gradation to heavy structures bearing setae that have developed from simple, slender setae to enormous articulated spurs of various sizes, shapes, and number. Frequently they are conspicuously different on the two sides of the same individual. Variform expansions and processes may be developed from the costal margins of the valvae themselves, and these may also differ on the two sides of the same individual.

Many years ago, when I first examined a few species of this complex, I supposed that the simple types of valvae which are typical of the *Euperissus*, *Neelysia*, and *Aphthonetus* assemblages, for example, represented a generic grouping distinct from the strong *Hypsmocoma* types whose valvae are ornamented with spurs. Then, as I studied more species, the complete gradation from one extreme to the other in a most beautiful example of evolutionary change emerged before me, and I found that there is no break from the beginning of one extreme to the end of the other. Almost every evolutionary intergrade from fine setae to huge spurs can be demonstrated when enough species are studied.

To add to the confusion, species representing the two major divisions of valvular development were sometimes placed in the same "generic" group by Walsingham. Walsingham described *Hypsmocoma longitudinalis* from a

series of seven specimens from the islands of Oahu, Molokai and Hawaii, but I have found that the type series contains not one but three species. Unfortunately, the type from Hawaii has lost its abdomen, but upon dissection I found that the Molokai species has simple valvae with no spurs, and the Oahu species has enormous spurs on the valvae. Thus, Walsingham placed together under one specific name these different species whose genitalia are so strikingly distinct and which belong to different subgenera. I have illustrated the genitalia of these species to prove this point (see figures 1105 and 1106). This is an example of how independent of most external characters these two types of genitalia are.

The *Neelysia* and *Aphthonetus* groups are in some ways degenerative, and their genitalia are evolving toward reduction and simplification instead of diversity and ornamentation. In *Neelysia subaurata* (figure 1013), for example, there is an extraordinary reduction of the valvae—they have been reduced to resemble somewhat the long, slender lobes of the anellus. A revelation in evolution!

Without studying the animals themselves, the diversity of structural variation and armature of the valvae can only be appreciated by a detailed study of the illustrations (which, unfortunately, give only a partially satisfactory picture of the structures). The two valvae may be symmetrical or asymmetrical, and the processes they bear may be equally or unequally developed in number, size, and shape. One can only wonder why it is always the left valva which is most highly developed and ornamented when it differs from the right valva.

The *aedeagus* is specifically variable but not remarkable. It ranges from short and stout to rather long and attenuated, and it may be nearly straight to strongly arcuate. The *anellus* has two long lobes which show much interspecific variation in size and shape, and they are often asymmetrical. The lobes are mistakenly called “costae of the valvae” or “costal projections” by some authors.

The *uncus* is absent—what appears to be a divided uncus is actually other structures which have been highly modified. For a long while I was confused and misled by this feature because these structures appear to represent the uncus. It was not until I studied *Trissodoris* in detail that I was able to ascertain that the structures do not represent the uncus. *Trissodoris* appears to have retained its uncus (unless it has developed a new structure), and it also has highly modified gnathuslike structures basically similar to those of *Hypsmocoma*. I once accepted the opinions of various workers who call the structures arms of the *gnathus*, but I am forced to question that opinion. At the bases of the arms of the structures in question on most species there are obviously setae or setose areas which appear to be remnants of the *socii*. Also, the arms themselves often bear conspicuous setae. We know that the normal position of the *socii* is *dorsad* of the arms of the *gnathus*. If we were to conclude that the structures in question in *Hypsmocoma* represent arms of the *gnathus*, then we must assume that in *Hypsmocoma* and other cosmopterigines the arms of the *gnathus* have been rotated in relation to the *socii* so that they have in some way moved *dorsad* from their normal positions *ventrad* of the *socii* and have now confusingly come to lie above the *socii* in abnormal positions. If the uncus is lost, and if the *gnathus* is also lost, there can be little doubt that these structures are modified *socii* unless they are new structures in the Cosmop-

teriginae. [Since these studies were made, I have found that Eyer (1926b:243) considered that the gnathus is "usually absent" in the Cosmopteriginae, and he concluded that the uncus was replaced by the socii.] These questions demand detailed study. I have concluded that we may avoid confusion if we call the structures simply "*brachia*" (arms) and avoid the use of gnathus or socii in this group until we learn more about them. Riedl (1969) has also been unable to determine their exact nature, and he has called them "arms of the tenth segment".

It is noted above that when the valvae have asymmetrical developments it is the left valva that bears the greatest elaboration. The brachia, however, reverse this situation, and the right brachium is usually much more developed than the left brachium. It is usually developed into a strong unculuslike organ. The left brachium is normally much reduced. The right brachium is divided into a more or less "thumb and finger" arrangement in many species, especially those of *Euperissus*. The structure of the brachia is almost as varied as the structure of the valvae. It is difficult to illustrate adequately the brachia because of their curvatures and arrangement. An adequate portrayal would demand a model or a number of drawings from different aspects. They are usually distorted during the slide mounting process. Consequently, most of my illustrations are inadequate. The brachia should be drawn separately before the genitalia are placed on slide mounts.

On some species, an astonishing, curved, sclerotized hook or "*pseuduncus*" (figures 791, 1050) arises from the seventh abdominal segment. This, when strongly developed, can be curved over the genitalia to engage the female during copulation. It can sometimes be seen projecting from the scaling above the genitalia on dried specimens of species in which it is highly developed. In using the term "*pseuduncus*" I realize that the structure to which I here append the name is not the same as other structures dorsad or cephalad of the true uncus in some other groups (see, for example, figure 27 which shows a different structure called pseuduncus). It is a new structure that has arisen in *Hypsmocoma*, and "*pseuduncus*" is simply a convenient term to apply to a structure that appears to function as an uncus when it is fully developed. It is thus a false uncus or pseuduncus. Its use should not cause any confusion in these cases where a convenient term is required to designate a structure that otherwise might be called "the sclerotized unculuslike process arising from the right side of the seventh abdominal segment". There is no reason why there should not be various kinds of pseudunci. On many species it is in a primitive stage of development and cannot really be considered a pseuduncus, but, for simplicity, I have called it pseuduncus regardless of the degree of development it has reached.

This structure may arise as a sclerotized ring on the anterior or posterior margin of the seventh abdominal sternum, or on a combination of both margins, and curve around the pleurum to give rise to the free pseuduncus at the dorsal edge of the sternum (usually only on the right side). The pseuduncus can be traced in development from a minute indication on some species (figure 1054 of *carnea*, for example) through an entire series of diverse forms to those in which it has become very large and very heavy. It often forms a

prominent C-shaped sclerite which forms a ventral and lateral ring around the sternum and curves freely up over the dorsum. Some species have developed another process on the left side, but if two hooks are present, the left one is always smaller than the right one.

*Hyposmocoma nigralbida* (figure 1138) not only has a process from both right and left sides of the seventh abdominal segment, but it also has another pair of pseuduncus-type lobes on the sixth segment! A group of species typified by *malornata* and its associates has a large, semicircular, heavily sclerotized lobe on the seventh tergite in addition to a heavy pseuduncus arising from the sternum (figures 1119, 1120, 1121). On *domicolens*, sternites five, six, and seven have their posterior margins formed into sclerotized arcs (figure 1066). In addition to these structures, the abdomen may have various kinds of other specific developments. On *lignivora*, and some undescribed closely allied forms making up the *lignivora* species group, the apex of the seventh abdominal tergum has a wide, dense brush of modified setaelike squamae. In so far as I now know, no similar structure is found on any other species in this great genus (see figure 1097). *Hyposmocoma fractistriata* (figure 1076) has an unusual transverse comb of spines on the fourth visible tergum; I have seen nothing similar to it on any other species. I have discussed the unusual structure of the apex of the abdomen on the *Aphthonetus* group on page 1093, and there is nothing similar to that development in any other group.

The *eighth abdominal segment* is usually mostly membranous, but it varies. On some species the sternum is decidedly more heavily sclerotized (figures 1032, 1044, 1115, for example) to form an encompassing hull around the ventral and ventrolateral parts of the tegumen (this more strongly sclerotized structure bears the epiptygmata or "genital flaps"), and its degree of sclerotization may approach that of the tegumen. This more strongly sclerotized area, when present, is specifically variable and is of value in identification. The nature of its dorsocaudal area where it attaches to the tegumen varies in degree of sclerotization and extension on the tegumen.

I refer my readers to the many accompanying illustrations for extended study of these fascinating structures and urge them to reflect upon the marvels of evolution as they are displayed so vividly in this astonishing and wonderful swarm of species.

Many of the microscope preparations of the genitalia made for this study are inadequate. Not a few of the moths had partly decomposed before they were dried following capture, and some were damaged by mold. This is not surprising when the difficult conditions under which many of them were captured and prepared in the wet Hawaiian forests are considered. Good microscope slide preparations cannot be made from such material. In some cases we have only unique specimens to study, and it is not always possible to get a good microscope mount from a single specimen no matter how much care is taken. A large number of microscope slide mounts of this group were made while I was engaged in other work, before I began my detailed study of *Hyposmocoma*, and before a proper technique for dissection and mounting was evolved. As a result, many of the dissections were mounted in inferior positions, and it has not been possible to obtain good photographs of them. Some of the slide mounts were remounted, but it was not possible to obtain satisfactory

mounts of a number of species. Even many of the slide preparations made by experts, such as August Busck, proved unsatisfactory for proper illustration. Comparing figure 1140 with figure 1120, for example, it can clearly be seen how important it is to have the dissections made and displayed on the slide mounts in the most appropriate positions possible. The preparation of slide mounts is slow, tedious, hard work, and one should not have to rush the process. It would be best to make drawings of various parts such as the brachia, anellar lobes and aedeagus from various aspects during the dissection process *before* the specimens are mounted because important shapes and features are often obscured in the slide mounts. Cleaned, potash-treated specimens preserved in glycerin are also of great assistance to the studies.

After most of the microscope slides of dissections were prepared, and after I had begun to study the group in final detail, I devised the following method for preparing the male genitalia to ensure the best possible views of the various structures when they are mounted on microscope slides:

1. After treatment in 10% KOH, followed by glacial acetic acid, the entire abdomen is given a preliminary cleaning in water and stained in Mercurochrome (see p. 87 above for detailed discussion).

2. A second cleaning is made of the entire abdomen in water after staining. The genitalia, with the genital flaps, are removed and cleaned.

3. The cleaned abdomen is transferred to clean 70% alcohol and flattened. The genitalia are transferred to the clean alcohol, cleaned further and spread.

4. The genital flaps are carefully detached from the genitalia, cleaned further, spread open and flattened.

5. The tegumen is cut or torn away on each side from the bases of the valvae, removed, and flattened. Special care is taken to remove all the anal tube membrane so that it will not obscure or distort the view of the brachia. An attempt is made to manipulate the brachia into good positions for illustration; but this is not always easy or possible.

6. If the operation is successful at this point, the aedeagus and anellar lobes will remain adhering to the valvae. The valvae are then opened and spread, and their appendages, together with the aedeagus and anellar lobes, are arranged for the best possible view. On occasion, it may be advisable to separate one or both valvae, and sometimes the anellar lobes, to obtain satisfactory views of the parts.

7. All parts are transferred to 95%–100% alcohol and each is held down for a few moments, as required, to assist in their hardening in the best position possible, and they are given a final cleaning as required. The parts are then ready to transfer to clearing agent and mounting medium, or they may be mounted directly from 95% or absolute alcohol to Euparal. I have found this later method completely satisfactory.

Usually three photographs will enable the genitalia to be illustrated to best advantage, that is: one of the valvae with the attached aedeagus and associated anellar lobes, one of the tegumen and brachia, and one of the genital flaps. Sometimes all of these parts can be taken on one or two photographs. Supplementary drawings may have to be made of some parts from aspects different from those that can be shown in the usual photographs.

(I deeply regret that I have not been allowed the opportunity to prepare many such drawings for this text.) If the abdomen bears a pseuduncus or other feature, a fourth, and perhaps a fifth photograph will be required to record adequately the details.

If dismemberment as suggested above is not employed, it is usually impossible to obtain good views of the features of the genitalia, and most photographs will be inadequate or poor. The natural arrangement of the parts of the genitalia of many species renders them poor subjects for illustration if they are not dismembered, although many species of subgenus *Euperissus* can be mounted entire.

In spite of all the care one takes, it is often impossible to obtain an excellent slide preparation. It is frequently difficult to descale the abdomens of many of the species, and, not infrequently, moldy or partly decomposed specimens add to the difficulties of preparation. The accompanying illustrations demonstrate the full range of excellent to poor preparations.

One may frequently have reason not to wish to make a microscope slide preparation of the genitalia—when one is checking details for identification or using the specimen for the preparation of drawings, for example. In such instances, one may preserve the cleaned abdomens, with genitalia attached or detached, in glycerin in microvials placed on the pin on which the moth is mounted. For such preparations one may proceed as above for slide mounting, but when the final 70% alcohol stage is reached, the specimen is placed in glycerin for a few minutes. Then the specimen is placed carefully into the bottom of a microvial (being careful not to touch the sides of the tube near the cork end) with only the amount of glycerin which adheres to the specimen or only a drop more. There is no need to use more glycerin in the microvial. If much more is used, or the cork end is wetted with glycerin, it may creep around the cork and cause corrosion of the pin. Glycerin exposed to air may absorb moisture.

### DESCRIBED HYPOSMOCOMA SPECIES WHOSE MALE GENITALIA ARE NOT ILLUSTRATED

About two-thirds of the following 65 species are known only from females. Males are known from the remaining third, but they have all lost their abdomens. It will be difficult, and perhaps impossible for some species, to arrange them in a proper scheme of classification until males are collected. Most unfortunately, almost half of the nearly 40 species of *Hyposmocoma* described by Meyrick are represented by males whose abdomens have been lost or by females.

Where the genus in which these species were originally described was other than *Hyposmocoma*, I have noted the original generic assignments in parentheses.

#### Subgenus **EUPERISSUS**

*argomacha*  
*aspersa* (*Aphthonetus*)  
*barbata*  
*catapyrrha* (*Euperissus*)

#### Subgenus **HYPOSMOCOMA**

*adjacens*  
*advena*  
*argentifera* (*Agonismus*)  
*atrovittella*

<i>centronoma</i>	<i>bilineata</i>
<i>discolor</i>	<i>calva</i>
<i>eleuthera</i> ( <i>Aphthonetus</i> )	<i>cincta</i>
<i>epicharis</i>	<i>continuenta</i>
<i>erebogramma</i> ( <i>Neelysia</i> )	<i>crossotis</i>
<i>fractivittella</i>	<i>cupreomaculata</i>
<i>fuscodentata</i> ( <i>Neelysia</i> )	<i>endryas</i>
<i>hirsuta</i> ( <i>Aphthonetus</i> )	<i>ferricolor</i>
<i>homopyrrha</i> ( <i>Phthoraula</i> )	<i>fervida</i>
<i>lichenalis</i> ( <i>Aphthonetus</i> )	<i>flicivora</i>
<i>longitudinalis</i>	<i>flavipalpis</i> ( <i>Agonismus</i> )
<i>lunifer</i>	<i>fuscotogata</i>
<i>mormopica</i> ( <i>Neelysia</i> )	<i>intermixta</i>
<i>municeps</i> ( <i>Neelysia</i> )	<i>inversella</i>
<i>nipholoncha</i>	<i>lacticretella</i>
<i>pallidipalpis</i>	<i>longisquamella</i> ( <i>Elachista</i> )
<i>palmivora</i>	<i>lucifer</i>
<i>phantasmatella</i>	<i>oxypetra</i>
<i>pluviella</i> ( <i>Neelysia</i> )	<i>progressa</i>
<i>prae fracta</i> ( <i>Aphthonetus</i> )	<i>prophantis</i>
<i>psaroderma</i> ( <i>Neelysia</i> )	<i>punctiplicata</i>
<i>quadripunctata</i>	<i>rhabdophora</i>
<i>quadristriata</i>	<i>scapulella</i> ( <i>Rhinomactrum</i> )
<i>rotifer</i> ( <i>Neelysia</i> )	<i>semifusa</i> ( <i>Neelysia</i> )
<i>sublimata</i>	<i>thoracella</i>
<i>trilunella</i>	<i>tomentosa</i>
<i>veterella</i> ( <i>Aphthonetus</i> )	<i>torquata</i>
	<i>trifasciata</i> ( <i>Petrochroa</i> )
	<i>trimelanota</i>
	<i>vinicolor</i>

### HABITS OF HYPOSMOCOMA

Until the field studies of Dr. Swezey demonstrated otherwise, it had been assumed that all of the larvae were case-makers. We know now that the habits of the species are diverse, and although the larvae of many are case-makers, many species do not make cases. The kinds of cases made are almost as varied as the many species which make them. An extremely interesting study could be made of the cases alone, and one of the great regrets of this preliminary study is that I have not had opportunity to devote adequate time to the study of the larval cases. It was my intention to include illustrations of all of the known larval cases, but I have been able to include only a few examples. As I have stated above, it appears that the species of *Hypsmocoma sensu stricto* are case-makers and the larvae of subgenus *Euperissus* do not construct cases.

A study of the methods employed by *Hypsmocoma* in constructing their larval cases would be fascinating and instructive. There are remarkable differences in the larval cases. The last larval skin and the pupal skin are to be found in the larval cases after the moths have emerged. To retrieve the



skins for study, one may open the the larval cases by cutting along their lateral sutures. The moth must push open the slitlike exit, or the operculum where one is formed, and force its way out of the larval case to emerge. In doing so it appears that most specimens lose a number of squamae which can be found adhering to the inside of the case if one forces it open. The pupal skin remains attached near the caudal end of the larval case after the moth emerges, and it does not protrude from the case.

We know little about the habits and food of the group, but we do know that the habits of the larvae are remarkably diverse. Many are to be found on rocks; some on the bark of trees and shrubs; others on, in, or under dead bark; others in dead stems or in dead logs; some feed among lichens; some feed among vegetable trash on the ground; others form silken tunnels in moss; some bore in living wood, stems, or pith; some feed on the fronds or bore in living ferns; some feed on living leaves; some feed on the tomentum of palm fronds. Some species are host-specific, others are not. Some of those which appear not to be host-specific may actually be so—feeding upon algae, fungi, or lichens on the plants from which they have been reared. Many case-makers live on nearly bare rocks where they evidently feed upon minute lichens, algae, or fungi. Some case-makers may be found in barren areas on comparatively new lava far from forests where there is little other insect life. None are known to be leaf miners.

To summarize what is known about the larval habits of *Hypsmocoma*, I have listed under several categories the species whose habits have been recorded and have listed them under the “generic” names in which they were described.

## I. CASE-MAKING LARVAE

### *Hypsmocoma*

*abjecta*: on dead *Freycinetia* and dead limbs.

*alliterata*: feeds on lichens on the trunks of many trees, native and foreign.

*bacillella*: on *Metrosideros*.

*blackburnii*: in dead *Acacia koa*.

*candidella*: on or under dead bark of *Acacia koa*.

*canella*: on rocks.

*discella*: on bark of *Cheirodendron* and *Metrosideros*.

*empedota*: on bark of various trees.

*filicivora*: lives in hollows in dead stems of tree ferns.

*hygroscopa*: on bark of *Eucalyptus* and on *Pandanus* leaves.

*liturata*: on rocks and on *Pipturus*.

*lupella*: on *Freycinetia*.

*metrosiderella*: on *Metrosideros*.

*montivolans*: on lichens on rocks.

*notabilis*: at base of palm fronds.

*oxypetra*: habit unknown to me.

*saccophora*: on lichens on rocks.

*subcitrella*: on bark of *Cheirodendron* and *Metrosideros*.

*suffusella*: on dead *Pipturus*.

*trimaculata*: on and beneath bark of *Acacia koa* and *Aleurites*.

*Petrochroa**swezeyi*: on rocks.*trifasciata*: on rocks.*Diplosara lignivora*: in rotten wood or under dead bark of various trees.**II. NAKED STEM- OR WOOD-BORERS, OR FEEDERS IN BARK***Euperissus**catapyrrha*: bores in pith of dead *Rubus*.*cristatus*: bores in pith of dead *Freycinetia*.*Semnoprepia**coprosmae*: bores in living trunks and branches of *Coprosma*.*ferruginea*: bores in dead twigs and branches of *Cheirodendron*.*petroptilota*: bores in dead wood of *Metrosideros* and *Pelea*.*pittospori*: bores in dead wood of *Pittosporum*.*Hyperdasyella**cryptogamiella*: bores in dead stems of many trees and shrubs.*semiusta*: bores in rotten wood of *Acacia koa*.*unicolor*: bores in dead wood of many trees.*Hyposmocoma**argomacha*: bores in dead stems of *Smilax*.*caecinervis*: has similar habits.*centronoma*: bores in bark of *Metrosideros*.*chilonella chilonella*: bores in dead pith or dead wood of many trees and shrubs.*chilonella triocellata*: has similar habits.*chilonella venosa*: bores in dead *Wikstroemia* wood.*chloraula*: bores in dead stems of *Astelia*.*erismatias*: bores in dead *Euphorbia* stems.*insinuatrix*: bores in dead *Smilax* stems.*jugifera*: bores in dead wood of *Acacia koa* and *Pelea*.*nipholoncha*: bores in dead *Euphorbia* stems.*Phthoraula homopyrrha*: bred from dead *Metrosideros* wood.*Neelysia palmifera*: bores in dead parts of several trees.*Aphthonetus**bitincta*: in (or on?) dead *Acacia koa* bark.*prae fracta*: in (or on?) *Pipturus* bark.new species 35: in (or on?) *Sapindus* bark.**III. NAKED LARVAE IN SILKEN TUNNELS IN MOSS***Neelysia**argyresthiella*.*mactella*.

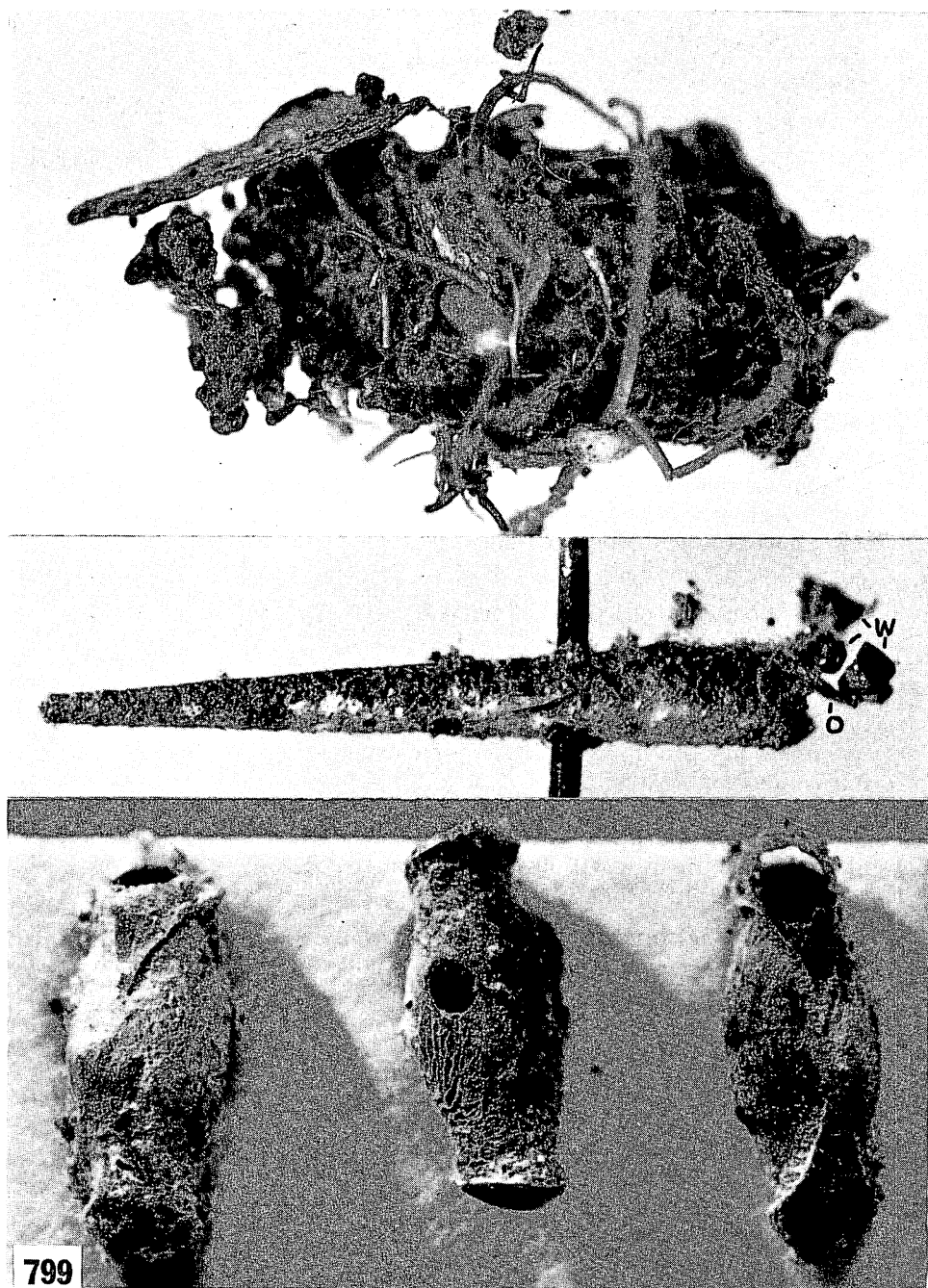
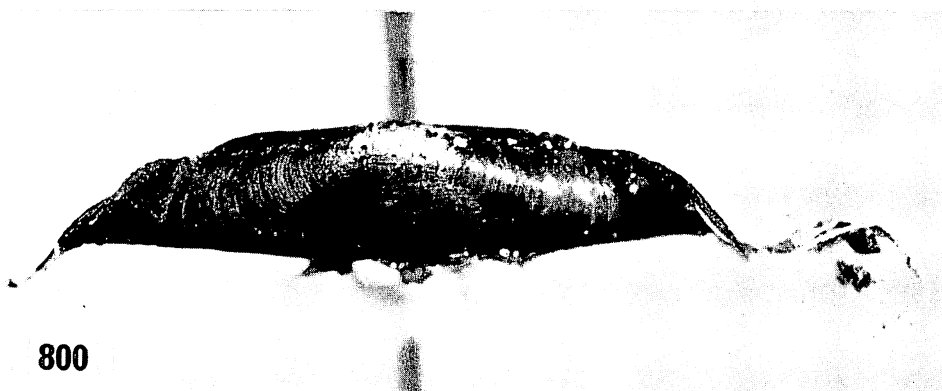
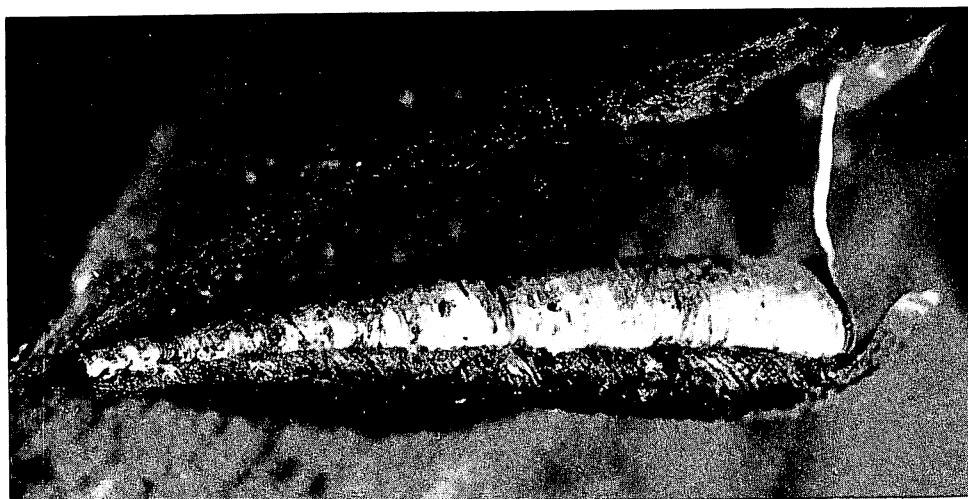


Figure 799—*Hyposmocoma*, larval cases. Top, *discella* Walsingham, paratype; Kaholuamano, Kauai; on *Cheirodendron* or *Metrosideros*, "lichenivorous"; length 10 mm.; male genitalia on slide BM 7873. Middle, *saccophora* Walsingham, holotype; Mt. Kaala, 3,000 feet, Oahu; on rocks, "lichenivorous"; length 9 mm. Compare *bacillella* in figure 800. *O*, operculum; *W*, sand grain weights fastened by silk. See text for discussion. Bottom, *trimaculata* Walsingham?, as determined by Dr. Swezey; Waianae, Oahu; on bark of *Aleurites moluccana*; length of case at right, 4.5 mm. Note the parasite emergence hole in the case at middle.



800

Figure 800—Larval cases of *Hyposmocoma*. Top, *bacillella* Walsingham; Halemanu and Kaholuamano, 4,000 feet, Kauai; on underside of a *Metrosideros* leaf; length 9 mm. Note the operculum at the right. The pale side of the case is ventral when the larva is active. Compare *saccophora* in figure 799. Middle and bottom, ventral and lateral aspects of a species possibly in the *blackburnii* complex—this was identified by Dr. Swezey as *blackburnii*, but I consider it a different species; Kalihi, Oahu; length 9 mm.

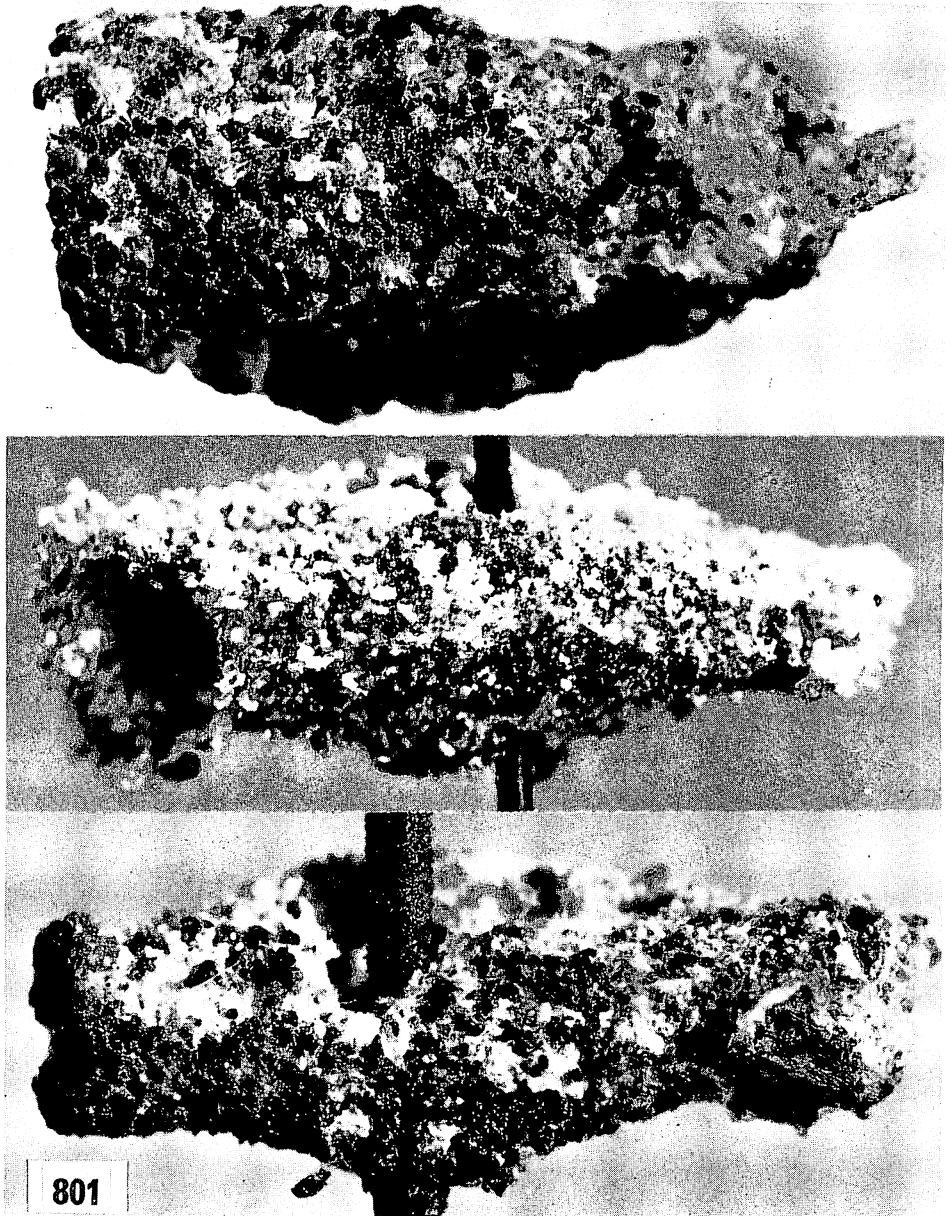
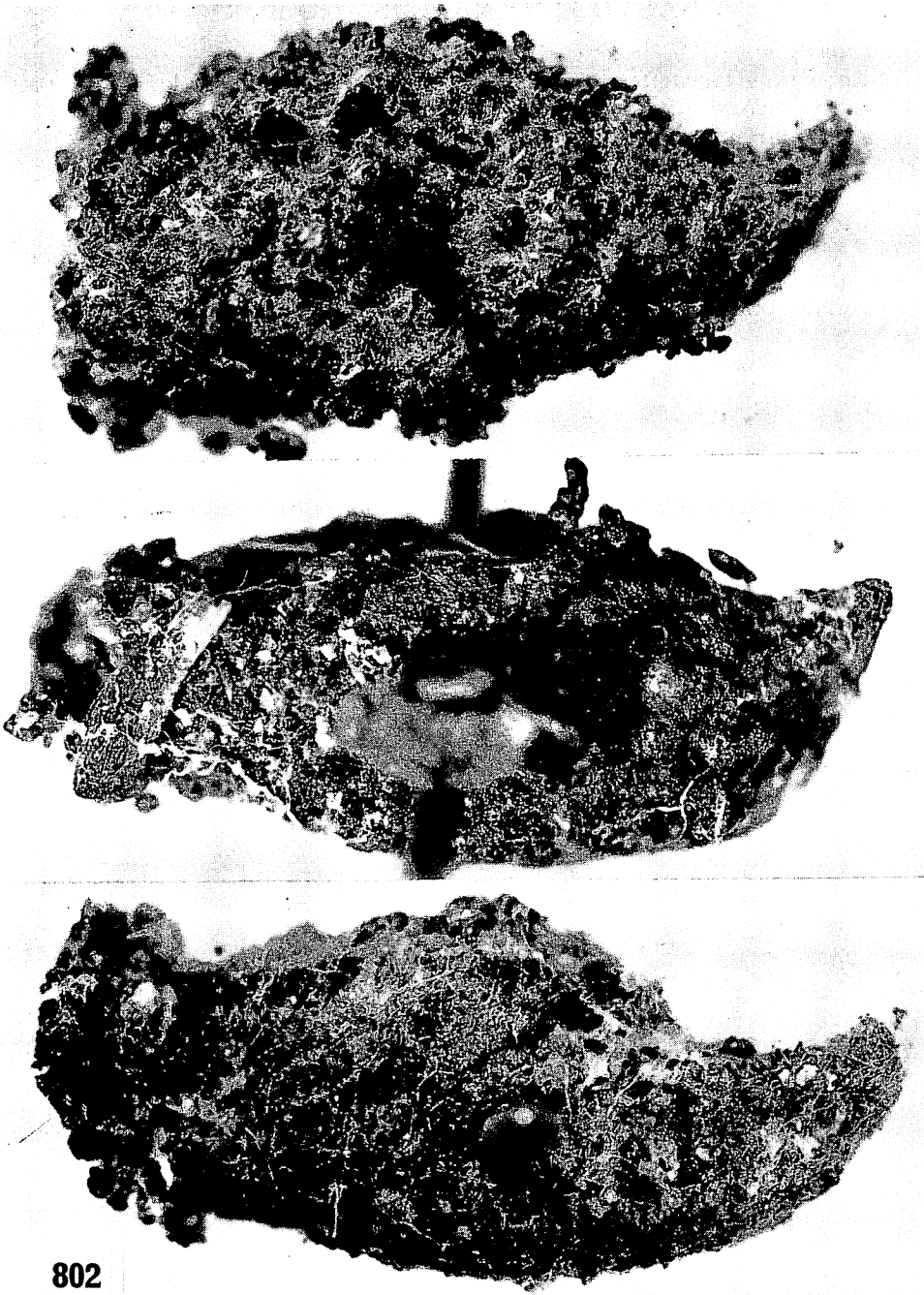


Figure 801—*Hypsomocoma*, larval cases. Top, *alliterata* Walsingham, as determined by Dr. Swezey; Lanihuli, Oahu; length 7 mm. Middle, *literata* Walsingham, as determined by Dr. Swezey; Kalihi, Oahu; length 9.5 mm. Bottom, *subcitrella* Walsingham, holotype male; Kaholuamano, 4,000 feet, Kauai; on *Cheirodendron* or *Metrosideros*; "lichenivorous"; length 5 mm.



802

Figure 802—Larval cases of *Hyposmocoma*. Top, *montivolans* (Butler); Waianae Mts., Oahu; on rocks; "lichenivorous"; length 8 mm. Middle, *metrosiderella* Walsingham; Kaholuamano, Kauai; paratype, reared from *Metrosideros*; length 6 mm. Bottom, the holotype male of *metrosiderella* Walsingham, Halemanu and Kaholuamano, 4,000 feet, Kauai; reared from *Metrosideros*; length 6 mm.

#### IV. NAKED FERN-EATERS AND BORERS

*Euhypsmocoma*

*ekaha*: young larvae feed on the under surfaces of fronds; older larvae also bore in fronds of *Asplenium nidus*.

*trivitella*: larvae bore in *Elaphoglossum reticulatum* and *gorgoneum* fronds.

#### V. NAKED LARVAE WITH VARIOUS HABITS

*Hypsmocoma*

*latiflua*: feeds under webs on undersides of leaves of *Pittosporum cauliflorum*.

*palmivora*: feeds on cottony tomentum on undersides of the leaves of the endemic palm *Pritchardia eriophora*.

*Bubaloceras*

*pritchardiae*: feeds in cottony tomentum on spathe and inflorescence of *Pritchardia eriophora*.

*Aphthonetus*

new species 14: feeds in apical folds on upper surfaces of leaves of *Acacia koa*.

*sideroxyloni*: feeds beneath a web on the under surfaces of leaves of *Pouteria sandwicensis*.

In addition to the above-listed species, other larvae have been reared from various hostplants, but I do not know anything about the habits of the larvae. A number of reared species remain unidentified. The hostplants of about 80% of the species of *Hypsmocoma* are unknown. I have notes on the following groups of plants as hostplants for *Hypsmocoma*:



Figure 803—The larval case of *Hypsmocoma* ("Diplosara") *lignivora* (Butler), as determined by Dr. Swezey; Oahu. This case appears to differ from that shown in figure 1097. For more larval cases see figures 799–802, 905, 977.

"Algae?"	Euphorbiaceae
"Fungi?"	<i>Aleurites</i>
"Mosses"	<i>Euphorbia</i>
"Lichens"	<i>Manihot</i>
Ferns	Sapindaceae
<i>Asplenium</i>	<i>Alectryon</i>
<i>Cibotium</i>	<i>Sapindus</i>
<i>Elaphoglossum</i>	Tiliaceae
Pandanaceae	<i>Elaeocarpus</i>
<i>Freycinetia</i>	Malvaceae
<i>Pandanus</i>	<i>Hibiscus</i>
Graminae	Thymeleaceae
<i>Bambusa</i>	<i>Wikstroemia</i>
Palmae	Myrtaceae
<i>Pritchardia</i>	<i>Eucalyptus</i>
Liliaceae	<i>Metrosideros</i>
<i>Astelia</i>	Araliaceae
<i>Smilax</i>	<i>Cheirodendron</i>
Urticaceae	<i>Tetraplasandra</i>
<i>Boehmeria</i>	Sapotaceae
<i>Hesperomannia</i>	<i>Pouteria (Sideroxylon)</i>
<i>Pipturus</i>	Ebenaceae
Nyctaginaceae	<i>Diospyros (Maba)</i>
<i>Pisonia</i>	Apocynaceae
Pittosporaceae	<i>Pteralyxia</i>
<i>Pittosporum</i>	Verbenaceae
Rosaceae	<i>Lantana</i>
<i>Rubus</i>	Rubiaceae
Leguminosae	<i>Coprosma</i>
<i>Acacia</i>	Campanulaceae
<i>Prosopis</i>	<i>Clermontia</i>
<i>Sophora</i>	Compositae
Rutaceae	<i>Bidens</i>
<i>Pelea</i>	

From the foregoing account, which records the habits of comparatively few species, it is obvious that the variability of habit within *Hypsmocoma* is great. The foodplant range is from algae(?), lichens, mosses, and ferns all the way through most of the plant families in Hawaii. I expect that almost all suitable plants in the islands may serve as food for some species of *Hypsmocoma*. It is, however, significant that no species has yet been reared from a grass (although one or more species may be found "grazing" on the surface of bamboo, they probably feed upon lower forms of plant life which grow on the bamboo), or a sedge, and none is known as a leaf miner. How exciting it would be to make a detailed study of the larval habits of this group.

It will be noted that I have used the original group ("generic") names for the *Hypsmocoma* in the foregoing list. I have done this in an attempt to find



if there is any correlation between group and habit. It should be noted that all of the species listed above which have naked larvae are members of the subgenus *Euperissus*. It is significant that, with the exceptions of two "*Petrochroa*" and "*Diplosara*", all of the case-makers have been described in *Hyposmocoma*. "*Petrochroa*" *swezeyi* really is a "strong" *Hyposmocoma* with prominent spurs on its male genital valvae. The genitalia of "*Petrochroa*" *trifasciata* are unknown—the unique holotype has lost its abdomen—but it also belongs to *Hyposmocoma sensu stricto*. Other *Hyposmocoma* fall into larval categories II and V, but these all belong to subgenus *Euperissus*. *Euperissus* (in the original sense), *Semnoprepia*, and *Hyperdasylella* are closely allied groups, and their species have similar habits. *Euhyposmocoma* species, *Semnoprepia coprosmae*, and others bore in living tissues.

We may conclude that at this time we know too little about the diverse larval habits of *Hyposmocoma* to draw any fundamental conclusions other than it appears that most, if not all, of subgenus *Hyposmocoma* are case-makers, and that all members of subgenus *Euperissus* have naked larvae.

Many of the moths are extremely common, resting by day on rough tree-trunks, from which some readily take flight on the approach of the collector. Others are disturbed in quantities from amongst dead fern-fronds, or dry limbs of trees, or from dense bushy trees or shrubs, especially certain varieties of the Ohia tree (*Metrosideros*). Many are readily attracted by lights. A group of yellow or orange-coloured species are very conspicuous objects on the intermediate islands of Maui and Molokai. Some of the species exhibit much variation in colour, and when series of individuals have been collected from a great number of stations

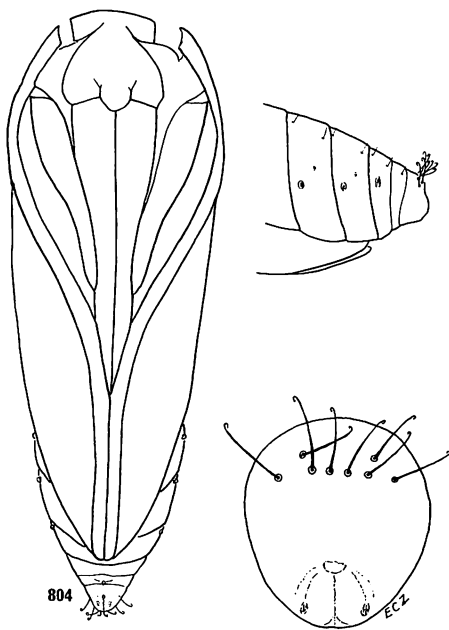


Figure 804—Pupal skin of *Hyposmocoma* (*Euperissus*) *latiflua* Meyrick, in ventral aspect, with a left lateral view of the caudal end of the body (drawn to same scale), and a greater enlargement of the tenth abdominal segment in caudal aspect. Puu Kalena, Oahu; length 5.5 mm.

it is probable that the discrimination of the species will become a very difficult matter. Some of the caterpillars feed in dead wood or bark of trees and are quite naked, while others form cases of silk mixed with frass or *débris*. These cases exhibit much variety of form and appearance. Some are acute and spiniform, while others are broadly oval; some are dilated at each extremity, or pointed at one end and broadly rounded at the other, others are dilated in the middle. Some, found on lichen-covered trees, greatly resemble the surface on which they rest. Of several species almost incredible numbers may be found attached to rocks or bare vertical surfaces of decomposing lava, where the larvae no doubt feed on the microscopic vegetable growths. . . . The moths are often caught by the little fan-tailed flycatchers (*Chasiempis*) and by the native dragonflies. Though the chief home of *Hyposmocoma* is in the true forest-belt, some occur both below and above this belt. Even in the dry lowlands a few kinds are found, their larvae feeding on the low forms of vegetable life, growing on rocks and tree-trunks . . . [A] once numerous lowland fauna has been no doubt, well-nigh exterminated by the ant *Pheidole*. . . . *Dysphoria* [semicolon] . . . comes freely to light at night. *Euperissus cristatus* . . . is very common in the larval state in the dead stems of *Freycinetia*. *Hyperdasys* . . . and *Semnoprepia* . . . are found hiding amongst masses of dead fern-fronds or are attracted by light. . . . *Diplosara lignivora* is a very common insect in the larval state, the cases sometimes being found by scores or hundreds beneath the bark of dead and fallen trees. The moth is freely attracted by light. (Perkins, 1913: clxv-clxvi.)

The larvae of *Hyposmocoma* are morphologically almost unknown, and no modern or adequate description of any of the species exists. I have found major differences between the few larvae and cast larval skins I have examined. For example, the "*Diplosara*" *lignivora* group have much larger prothoracic spiracles than do those of the *Hyposmocoma* (*H.*) *saccophora* group, and the arrangements of the ocelli differ as does the chaetotaxy. There are, of course, conspicuous adaptive differences between the case-makers and the naked larvae and between those species that are internal feeders and those which are exposed feeders. Dr. Swezey described superficially the larvae of the two species (*ekaha* and *trivittella*) which he placed in "*Euhyposmocoma*", and I have included the meager details under those species headings farther on in this text. I had hoped to include here descriptions, with detailed illustrations, of a representative series of larvae, but, most regrettably, I have been allowed neither the time required to accomplish the task, nor the opportunity for the required fieldwork.

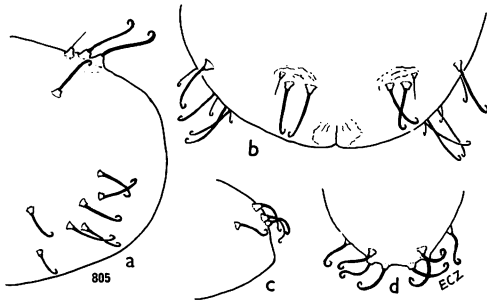


Figure 805—Details of the caudal abdominal segments of *Hyposmocoma* pupae in left lateral and dorsal aspects, not to same scale. *a, b*, *Hyposmocoma* ("*Diplosara*") determined as *lignivora* (Butler) by Walsingham; Molokai, 4,000 feet (Walsingham specimen number 28700); the antennae extend to or a little beyond the apex of the abdomen, and the wings are slightly shorter. *c, d*, *Hyposmocoma* (*Hyposmocoma*) *montivolans* (Butler); Waianae Mts., Oahu, Walsingham specimen number 25142; larvae "lichenivorous", on rocks. The wings and antennae extend caudad equal distances, reaching the ninth abdominal segment. The abdominal spiracles are protuberant, and caudo-mesad of each spiracle there is a sharply pointed denticle. These pupal skins were removed from cases made by their larvae.

## PARASITES AND PREDATORS OF HYPOSMOCOMA

We know little about the parasites and predators of this great group because no special study of them has ever been attempted. I have no records of predators except the statement quoted just above from Perkins regarding predation by *Chasiempis* flycatchers, Odonata, and the voracious ant *Pheidole*. The only records of parasites which I have assembled are all Hymenoptera, and they as follows:

### BRACONIDAE

*Agathis hawaiiicola* (Ashmead), in *Hyposmocoma* species.

*Apanteles carpatus* (Say), in *Hyposmocoma* species.

### ICHNEUMONIDAE

*Atrometus tarsatus* Ashmead, in *trimaculata*.

*Coccygomimus punicipes* (Cresson), in *ekaha* and *litrata*.

*Echthromorpha agrestoria fuscator* (Fabricius), in *trivitella*.

*Gelis tenellus* (Say), in *empedota* and *literata*.

*Pycnophion fuscipennis* Perkins, in *chilonella*.

### EULOPHIDAE

*Euderus metallicus* (Ashmead), in *empedota* and *literata*.

*Ophelinus mauensis* Ashmead, in *chilonella*.

*Pnigalio externa* (Timberlake), in *trivitella*.

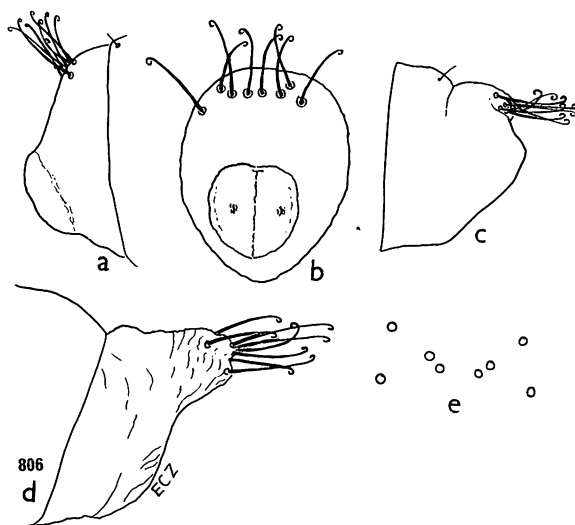


Figure 806—Details of the caudal segments of the pupae of three species of *Hyposmocoma* (*Euperissus*). *a*, right lateral, and *b*, caudal aspects of *latiflua* Meyrick; Puu Kalena, Oahu. *c*, left lateral aspect of *caecineris* Meyrick, Mt. Kaala, Oahu, paratype. *d*, left lateral aspect of *chilonella* Walsingham, Olinda, Maui, determined by Meyrick. *e*, the setal socket pattern of the cremasteral setae as seen in direct caudal view of the same. The larvae of these species do not make cases. Many species of *Euperissus* have similar clusters of eight cremasteral setae.

## EUPELMIDAE

*Eupelmus* species, in *chilonella*.

*Lepideupelmus setiger* (Perkins), in *empedota* and *trimaculata*.

## BETHYLIDAE

*Scleroderma chilonellae* Bridwell, in *chilonella*.

*Scleroderma semnoprepiae* Bridwell, in *coprosmae* and *pittospori*.

*Scleroderma* species, in *triocellata*.

It will be noted that these records pertain to only ten or eleven species of *Hyposmocoma*. Three species of parasites are recorded from *chilonella* and from *literata*. Two parasites are recorded from *empedota*, *trimaculata*, and *trivitella*. Most of the information on parasitism was assembled by Dr. Swezey incidental to his rearing a few species of these moths.

It is most interesting that not one species of the huge genus *Sierola* (Bethylidae), which probably contains more than 200 Hawaiian species, has yet been reared from *Hyposmocoma*. *Sierola* is known to parasitize a number of other Hawaiian moths.

We know nothing of introduced diseases that may now be widespread among Hawaiian Microlepidoptera.

This brief and inadequate account of the parasites and predators of *Hyposmocoma* reflects lack of observation and our enormous ignorance of the fauna.

**THE ORIGINAL GENERIC ASSIGNMENTS OF HYPOSMOCOMA**

I believe that it will be useful to list the species under the various "generic" names to which they have been assigned from the time of the publishing of Walsingham's monograph in *Fauna Hawaiiensis* in 1907 onward. The Walsingham arrangement of supposed "subspecies" is also followed in this list. This will summarize the opinions of various workers and will provide the reader with an easily consulted tabulation of the species as they were formerly classified. I shall list the genera and species alphabetically to render the lists more readily used. A phylogenetic arrangement is impossible at this stage of our inadequate knowledge. After each species name I indicate to which subgenus of *Hyposmocoma* I now assign the species: (E) = *Euperissus*; (H) = *Hyposmocoma sensu stricto*.

*Agonismus* Walsingham, 3 species.

*argentiferus* Walsingham (H)

*coruscans* Walsingham (H)

*flavipalpis* Walsingham (H)

*Aphthonetus* Walsingham, 33 species.

*albocinerea* Walsingham (E)

*aspersa* (Butler) Walsingham (E)

*bitincta* Walsingham (E)

*columbella* Walsingham (E)

*confusa* Walsingham (E)

*corticicolor* Walsingham (E)

*diffusa* Walsingham (E)  
*digressa* Walsingham (E)  
*divergens* Walsingham (E)  
*elegans* Walsingham (E)  
*eleuthera* Walsingham (E)  
*empetra* Meyrick (E)  
*exsul* Walsingham (E)  
*fluctuosa* Walsingham (E)  
*fugitiva* Walsingham (E)  
*hirsuta* Walsingham (E)  
*humerella* Walsingham (E)  
*kauaiensis* Walsingham (E)  
*lichenalis* Walsingham (E)  
*mediocris* Walsingham (E)  
*nemo* Walsingham (E)  
*passerella* Walsingham (E)  
*plumbifer* Walsingham (E)  
*polia* Walsingham (E)  
*prae fracta* Meyrick (E)  
*puncticiliata* Walsingham (E)  
*sagittata* Walsingham (E)  
*sideroxyloni* Swezey (E)  
*spurcata* Walsingham (E)  
*subocellata* Walsingham (E)  
*triaula* Meyrick (now in *Asymphorodes*)  
*trichophora* Walsingham (E)  
*veterella* Walsingham (E)

*Bubaloceras* Walsingham, 2 species.

*pritchardiae* Swezey (E)  
*subburneum* Walsingham (E)

*Diplosara* Meyrick, 1 species.

*lignivora* (Butler) Meyrick (H)

*Dysphoria* Walsingham, 1 species.

*semicolon* Walsingham (H)

“*Elachista*”, *sensu* Walsingham, 1907, not of Treitschke, 1 species.

*longisquamella* Walsingham (H)

*Euhypso mocomma* Swezey, 2 species.

*ekaha* (Swezey) Swezey (E)  
*trivitella* Swezey (E)

*Euperissus* Butler, 2 species.

*catapyrrha* Meyrick (E)  
*cristatus* Butler (E)

*Hyperdasysella* Fletcher ( = *Hyperdasys* Walsingham), 5 species.

- arundinicolor* (Walsingham) Fletcher (E)
- cryptogamiella* (Walsingham) Fletcher (E)
- philocharis* (Meyrick) Fletcher (E)
- semiusta* (Walsingham) Fletcher (E)
- unicolor* (Walsingham) Fletcher (E)

*Hyposmocoma* Butler, 214 species.

- abjecta* (Butler) Walsingham (H)
- adelphella* Walsingham (E)
- admirationis* Walsingham (H)
- adolescens* Walsingham (E)
- advena* Walsingham (H)
- albifrontella* Walsingham (H)
- albonivea* Walsingham (H)
- alliterata* Walsingham (H)
- alticola* Meyrick (E)
- anisoplecta* Meyrick (H)
- arenella* Walsingham (H)
- argentea* Walsingham (E)
- argomacha* Meyrick (E)
- atrovittella* Walsingham (H)
- auripennis* (Butler) Walsingham (H)
- auroargentea* Walsingham (E)
- auropurpurea* Walsingham (H)
- bacillella* Walsingham (H)
- barbata* Walsingham (E)
- bella* Walsingham (H)
- belophora* Walsingham (H)
- bilineata* Walsingham (H)
- blackburnii* Butler (H)
- brevistrigata* Walsingham (E)
- butalidella* Walsingham (H)
- caecinervis* Meyrick (E)
- calva* Walsingham (H)
- canella* Walsingham (H)
- carbonenotata* Walsingham (H)
- carnea* Walsingham (H)
- centralis* Walsingham (E)
- centronoma* Meyrick (E)
- chilonella chilonella* Walsingham (E)
- chilonella percondita* Walsingham (E)
- chilonella triocellata* Walsingham (E)
- chilonella venosa* Walsingham (E)
- chloraula* Meyrick (E)
- cincta cincta* Walsingham (H)
- cincta adjacens* Walsingham (H)

*cinerosparsa* Walsingham (H)  
*commensella* Walsingham (H)  
*conditella* Walsingham (H)  
*continuella* Walsingham (H)  
*corvina* (Butler) Walsingham (H)  
*costimaculata* Walsingham (H)  
*crossotis* Meyrick (H)  
*cupreomaculata* Walsingham (H)  
*discella* Walsingham (H)  
*discolor* Walsingham (E)  
*divisa* Walsingham (H)  
*domicolens domicolens* (Butler) Walsingham (H)  
*domicolens suffusa* Walsingham (H)  
*dorsella* Walsingham (E)  
*emendata* Walsingham (E)  
*empedota* Meyrick (H)  
*endryas* Meyrick (H)  
*enixa* Walsingham (E)  
*ensifer* Walsingham (E)  
*epicharis* Walsingham (E)  
*erismatias* Meyrick (E)  
*evanescens* Walsingham (H)  
*exornata exornata* Walsingham (E)  
*exornata flavicosta* Walsingham (E)  
*fallacella* Walsingham (H)  
*falsimella* Walsingham (E)  
*ferricolor* Walsingham (H)  
*fervida* Walsingham (H)  
*filicivora* Meyrick (H)  
*fractinubella* Walsingham (H)  
*fractistriata* Walsingham (H)  
*fractivittella* Walsingham (E)  
*fulvida* Walsingham (E)  
*fulvocervina* Walsingham (E)  
*fuscopurpurea* Walsingham (H)  
*fuscotogata* Walsingham (H)  
*geminella* Walsingham (H)  
*genitalis* Walsingham (H)  
*haleakalae* (Butler) Walsingham (H)  
*hemicasis* Meyrick (H)  
*humero vittella* Walsingham (H)  
*hygroscopa* Meyrick (H)  
*illuminata* Walsingham (H)  
*impunctata* Walsingham (H)  
*indicella* Walsingham (H)  
*inflexa* Walsingham (E)  
*insinuatix* Meyrick (E)

*intermixta* Walsingham (H)  
*inversella* Walsingham (H)  
*iodes* Walsingham (H)  
*irregularis* Walsingham (H)  
*jugifera* Meyrick (E)  
*lacertella* Walsingham (H)  
*lactea* Walsingham (H)  
*lacticretella* Walsingham (H)  
*latiflua* Meyrick (E)  
*lebetella* Walsingham (H)  
*leporella* Walsingham (H)  
*limata* Walsingham (E)  
*lineata* Walsingham (H)  
*liturata* Walsingham (H)  
*lixiviella* Walsingham (H)  
*longitudinalis* Walsingham (E)  
*lucifer* Walsingham (H)  
*ludificata* Walsingham (H)  
*lugens* Walsingham (E)  
*lunifer* Walsingham (E)  
*lupella lupella* Walsingham (H)  
*lupella candidella* Walsingham (H)  
*lupella suffusella* Walsingham (H)  
*maestella* Walsingham (E)  
*malacopa* Meyrick (E)  
*malornata* Walsingham (H)  
*marginenotata* Walsingham (H)  
*mediella* Walsingham (H)  
*mediospurcata* Walsingham (H)  
*mesorectis* Meyrick (H)  
*metallica* Walsingham (H)  
*metrosiderella* Walsingham (H)  
*mimema* Walsingham (H)  
*mimica* Walsingham (H)  
*modesta* Walsingham (H)  
*montivolans* (Butler) Walsingham (H)  
*mystodoxa* Meyrick (E)  
*nebulifera* Walsingham (H)  
*nephelodes* Walsingham (H)  
*niger* Walsingham (H)  
*nigralbida* Walsingham (H)  
*nigrescens* Walsingham (H)  
*nigrodentata* Walsingham (E)  
*nipholoncha* Walsingham (E)  
*niveiceps* Walsingham (E)  
*nividorcella* Walsingham (H)  
*notabilis* Walsingham (H)



*numida* Walsingham (H)  
*obliterata* Walsingham (E)  
*obscura* Walsingham (E)  
*ocellata* Walsingham (E)  
*ochreocervina* Walsingham (H)  
*ochreociliata* Walsingham (H)  
*ochreovittella* Walsingham (E)  
*oculifera* Walsingham (E)  
*ossea* Walsingham (E)  
*oxypetra* Meyrick (H)  
*pallidipalpis* Walsingham (E)  
*palmivora* Meyrick (E)  
*paradoxa* Walsingham (H)  
*parda* (Butler) Walsingham (H)  
*partita* Walsingham (H)  
*patriciella* Walsingham (H)  
*persimilis* Walsingham (H)  
*petroscia* Meyrick (H)  
*phalacra* Walsingham (H)  
*phantasmatella* Walsingham (E)  
*pharsotoma* Meyrick (H)  
*picticornis* Walsingham (H)  
*progressa* Walsingham (H)  
*prophantis* Meyrick (H)  
*propinqua* Walsingham (H)  
*pseudolita* Walsingham (H)  
*pucciniella* Walsingham (E)  
*punctifumella* Walsingham (E)  
*punctiplicata* Walsingham (H)  
*quadripunctata* Walsingham (E)  
*quadristriata* Walsingham (E)  
*quinquemaculata* Walsingham (H)  
*radiatella* Walsingham (E)  
*rhabdophora* Walsingham (H)  
*roseofulva* Walsingham (E)  
*rubescens* Walsingham (H)  
*rusius* Walsingham (E)  
*sabulella* Walsingham (H)  
*saccophora* Walsingham (H)  
*saliaris* Walsingham (H)  
*scandens* Walsingham (E)  
*scepticella* *scepticella* Walsingham (E)  
*scepticella dubia* Walsingham (now a synonym of *scepticella*)  
*schismatica* Walsingham (H)  
*scolopax* Walsingham (H)  
*semifuscata* Walsingham (E)  
*sideritis* Walsingham (H)  
*similis* Walsingham (H)

*somatodes* Walsingham (H)  
*stigmatella* Walsingham (E)  
*straminella* Walsingham (H)  
*subargentea* Walsingham (E)  
*subcitrella* Walsingham (H)  
*subflavidella* Walsingham (H)  
*sublimata* Walsingham (E)  
*subnitida* Walsingham (E)  
*subscolopax* Walsingham (H)  
*subsericea* Walsingham (E)  
*sudorella* Walsingham (E)  
*syrrhaptēs* Walsingham (H)  
*tarsimaculata* Walsingham (H)  
*tenuipalpis* Walsingham (H)  
*tetraonella* Walsingham (H)  
*thermoxyla* Meyrick (E)  
*thiatma* Meyrick (H)  
*thoracella* Walsingham (H)  
*tomentosa* Walsingham (H)  
*torella* Walsingham (H)  
*torquata* Walsingham (H)  
*tricincta* Walsingham (E)  
*trilunella* Walsingham (E)  
*trimaculata* Walsingham (H)  
*trimelanota* Meyrick (H)  
*tripartita* Walsingham (H)  
*triptila* Meyrick (H)  
*trossulella* Walsingham (H)  
*turdella* Walsingham (H)  
*unistriata* Walsingham (H)  
*vermiculata* Walsingham (H)  
*vicina* Walsingham (E)  
*vinicolor* Walsingham (H)  
*virgata* Walsingham (H)

*Neelysia* Walsingham, 35 species.

*agnetella* Walsingham (E)  
*alveata* Meyrick (H)  
*anthinella* Walsingham (E)  
*argyresthiella* Walsingham (E)  
*basivittata* Walsingham (E)  
*cleodorella* Walsingham (E)  
*complanella* Walsingham (E)  
*cuprea* Walsingham (E)  
*erebogramma* Meyrick (E)  
*exaltata* Walsingham (E)  
*fuscodentata* Walsingham (E)  
*fuscofusa* Walsingham (E)

*incongrua* Walsingham (E)  
*lignicolor* Walsingham (E)  
*mactella* Walsingham (E)  
*mormopica* Meyrick (E)  
*municeps* Walsingham (E)  
*nemoricola* Walsingham (E)  
*ningorella* Walsingham (E)  
*ningorifera* Walsingham (E)  
*palmifera* Meyrick (E)  
*paltodorella* Walsingham (E)  
*petalifera* Walsingham (E)  
*pluviella* Walsingham (E)  
*poeciloceras* Walsingham (E)  
*psaroderma* Walsingham (E)  
*rediviva* Walsingham (E)  
*repandella* Walsingham (E)  
*rotifer* Walsingham (E)  
*sciurella* Walsingham (E)  
*semifusa* Walsingham (H)  
*subaurata* Walsingham (E)  
*terminella* Walsingham (E)  
*tigrina* (Butler) Walsingham (E)  
*tischeriella* Walsingham (E)

*Petrochroa* Busck, 7 species.

*communis* Swezey (H)  
*dimorpha* Busck (now in *Asymphorodes*)  
*elegantula* Swezey (H)  
*neckerensis* Swezey (H)  
*nigrella* Swezey (now a synonym of *longisquamella*) (H)  
*swezeyi* Busck (H)  
*trifasciata* Swezey (H)

*Phthoraula* Meyrick, 1 species.

*homopyrrha* Meyrick (E)

*Rhinomactrum* Walsingham, 2 species.

*rutilellum* Walsingham (E)  
*scapulellum* Walsingham (H)

*Semnoprepia* Walsingham, 7 species.

*coprosmae* Swezey (E)  
*ferruginea* Swezey (E)  
*fulvogrisea* Walsingham (E)  
*fuscopurpurea* Swezey (now *fuscopurpurata*) (E)  
*margella* Walsingham (E)  
*petroptilota* Walsingham (E)  
*pittospori* Swezey (E)

## DISTRIBUTION OF HYPOSMOCOMA SPECIES

We may state at the beginning that we know little about the distribution of most species of *Hypsmocoma*. No collections have been made from vast areas of the islands. (See the discussion on p. 1147 where I have listed the few localities from which the type specimens were collected). Many records of species which are supposed to inhabit two or more islands or different localities on one island are in error. I have found as many as seven or eight different species from different localities confused under one specific name. It is possible, also, that some species which are not limited to single islands are listed by different names on different islands, but, if this is true, the number is not great. Distribution ranges from species which are restricted to very small areas on single islands to those which range widely over the main islands. Most species are restricted to single islands, and many species are confined to very small areas on single mountain masses. It is probable that some species occupy such limited areas that their ranges can be expressed in hectares rather than in square kilometers.

Species of *Hypsmocoma* are found from the sea shores, across the lowlands, through the lower and upper forests to above the tree line in the high mountains. Species are found from desert areas to the densest rain forests, from hot lowlands to cold highlands. A few species maintain themselves in the drastically altered environments of cities and in plantation fields. I am not aware of any area that supports plant life in Hawaii where at least a few *Hypsmocoma* may not be found. Of course, the lowlands, and other vast areas of the islands, which have been changed so violently from their original conditions by man, his cultivations, his fires, his destructions, and by the plants and animals he has introduced, now support only a small fraction of the species which once existed there. The area now occupied by diverse and thriving complexes of *Hypsmocoma* is now much less than half of what it was before man destroyed so much of the native ecosystem.

*Hypsmocoma* is one of the marvels of creation. How sad it is to reflect upon what we have exterminated. What we have lost we shall never know. How fortunate we are that the foresight of British institutions, and the devotion, diligence, and perseverance of R. C. L. Perkins rescued representatives of a large number of these wonderful creatures for posterity. How unfortunate it is that for many years administrators of various Hawaiian institutions never realized fully what was, and is, being lost before their eyes. They have not appreciated how future generations will regret that they have not properly carried out their duties to collect, to study, and to preserve examples and information—some of which may still be obtained—of these and other marvellous products of Hawaii. They continue to neglect their Hawaiian heritage and to ignore those who are to follow.

This discussion of distribution may be divided into two parts: (I) the Leeward Islands northwest of Kauai, which are now really only the "grave-stones" of once extensive, high, forested islands, and (II) the main islands from Kauai and Niihau to Hawaii, where active volcanism continues today.

## I. HYPOSMOCOMA OF THE LEEWARD HAWAIIAN ISLANDS

The Leeward Islands, which are islets and reefs, have been inadequately explored, and only a few naturalists have set foot on any of them except Midway. The first collections of any consequence were made during the Tanager Expedition of 1923 (Bryan, 1926). Most of the specimens were collected by E. H. Bryan, Jr., but a few were taken by Ball. Most of the specimens returned to Bishop Museum in such poor condition, because of lack of care in collecting and because of abrasion and mashing, that they were mostly inadequate for determination and description by Dr. Swezey. However, from the specimens collected, Dr. Swezey recorded several *Hyposmocoma*, and he described one as new (as a *Petrochroa*). He identified three species as being the same as species that occur on the main islands, but his determinations were erroneous. In 1964, J. W. Beardsley collected specimens of three of the species from Nihoa and Necker Islands.

To my knowledge, the only records we have of *Hyposmocoma* from the Leeward Islands are from Nihoa, Necker, Gardner, and Laysan. I have not had the time nor the opportunity to study all of the material, and I cannot discuss the Leeward Island species with much authority. My preliminary, fragmentary notes on the species follow.

### ***Hyposmocoma neckerensis*** (Swezey).

Necker: "3 specimens collected on rocks." Gardner: "1 specimen."

"The specimens are too much abraded for proper description." (Swezey, 1926b:78.) Do all four specimens belong to the same species? See further details on p. 1412.

### ***Hyposmocoma malornata*** Walsingham.

*Hyposmocoma quinque maculata*, as a misidentification by Swezey, 1926b:76.

Nihoa: "11 poor specimens collected at lights." Necker: "29 poor specimens." (Swezey, 1926:76.)

I have examined one of the above-mentioned specimens from Nihoa and one from Necker, and they are *malornata* and obviously not *quinque maculata* which is known only from Kona, Hawaii. Additional specimens were collected by J. W. Beardsley on Nihoa and Necker during September, 1964. I cannot distinguish this material from specimens of *malornata* from the lowlands of Oahu. See the illustrations of the genitalia.

### ***Hyposmocoma***, Leeward Island species 3 (new species 23).

Nihoa. J. W. Beardsley collected representatives of an apparently new species at light during September, 1964. The left male genital valva has two very large, extraordinary, squamiform, subapical spurs and an even larger squamiform spur arises from a very strong, flangelike protuberance from about the middle of the dorsal margin of the left valva. The right valva bears three stout spurs. The right anellar lobe is longer than the left; usually the left one is longest. The male abdomen has a strong pseuduncus, and the male has a pale subcostal brush on the hindwing. See figure 1131 for an illustration of the male genitalia.

**Hyposmocoma**, Leeward Island species 4 (new species 28).

*Hyposmocoma mimica*, as a misidentification by Swezey, 1926b:76.

Nihoa, Necker ("36 poor specimens, some collected on rocks and some at lights." Swezey, 1926b:76).

I have examined the male genitalia of one of the above-mentioned examples identified by Swezey, and they are obviously distinct from *mimica* which is known only from the mountains of Molokai. This species was also collected at lights on both Nihoa and Necker during September, 1964, by J. W. Beardsley. It appears to belong to the *saccophora* group, and it lacks a subcostal brush on the hindwing of the male. See figure 1167 for the male genitalia.

**Hyposmocoma**, Leeward Island species 5.

*Hyposmocoma arenella*, as a misidentification by Swezey, 1926b:75.

Nihoa: "4 poor specimens collected at lights." (Swezey, 1926b:75.) These specimens do not belong to *arenella* Walsingham, which is known only from Kona, Hawaii.

In addition to the above species, Swezey (1926b:76) listed a "*Hyposmocoma* sp." from "Nihoa Island, June 11-14, 1923 (Bryan): 14 poor specimens collected at lights. Necker Island, June 20, 1923 (Bryan): 8 poor specimens collected at lights. These specimens represent a different species from the others, but they are too imperfect for determination or description." He also listed two species from "Gardner Rock, May 22, 1923 (Ball): 3 specimens of one species and one of another, too much abraded for determination." I have not studied these specimens. They may or may not include the five species listed above. If they do not represent the same species, then they are Leeward Island species 6, 7, and 8.

In addition to the above-mentioned species, Fullaway (1914b:20) erroneously listed *Hyposmocoma notabilis* Walsingham, a species described from Molokai, as occurring on Laysan. He based his record on a single larval case! In addition to the records based upon *moths* from the Leeward Islands, Dr. Swezey (1926b:76) reported that "several kinds of larval cases were collected in different places and situations. Undoubtedly they belong to the species enumerated, but it is hardly possible to associate them properly. At least three kinds of these cases were found on Nihoa Island; two kinds on Necker Island; one similar to *H. notabilis* quite numerous on Laysan Island, April 25, 1923 (Ball). One kind (thorn-shaped) attached to under surface of rocks by hundreds, Gardner Rock, May 22, 1923 (Ball)."

The foregoing details demonstrate that a number of species of *Hyposmocoma* live on the remnants of the Leeward Islands and that we are mostly ignorant of the fauna. What awaits the careful collector there?

## II. HYPOSMOCOMA OF THE MAIN ISLANDS

Below are listed the species of *Hyposmocoma* according to their supposed distributions on the islands from Kauai to Hawaii. I have listed the species in the so-called "genera" in which they were described, and the "genera" are arranged in alphabetical order for convenience of reference. (I have not included the meaningless "*Elachista*" in which Walsingham incorrectly

included *Hyposmocoma longisquamella*.) The species are arranged according to the Walsingham-Meyrick-Swezey system to allow them to be studied according to their groupings into so-called "genera". I have found nothing significant in the recorded distribution of the supposed groups to support the contentions that they are genera.

For the purpose of study and discussion only, if we assume that we cannot now be positive of any of the distribution records except the type locality of each form, and thus *to tabulate the described species according to their type localities only*, the following table results:

GROUP	Kauai	Oahu	Molokai	Maui	Lanai	Hawaii	Totals
<i>Agonismus</i>					1	2	3
<i>Aphthonetus</i>	12	3	2	11	1	3	32
<i>Bubaloceras</i>	1		1				2
<i>Diplosara</i>		1					1
<i>Dysphoria</i>	1						1
<i>Euhyposmocoma</i>	1	1					2
<i>Euperissus</i>		1	1				2
<i>Hyperdasyella</i>	2	1	1			1	5
<i>Hyposmocoma</i>	53	42	38	38	2	41	214
<i>Neelysia</i>	8	6	6	11	1	3	35
<i>Petrochroa</i>		3				2	5
<i>Phthoraula</i>		1					1
<i>Rhinomactrum</i>	1					1	2
<i>Semnoprepia</i>	1	4				2	7
Totals	80	63	49	60	5	55	312

Table showing the distribution of the *described* Main Island species of *Hyposmocoma* according to type localities only and using the original "generic" name assignments.

The table will be misleading unless it is used with caution and with the understanding that *it is based upon type localities only* and that it does not take into consideration distributions outside the islands where the types were found. It is based upon incomplete records and not upon true situations in nature. Much of what it may appear to indicate is erroneous. For example, only one species of *Diplosara* from Oahu appears in the table, but *Diplosara* represents a species cluster which is widely distributed in the islands and its other forms remain undescribed. If *Euperissus*, *Hyperdasyella*, and *Semnopropeia* were united, it would be more significant, as would be the merging of the smaller "genera" under *Hypsmocoma*. But, if merging begins, it cannot logically be stopped until all of the groups are merged with *Hypsmocoma*.

The table is restricted to type localities and does not include the records of the species which occur on two or more islands. The total number of forms, narrow endemics plus widespread forms, recorded from each island (and tabulated under each island in the lists which follow), plus 34 new species recorded in the main text are: Kauai, 101; Oahu, 81; Molokai, 63; Maui, 70; Lanai, 11; Hawaii, 69. These figures will be greatly increased as more material is studied, and they surely represent only a substantial fraction of the existing species.

Kauai (555 square miles; maximum elevation 5,170 feet) has the richest known fauna, and this reflects its great age and isolation—73 miles from Oahu. Many other groups of insects have a particularly rich fauna on Kauai.

Oahu (604 square miles; elevation 4,025 feet) has a larger proportion of its species recorded than do the other islands because much more collecting has been done on Oahu. The number of recorded species on Oahu has been doubled since the publication of *Fauna Hawaiiensis* in 1907, thanks to the efforts of Dr. Swezey.

Molokai (260 square miles; elevation 4,970 feet) has little more than one-third the area of Maui, it is less than one-half as high as Maui, its remaining forest area is very much smaller than that of Maui, and comparatively little collecting has been done there since Perkins' survey. Yet there are 48 species whose type localities are on Molokai compared with 62 for the large island of Maui, and the total number of recorded species from Molokai is 63 compared with 70 from Maui. Many wonderful species remain to be described from Molokai.

Maui (728 square miles; elevation 10,025 feet) surely is much richer in species than the total of 62 whose types come from Maui would indicate. I do not recall seeing any record of a *Hypsmocoma* from West Maui, which by itself is almost a separate, high, extensively forested island with a rich flora. This is an astonishing fact. West Maui is in many ways a distinctive region, and we can accept that many unusual species of *Hypsmocoma* have developed there.

The table shows only five species with Lanai (141 square miles; elevation 3,370 feet) as the type locality. This is because of three things: (1) the great deforestation and consequent reduction of the fauna of Lanai, (2) its comparatively small size, and (3) inadequate collecting on the island.

Hawaii (elevation 13,784 feet) is nearly twice as large as all the other main islands combined (4,030:2,405 square miles), but it is the type locality of



only 55 species. A total of 69 species has been recorded from it. This reflects its youth and the inadequate collecting that has been done there.

No species have been described from Niihau (72 square miles; elevation 1,281 feet) or from Kahoolawe (45 square miles; elevation 1,415 feet) because of lack of collecting and deforestation. Whatever endemic insect faunas those small islands had were mostly exterminated long ago by the influence of man.

The table above shows a distorted and inaccurate picture of the true distribution and development of *Hyposmocoma*. Careful surveys of the genus over vast areas of the islands remain to be done. But, because of deforestation, predation, parasitism, and extermination, it is unfortunately too late to obtain much information that could have been obtained by earlier study. Each year that passes without intensive field studies exacerbates the sad situation. It is obvious that large numbers of unknown species remain to be discovered. When one reflects upon the fact that the number of species recorded from the better-known island of Oahu has doubled since the great Perkins' surveys, it becomes obvious how little we really know about the fauna and how much collecting remains to be done on all the islands. Since the publication of *Fauna Hawaiiensis* in 1907, the following numbers of described new species of *Hyposmocoma* have been added to the faunal lists: Necker, 1; Kauai, 6; Oahu, 38; Molokai, 1; Maui, 3; Lanai, 0; and Hawaii, 3—a total of 52 species. The largest number of new species has been described from Oahu because Honolulu is on that island, and most collecting is done on Oahu. This is mostly a reflection of the weekend field work of Dr. Swezey. These figures demonstrate how little attention has been given this great group during a period of about 75 years since Dr. Perkins completed his remarkable field surveys.

The floras and faunas of the lowlands and drier parts of the islands were decimated and drastically altered by the activities of man and by organisms purposely or accidentally introduced by man long before any biological surveys of those areas had been made. Hence, we know almost nothing of the original lowland endemic insect faunas which undoubtedly were rich ones. The numbers of endemic species exterminated since man arrived in Hawaii is very large, but we have no way of estimating what has been lost. It is a well-documented fact that many of the drier areas of Hawaii were occupied by the greatest diversity of endemic trees, and no doubt there were associated rich and diversified floras of shrubs and herbs. We know that most of the endemic plants had species of *Hyposmocoma* associated with them, and we can now only wonder how many species and what kinds of lowland and dryland *Hyposmocoma* have become extinct. When the flora is exterminated the fauna is exterminated.

My friend Harold St. John has interested himself in the nearly extinct lowland flora, and he has recently (1969) monographed the Hawaiian species of the genus *Gouania* (Rhamnaceae) whose members favored the Hawaiian lowlands. They have been almost totally exterminated. St. John said (1969: 508) that

The Hawaiian species of *Gouania* are native to the dryland scrub or the lower dry forest zone. This is the region most drastically affected by human settlement and by the eating and trampling by introduced grazing animals. The vegetation of these lowlands was largely destroyed before it was observed or collected by scientists. The result of the same wholesale destruction was observed by the writer in his revision of the

Hawaiian species of *Isodendron* (1952, p. 216). Most of the recent Hawaiian botanists have never found a living specimen of *Gouania*, and of the 14 [known] species only 3 have been found and collected since 1886. . . .

Like *Isodendron*, this genus *Gouania* evidences what has happened to the native flora of the dry lowland regions; it has suffered an almost complete extinction. How many other native plants of the lowland region were exterminated before they were collected and recognized, we cannot even guess.

In his monograph of the violaceous genus of shrubs *Isodendron* (1952), Professor St. John noted that the Hawaiian lowlands were overrun by cattle soon after 1782. He said that as a result the majority of the 14 known species of *Isodendron* are extinct and that two-thirds of the species have not been collected since 1871. *Isodendron* species were also members of that lowland flora. Surely, the extinct *Gouania* and *Isodendron* had an associated fauna of endemic moths, but I have no record of either of these plant genera as a host of any Hawaiian moth.

I have made a brief survey of the localities, as listed by the collectors, from which the types of the species of *Hypasmocoma* were obtained, and it is astonishing to me to learn that the species have been collected from so very few localities. In spite of the fact that more than 350 species of this great genus have been collected (but not all of these are described), most of Hawaii remains *terra incognita* in so far as *Hypasmocoma* is concerned. With the exception of one Leeward Island species collected by E. H. Bryan, Jr., and three main island species taken by J. C. Bridwell, the species have, astonishingly, been named from the collections of only three persons: Blackburn, Perkins, and Swezey. We cannot guess what kinds of remarkable forms remain to be discovered or have recently been exterminated. How little we really know!

The types of *Hypasmocoma* were collected in the following localities:

Necker Island.

Kauai (most collecting has been done in what is known today as the Kokee region and its nearby surroundings):

Mountains, 3,000 to 4,000 feet (probably meaning the Waimea District, or western Kauai).

Halemanu, 4,000 feet.

Halemanu and Kaholuamano, 4,000 feet.

Kaholuamano, 4,000 feet.

Kumuwela.

Summit Camp.

Behind Lihue, 4,000 feet.

Near head of Grove Farm Ditch.

Oahu:

Waianae Mountains, 1,700 feet, 2,000 to 3,000 feet.

Mt. Kaala.

Koolau Mountains.

Koolau Mountains near Honolulu.

Mt. Tantalus.

Honolulu.

Nuuanu.

Palolo.

Kaimuki.  
Koko Head.  
Pauoa Flats.  
Mt. Olympus.  
Konahuanui.  
Malamalama, Konahuanui.  
Ridge above Peahinaia.  
Halawa Valley.  
Kawaihapai, 3,000 feet.  
Kuliouou.  
Punaluu.  
Kahuku.  
Head of Kawailoa Gulch.

Molokai:

Various localities between 3,000 and 4,500 feet.  
Forest above Pelekunu.  
Kainalu, 2,000 to 3,000 feet.

Maui:

Makawao, about 2,000 feet.  
Olinda.  
Olinda, 4,000 feet.  
Haleakala, various places between 4,000 feet and 7,000 feet.

Lanai:

2,000 to 3,000 feet.

Hawaii:

Hilo, 2,000 feet.  
Olaa.  
Kilauea.  
Laupahoehoe.  
Kona, various stations between 2,000 feet and 4,000 feet.  
Kaawaloa, Kona, above 2,000 feet.  
Hualalai, 5,000 feet.

It should be of assistance to future workers if lists of the species of *Hyposmoma* are given according to their distributions island by island. These lists may assist in identification and in working with local faunas, but it must be remembered that the lists are incomplete and are based upon tentative and fragmentary information. In the following lists, I have retained the Walsingham system of arrangement for purposes of interest and study. Where no other island name or names follow the species names, the species in question are recorded only from the one island under which they are listed. I have indicated the type island where it is different from that of the island heading each list. Thus, under Kauai, immediately below, *Aphthonetus diffusa* is recorded with uncertainty from Kauai, and it is known elsewhere from its type island of Maui.

**HYPOSMOCOMA OF KAUAI** (101 species)*Aphthonetus albocinerea* Walsingham*diffusa* Walsingham?, Maui (type)*fluctuosa* Walsingham*fugitiva* Walsingham*hirsuta* Walsingham*kauaiensis* Walsingham*passerella* Walsingham*plumbifer* Walsingham*polia* Walsingham*prae fracta* Meyrick*sagittata* Walsingham*trichophora* Walsingham*veterella* Walsingham*Bubaloceras pritchardiae* Swezey*Dysphoria semicolon* Walsingham*Euhypsmocoma trivitella* Swezey*Hyperdasyella arundinicolor* (Walsingham) Fletcher*cryptogamiella* (Walsingham) Fletcher, Oahu, Molokai, Lanai, Hawaii (type)*semiusta* (Walsingham) Fletcher, Oahu*unicolor* (Walsingham) Fletcher?, Oahu, Molokai (type)*Hypsmocoma adjacens* Walsingham*bacillella* Walsingham*bella* Walsingham*brevistrigata* Walsingham*canella* Walsingham, Oahu, Molokai (type), Hawaii*carbonenotata* Walsingham*carnea* Walsingham*centralis* Walsingham*chilonella chilonella* Walsingham, Oahu, Maui, Hawaii*chilonella percondita* Walsingham, Hawaii (type)*chilonella triocellata* Walsingham, Oahu, Molokai (type), Hawaii*chilonella venosa* Walsingham*chloraula* Meyrick*cincta* Walsingham*cinereosparsa* Walsingham*conditella* Walsingham*discella* Walsingham*divisa* Walsingham*enixa* Walsingham*fallacella* Walsingham*fractivittella* Walsingham*fulvida* Walsingham, Molokai (type)*fulvocervina* Walsingham

*geminella* Walsingham  
*hygroscopa* Meyrick  
*irregularis* Walsingham  
*lactea* Walsingham  
*leporella* Walsingham  
*lixiviella* Walsingham  
*lupella* Walsingham  
*maestella* Walsingham  
*malornata* Walsingham, Oahu, Molokai, Maui (type), Hawaii, Nihoa,  
 Necker  
*marginenotata* Walsingham  
*metrosiderella* Walsingham  
*modesta* Walsingham  
*nigralbida* Walsingham  
*nigrodentata* Walsingham  
*nividorcella* Walsingham  
*obliterata* Walsingham  
*ocellata* Walsingham  
*oculifera* Walsingham  
*palmivora* Meyrick  
*paradoxa* Walsingham  
*phalacra* Walsingham  
*phantasmata* Walsingham  
*quadripunctata* Walsingham  
*radiatella* Walsingham, Oahu, Molokai, Hawaii (type)  
*roseofulva* Walsingham  
*rubescens* Walsingham  
*sabulella* Walsingham  
*scandens* Walsingham  
*schismatica* Walsingham  
*scolopax* Walsingham  
*subargentea* Walsingham  
*subcitrella* Walsingham  
*subsericea* Walsingham?, Molokai (type), Lanai?  
*sudorella* Walsingham  
*syrrhaptus* Walsingham  
*tarsimaculata* Walsingham  
*torquata* Walsingham  
 new species 1, 2, 3, 8, 15, 19, 22, 26, 29

*Neelysia argyresthiella* Walsingham, Oahu, Molokai, Hawaii (type)

*cuprea* Walsingham  
*fuscifusa* Walsingham  
*mactella* Walsingham  
*municeps* Walsingham  
*paltodorella* Walsingham  
*rediviva* Walsingham  
*subaurata* Walsingham  
*tischeriella* Walsingham

*Rhinomactrum rutilellum* Walsingham

*Semnoprepia fulvogrisea* Walsingham

*petroptilota* Walsingham, Oahu, Maui, Hawaii (type)

**HYPOSMOCOMA OF OAHU** (81 species)

It is noteworthy that in *Fauna Hawaiiensis* Walsingham listed only 36 species from Oahu. The number of Oahu species has been more than doubled, mostly because of collecting by Dr. Swezey. It must be admitted, however, that there never has been an adequate survey made of the moths of Oahu—or of any Hawaiian island. One can only wonder what would result from extensive field surveys and the use of modern equipment such as ultraviolet lights and patient, careful collecting.

*Aphthonetus aspersa* (Butler) Walsingham

*empetra* Meyrick

*sideroxyloni* Swezey

*Diplosara lignivora* (Butler) Meyrick

*Euhyposmocoma ekaha* (Swezey) Swezey

*Euperissus cristatus* Butler, Molokai, Hawaii

*Hyperdasyella cryptogamiella* (Walsingham) Fletcher, Kauai, Molokai, Lanai, Hawaii (type)

*philocharis* (Meyrick) Fletcher

*semiusta* (Walsingham) Fletcher, Kauai (type)

*unicolor* (Walsingham) Fletcher?, Kauai?, Molokai (type)

*Hyposmocoma abjecta* (Butler) Walsingham

*albonivea* Walsingham

*alliterata* Walsingham, Molokai (type), Maui, Hawaii

*alticola* Meyrick

*anisoplecta* Meyrick

*auropurpurea* Walsingham

*belophora* Walsingham

*bilineata* Walsingham

*caecinervis* Meyrick

*canella* Walsingham, Kauai, Molokai (type), Hawaii

*centronoma* Meyrick

*chilonella chilonella* Walsingham, Kauai (type)

*chilonella triocellata* Walsingham, Kauai, Molokai (type), Hawaii

*crossotis* Meyrick

*dorsella* Walsingham

*empedota* Meyrick

*endryas* Meyrick

*erismatias* Meyrick

*filicivora* Meyrick

*fractistriata* Walsingham

*hemicasis* Meyrick

- humerovittella* Walsingham  
*inversella* Walsingham  
*jugifera* Meyrick  
*latiflua* Meyrick  
*malacopa* Meyrick  
*mediella* Walsingham  
*mesorectis* Meyrick  
*montivolans* (Butler) Walsingham  
*mystodoxa* Meyrick  
*nebulifera* Walsingham  
*nephelodes* Walsingham, Maui?  
*nipholoncha* Meyrick  
*ochreocervina* Walsingham  
*oxypetra* Meyrick  
*petroschia* Meyrick  
*pharsotoma* Meyrick  
*prophantis* Meyrick  
*pseudolita* Walsingham, Molokai, Hawaii  
*radiatella* Walsingham, Kauai, Molokai, Hawaii (type)  
*saccophora* Walsingham  
*thermoxyla* Meyrick  
*trimaculata* Walsingham  
*triptila* Meyrick  
*trossulella* Walsingham  
*vicina* Walsingham  
*vinicolor* Walsingham  
new species 4, 5, 11, 14, 20, 30, 31, 32
- Neelysia alveata* Meyrick  
*argyresthiella* Walsingham, Kauai, Molokai, Hawaii (type)  
*erebogramma* Meyrick  
*lignicolor* Walsingham  
*mormopica* Meyrick  
*palmifera* Meyrick, Hawaii  
*psaroderma* Walsingham
- Petrochroa communis* Swezey, Kauai  
*elegantula* Swezey  
*swezeyi* Busck
- Phthoraula homopyrrha* Meyrick
- Semnoprepia coprosmae* Swezey  
*ferruginea* Swezey  
*fuscopurpurata* Zimmerman ( = *fuscopurpurea* Swezey)  
*petroptilota* Walsingham, Kauai, Maui, Hawaii (type)  
*pittospori* Swezey

**HYPOSMOCOMA OF MOLOKAI** (63 species)

*Aphthonetus columbella* Walsingham  
*divergens* Walsingham

*Bubaloceras subburneum* Walsingham

*Euperissus cristatus* Butler, Oahu (type), Hawaii

*Hyperdasylella cryptogamiella* (Walsingham) Fletcher, Kauai, Oahu, Lanai,  
 Hawaii (type)  
*unicolor* (Walsingham) Fletcher, Kauai?, Oahu?

*Hyposmocoma admirationis* Walsingham

*advena* Walsingham

*albifrontella* Walsingham

*alliterata* Walsingham, Oahu, Maui, Hawaii

*argentea* Walsingham

*barbata* Walsingham

*canella* Walsingham, Kauai, Oahu, Hawaii

*chilonella triocellata* Walsingham, Kauai, Oahu, Hawaii

*costimaculata* Walsingham

*cupreomaculata* Walsingham

*domicolens* (Butler) Walsingham?, Maui (type), Lanai?, Hawaii?

*epicharis* Walsingham

*fervida* Walsingham

*fulvida* Walsingham, Kauai

*fuscotogata* Walsingham

*insinuatix* Meyrick

*intermixta* Walsingham

*iodes* Walsingham

*lucifer* Walsingham

*malornata* Walsingham, Kauai, Oahu, Maui (type), Hawaii, Nihoa, Necker

*mimica* Walsingham

*niger* Walsingham

*niveiceps* Walsingham, Lanai

*notabilis* Walsingham

*pallidipalpis* Walsingham

*picticornis* Walsingham, Maui

*propinqua* Walsingham

*pseudolita* Walsingham, Oahu (type), Hawaii

*punctiplicata* Walsingham

*quadristriata* Walsingham

*radiatella* Walsingham, Kauai, Oahu, Hawaii (type)

*rhabdophora* Walsingham

*rusius* Walsingham

*scolopax* Walsingham?, Kauai (type)

*stigmatella* Walsingham

*subsericea* Walsingham, Kauai, Lanai

*suffusella* Walsingham, Maui



*tenuipalpis* Walsingham  
*torella* Walsingham  
*tripartita* Walsingham  
*unistriata* Walsingham  
*vermiculata* Walsingham?, Hawaii (type)  
*virgata* Walsingham  
 new species 6, 9, 12, 18, 21, 24, 25

*Neelysia argyresthiella* Walsingham, Kauai, Oahu, Hawaii (type)  
*complanella* Walsingham  
*nemoricola* Walsingham  
*pluviella* Walsingham  
*repandella* Walsingham  
*rotifer* Walsingham  
*semifusa* Walsingham

### **HYPOSMOCOMA OF MAUI (70 species)**

*Agonismus flavipalpis* Walsingham

*Aphthonetus bitincta* Walsingham  
*confusa* Walsingham  
*corticicolor* Walsingham  
*diffusa* Walsingham, Kauai?  
*digressa* Walsingham  
*elegans* Walsingham  
*humerella* Walsingham  
*mediocris* Walsingham  
*nemo* Walsingham  
*spurcata* Walsingham  
*subocellata* Walsingham

*Euperissus catapyrrha* Meyrick

*Hypsmocoma alliterata* Walsingham, Oahu, Molokai (type), Hawaii  
*auripennis* (Butler) Walsingham  
*auroargentea* Walsingham  
*blackburnii* Butler  
*butalidella* Walsingham  
*chilonella chilonella* Walsingham, Kauai (type), Oahu, Hawaii  
*continuella* Walsingham  
*corvina* Walsingham  
*domicolens* Walsingham, Molokai?, Lanai?, Hawaii?  
*emendata* Walsingham  
*evanescens* Walsingham  
*falsimella* Walsingham  
*fractinubella* Walsingham  
*fuscopurpurea* Walsingham  
*genitalis* Walsingham  
*haleakalae* (Butler) Walsingham

*illuminata* Walsingham  
*indicella* Walsingham  
*inflexa* Walsingham  
*lacertella* Walsingham  
*lacticretella* Walsingham  
*lebetella* Walsingham  
*lineata* Walsingham  
*ludificata* Walsingham  
*lugens* Walsingham  
*lunifer* Walsingham  
*malornata* Walsingham, Kauai, Oahu, Molokai, Hawaii, Nihoa, Necker  
*mimema* Walsingham  
*nephelodes* Walsingham?, Oahu (type)  
*numida* Walsingham  
*obscura* Walsingham  
*parda* (Butler) Walsingham, Hawaii  
*patriciella* Walsingham  
*picticornis* Walsingham, Molokai (type)  
*progressa* Walsingham  
*punctifumella* Walsingham  
*scepticella* Walsingham  
*sideritis* Walsingham  
*subflavidella* Walsingham  
*suffusella* Walsingham, Molokai (type)  
*sublimata* Walsingham  
*thiatma* Meyrick  
*trilunella* Walsingham  
 new species 33, 34

*Neelysia agnetella* Walsingham  
*basivittata* Walsingham  
*exaltata* Walsingham  
*incongrua* Walsingham  
*ningorella* Walsingham  
*ningorifera* Walsingham  
*petalifera* Meyrick  
*poeciloceras* Walsingham  
*sciurella* Walsingham  
*terminella* Walsingham  
*tigrina* (Butler) Walsingham

*Semnoprepia petroptilota* Walsingham, Kauai, Oahu, Hawaii (type)

### **HYOSMOCOMA OF LANAI** (11 species)

*Aphthonetus lichenalis* Walsingham

*Hyperdasyella cryptogamiella* (Walsingham) Fletcher, Kauai, Oahu, Molokai, Hawaii (type)

*Hyposmocoma candidella* Walsingham, Kauai, Molokai, Maui, Hawaii (type)  
*domicolens* (Butler) Walsingham?, Molokai?, Maui (type), Hawaii?  
*niveiceps* Walsingham, Molokai  
*subsericea* Walsingham?, Kauai?, Molokai (type)  
*thoracella* Walsingham  
*turdella* Walsingham  
 new species 10, 13

*Neelysia anthinella* Walsingham

### **HYPOSMOCOMA OF HAWAII** (70 species)

*Agonismus argentiferus* Walsingham  
*coruscans* Walsingham

*Aphthonetus eleuthera* Walsingham  
*exsul* Walsingham  
*puncticiliata* Walsingham  
 new species 35

*Euperissus cristatus* Butler, Oahu (type), Molokai

*Hyperdasyella cryptogamiella* (Walsingham) Fletcher, Kauai, Oahu, Molokai, Lanai

*Hyposmocoma adolescens* Walsingham  
*alliterata* Walsingham, Oahu, Molokai (type), Maui  
*arenella* Walsingham  
*argomacha* Meyrick  
*atrovittella* Walsingham  
*calva* Walsingham  
*candidella* Walsingham  
*canella* Walsingham, Kauai, Oahu, Molokai (type)  
*chilonella chilonella* Walsingham, Kauai (type), Oahu, Maui  
*chilonella percondita* Walsingham, Kauai  
*chilonella triocellata* Walsingham, Kauai, Oahu, Molokai (type)  
*commensella* Walsingham  
*discolor* Walsingham  
*domicolens* (Butler) Walsingham?, Molokai?, Maui (type), Lanai?  
*ensifer* Walsingham  
*exornata* Walsingham  
*ferricolor* Walsingham  
*flavicosta* Walsingham  
*impunctata* Walsingham  
*limata* Walsingham  
*liturata* Walsingham, Oahu  
*longitudinalis* Walsingham  
*malornata* Walsingham, Kauai, Oahu, Molokai, Maui (type), Nihoa, Necker  
*mediospurcata* Walsingham  
*metallica* Walsingham

*nigrescens* Walsingham  
*ochreociliata* Walsingham  
*ochreovittella* Walsingham  
*ossea* Walsingham  
*parda* (Butler) Walsingham, Maui (type)  
*partita* Walsingham  
*persimilis* Walsingham  
*pseudolita* Walsingham, Oahu (type), Molokai  
*pucciniella* Walsingham  
*quinquemaculata* Walsingham  
*radiatella* Walsingham, Kauai, Oahu, Molokai  
*saliaris* Walsingham  
*semifuscata* Walsingham  
*similis* Walsingham  
*somatodes* Walsingham  
*straminella* Walsingham  
*subnitida* Walsingham  
*subscolopax* Walsingham  
*suffusa* Walsingham  
*tetraonella* Walsingham  
*tomentosa* Walsingham  
*tricincta* Walsingham  
*trimelanota* Meyrick  
*vermiculata* Walsingham, Molokai?  
 new species 7, 16, 17, 28

*Neelysia argyresthiella* Walsingham, Kauai, Oahu, Molokai  
*cleodorella* Walsingham  
*fuscodentata* Walsingham  
*palmifera* Meyrick?, Oahu (type)

*Petrochroa trifasciata* Swezey  
 ("Elachista") *longisquamella* (Walsingham) ( = *Petrochroa nigrella* Swezey)

*Rhinomactrum scapulellum* Walsingham

*Semnoprepia margella* Walsingham  
*petroptilota* Walsingham, Kauai, Oahu, Maui

### **SOME SUGGESTIONS FOR CONSTRUCTING A KEY TO THE SPECIES OF HYPOSMOCOMA**

No key to any of the species of this great complex has been written. A key can be prepared only after long and tedious study, and such a task is a major project in itself. It is a great personal frustration that I have not been allowed the time to prepare a key to the species of this extraordinary genus. The making of an adequate key will be a most difficult, time-consuming task, but it can be done if the required time and facilities are available.

It would be satisfying if a key could be prepared which would use only external and easily observed characters, but perhaps that is nearly impossible

to accomplish. It probably will be necessary to base a key mostly upon male characters, because it is easier to divide *Hypsmocoma* into groups of species based upon male characters. Unhappily, however, the males of many species are not known. Although groups based upon sexual characters might not all represent definitive subdivisions, such subdivisions would assist greatly the task of determination, and the best key will incorporate characters of the genitalia.

Herewith are some suggestions for key characters which may be found useful when an attempt is made to construct a key to the species of *Hypsmocoma*:  
(Text continued on page 1218.)

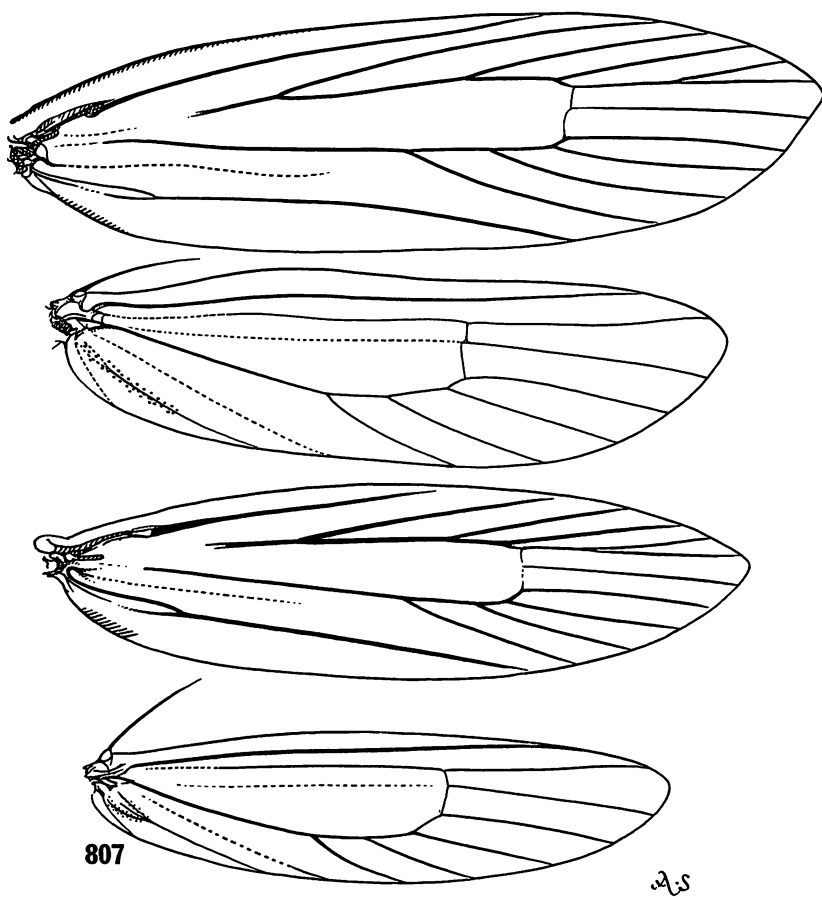


Figure 807—Wing venations of the more generalized types of larger, broad-winged species of *Hypsmocoma* (*Euperissus*). Top, *chilonella chilonella* Walsingham, paratype (BM slide 5438); Kilauea, Hawaii. Bottom, ("Sennoprepia") *petroptilota* (Walsingham), paratype (BM slide 5447). These two species were originally placed in two genera, but, as the illustrations demonstrate, the venations are similar.



Figure 808—Wing venations of a group of *Hyposmocoma* (*Hyposmocoma*) species with modified venations which were originally described in *Petrochroa* (which name is here reduced to a synonym of *Hyposmocoma*). Top, *communis* (Swezey) (BM slide 5432); Honolulu. Middle, *neckerensis* (Swezey), Gardner Island (Bishop Museum slide). Bottom, *elegantula* (Swezey), Barber's Point, Oahu (slide now in the Hawaii State Department of Agriculture.)

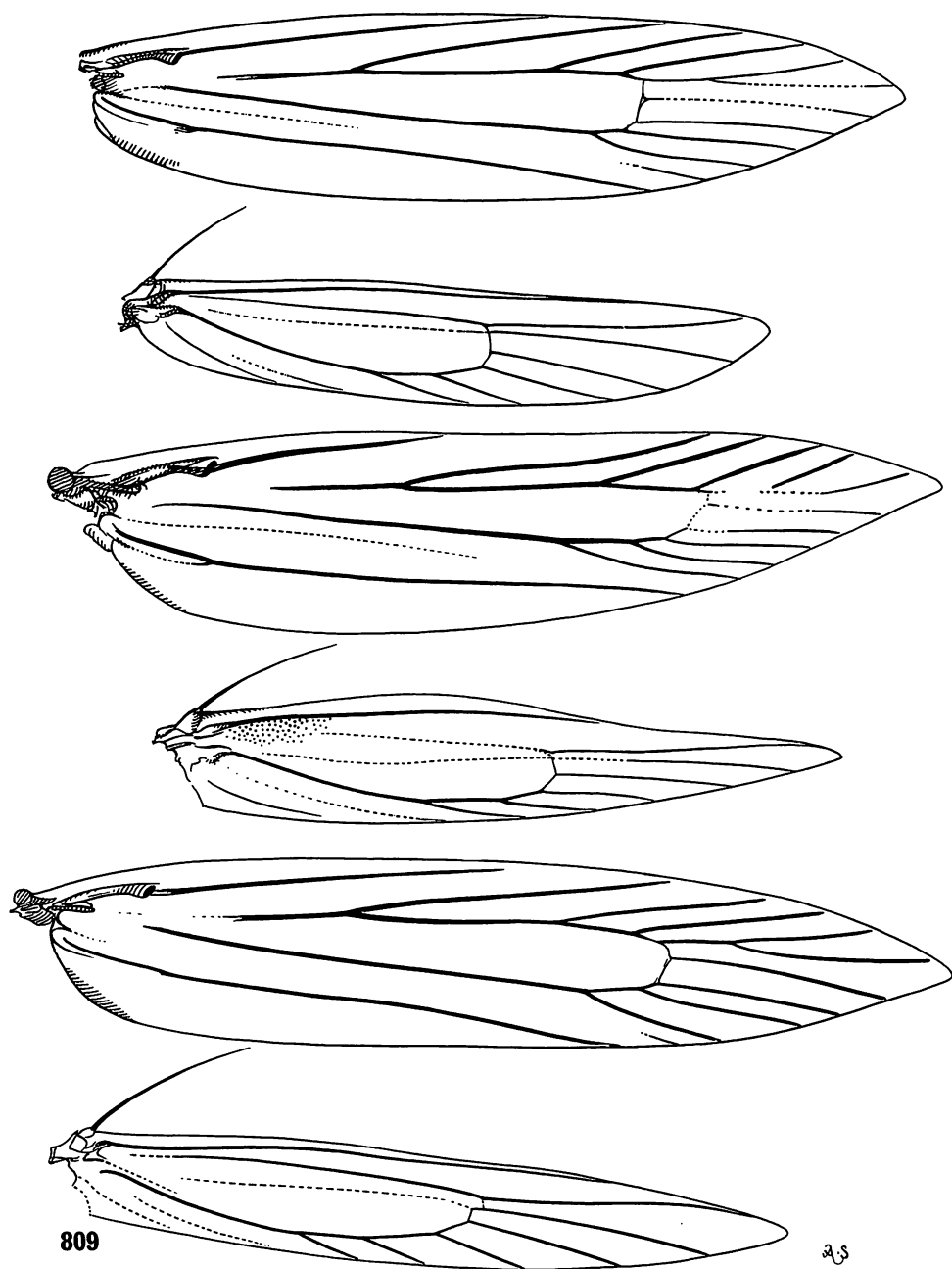


Figure 809—*Hyposmocoma* ("Neelysia"), wing venations. Top, *agnetella* (Walsingham), paratype (BM slide 5444); Haleakala, Maui. Middle, *alveata* (Meyrick), paratype (BM slide 5500); Koolau Mts., Oahu (this species does not belong to the *Neelysia* group—it is a typical *Hyposmocoma*; see the text for discussion). Bottom, *anthinella* (Walsingham), paratype (BM slide 8432); Lanai, 2,000 feet. Note the variable development of vein 2 in the forewings.

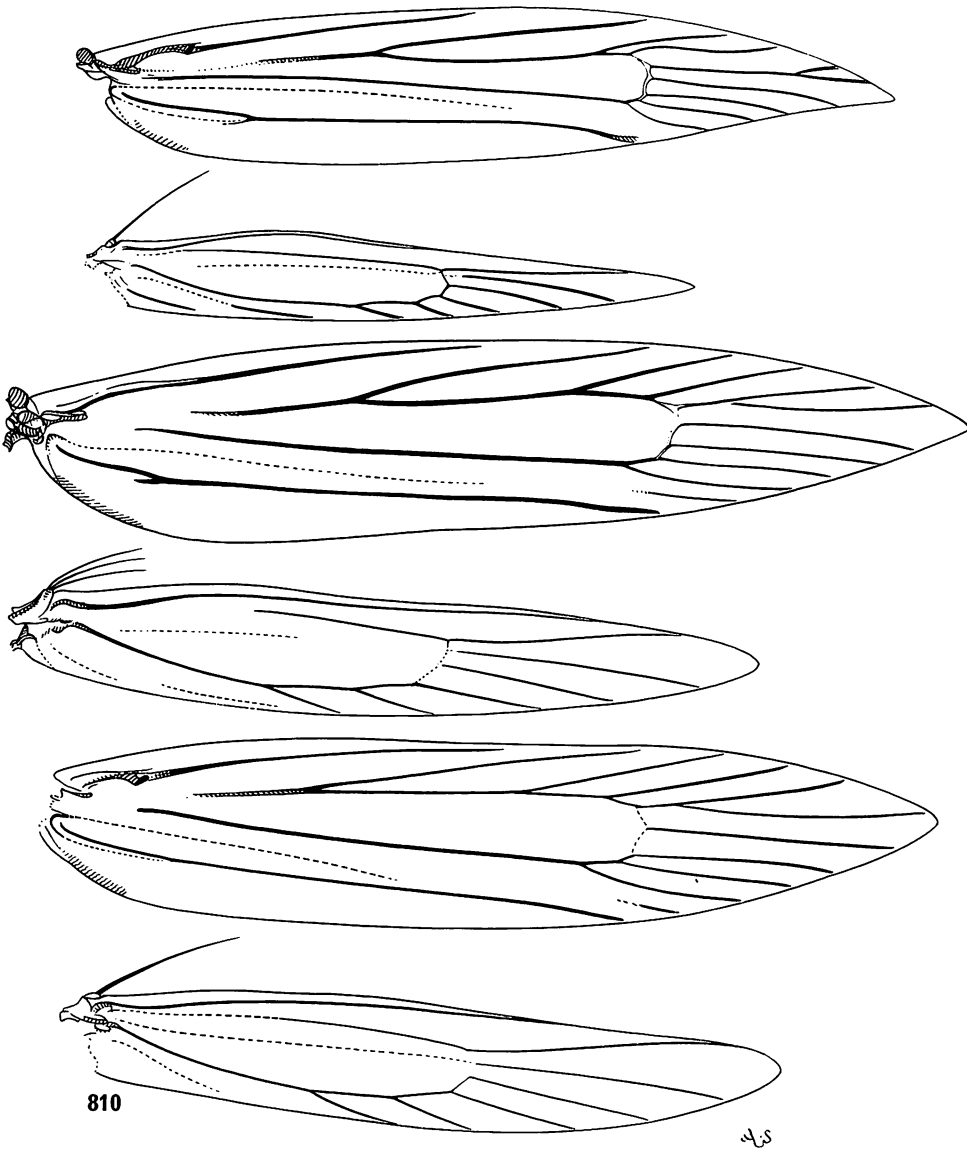


Figure 810—Wing venations of *Hyposmocoma* ("Neelysia"). Top, *argyresthiella* (Walsingham), paratype (BM slide 8428); Kona, 3,000 feet, Hawaii (note that vein 2 in the forewing is lost, and note the long stalk of 7 and 8). Middle, *basivittata* (Walsingham), paratype (BM slide 8433); Olinda, 4,000 feet, Maui. Bottom, *cleodorella* (Walsingham), paratype (BM slide 8431); Kona, 4,000 feet, Hawaii.



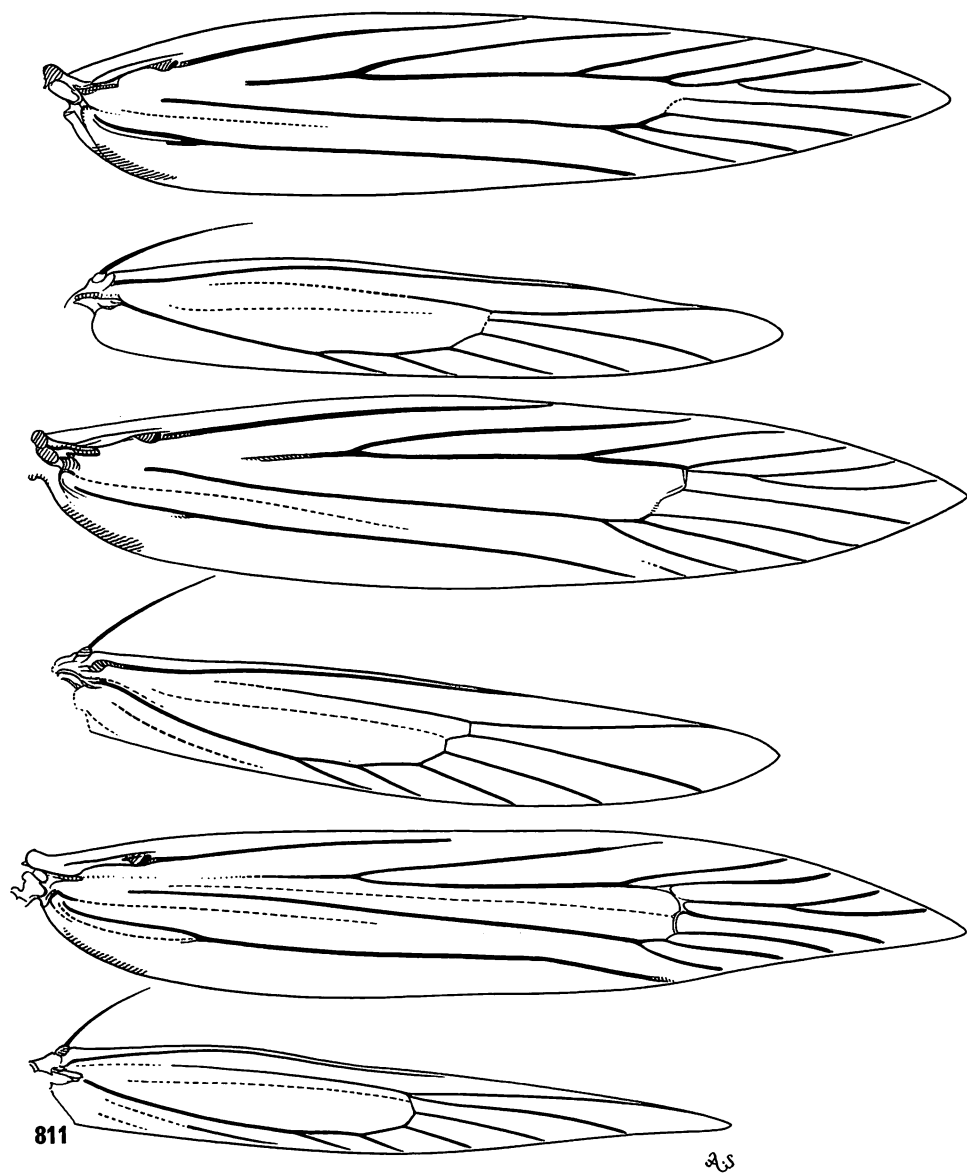


Figure 811—Wing venations of *Hyposmocoma* ("Neelysia"). Top, *complanella* (Walsingham), paratype (BM slide 8430); Molokai, about 4,000 feet. Middle, *cuprea* (Walsingham), paratype (BM slide 8426); Kauai, 3,000 to 4,000 feet. Bottom, *exaltata* (Walsingham), paratype (BM slide 8427); Haleakala, 5,000 feet, Maui. Note the differences in wing shape and the variability of vein 2 in the forewing.

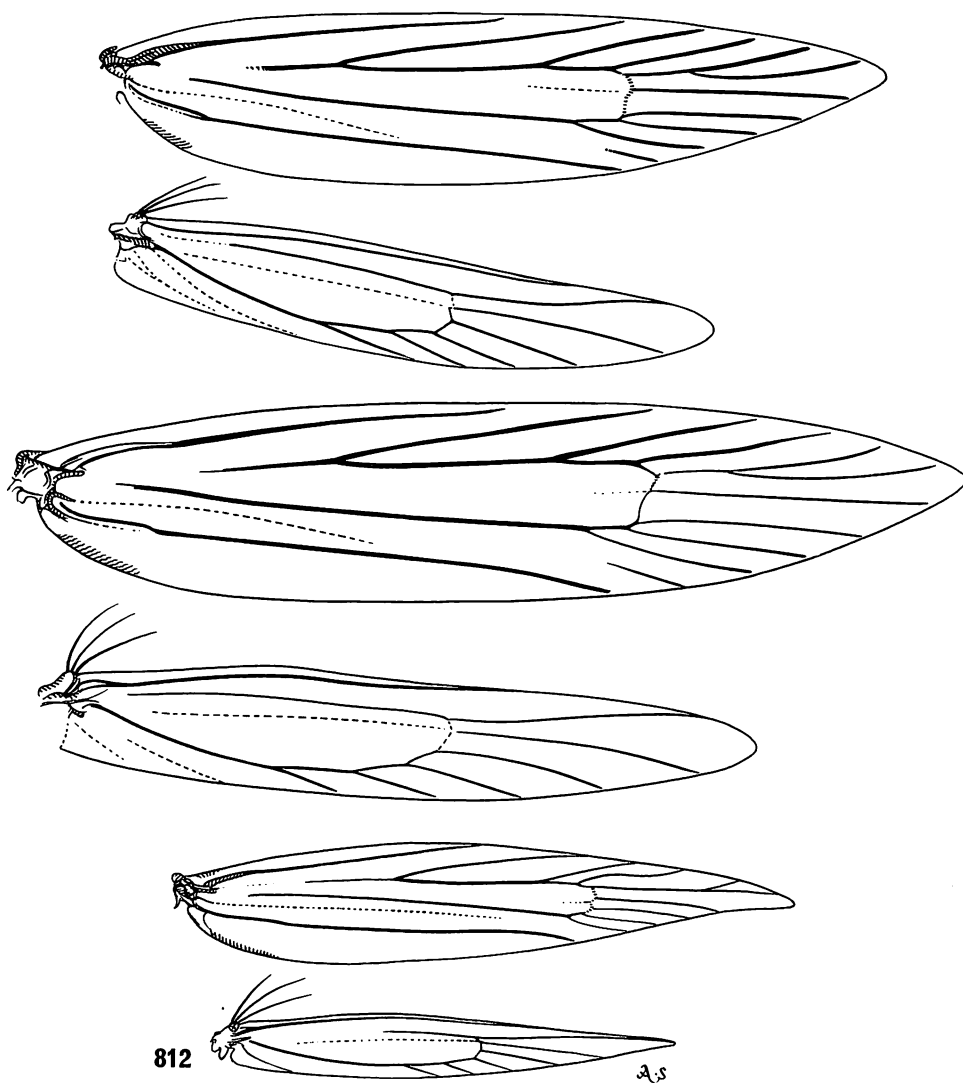


Figure 812—*Hyposmocma* ("Neelysia"), wing venations. Top, *fuscodentata* (Walsingham), paratype (BM slide 8425); Kilauea, Hawaii. Middle, *fuscifusa* (Walsingham), paratype (BM slide 8197); Kaholuamano, 4,000 feet, Kauai. Bottom, *mactella* (Walsingham), paratype (BM slide 5404); Kaholuamano, 4,000 feet Kauai.

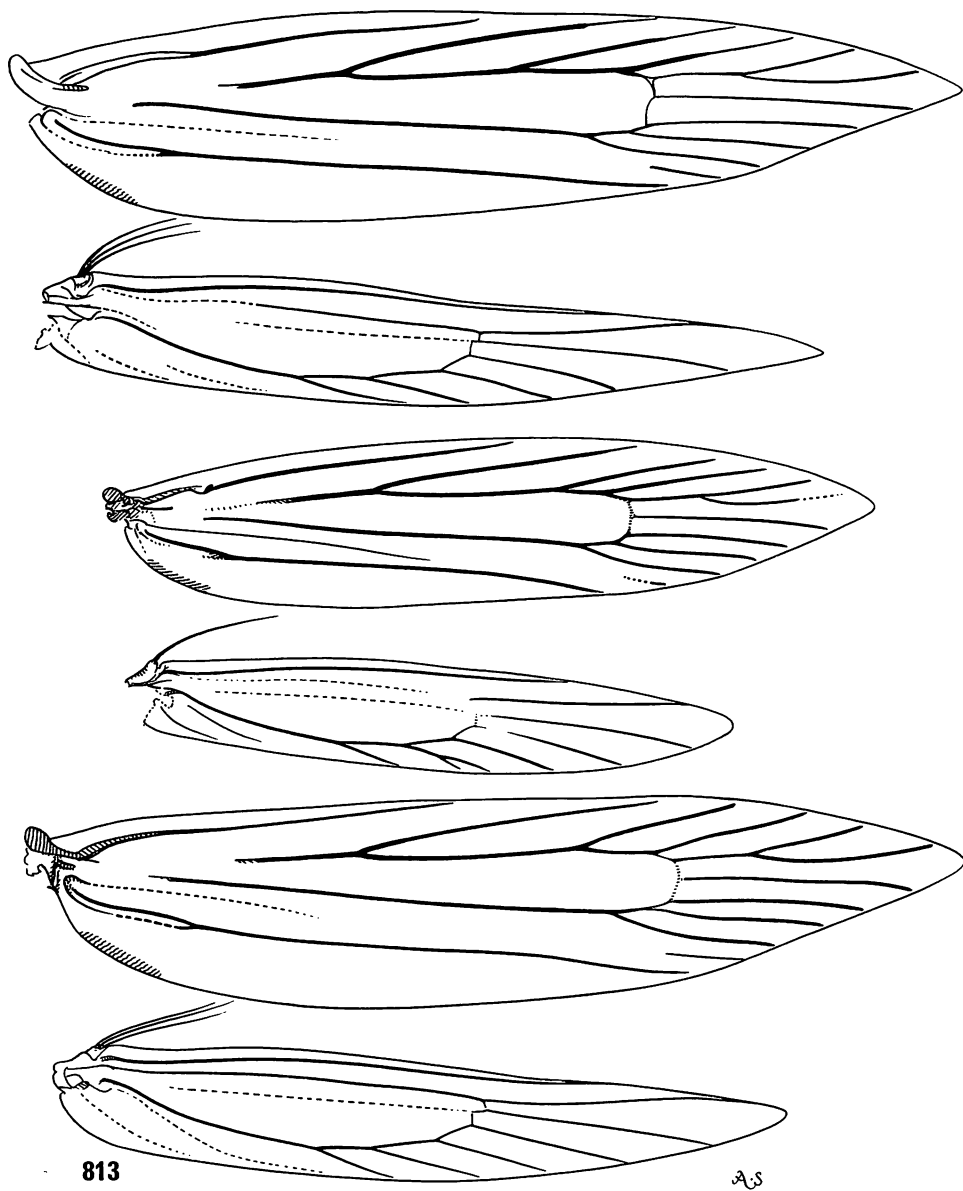


Figure 813—Wing venations of *Hypsmocoma* ("Neelysia"). Top, *ningorifera* (Walsingham), allotype female (BM slide 8199); Haleakala, 5,000 feet, Maui. Middle, *pallidorella* (Walsingham), paratype (BM slide 8435); Kauai, 3,000 to 4,000 feet. Bottom, *petalifera* (Walsingham), allotype female (BM slide 7722); Haleakala, 5,000 feet, Maui.

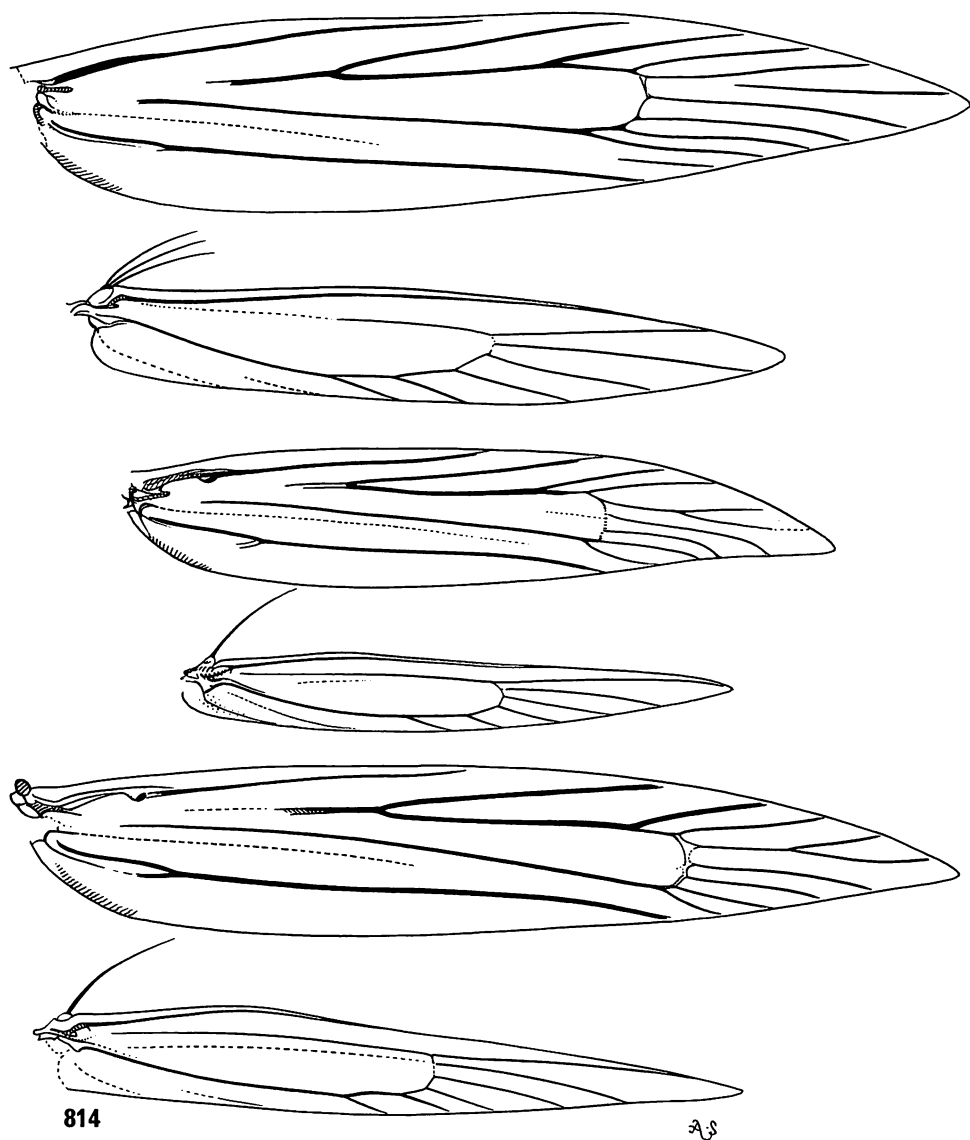


Figure 814—*Hyposmocoma* ("Neelysia"), wing venations. Top, *pluviella* (Walsingham), paratype (BM slide 8198); Molokai, about 4,000 feet. Middle, *poeciloceras* (Walsingham), paratype (BM slide 5443), Haleakala, 5,000 feet, Maui. Bottom, *rediviva* (Walsingham), paratype (BM slide 6471); Kaholuamano, 4,000 feet, Kauai.

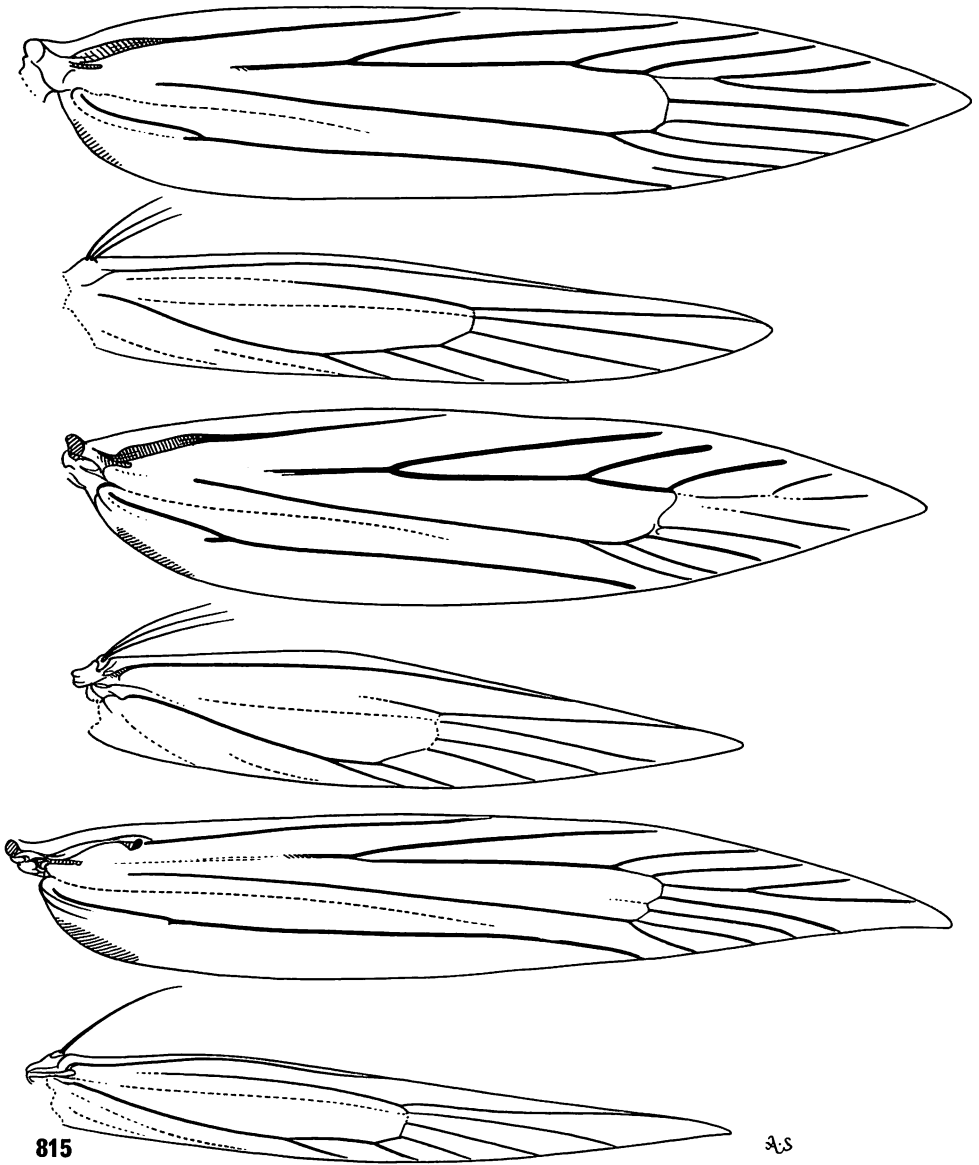


Figure 815—Wing venations of *Hyposmocoma* ("Neelysia"). Top, *repandella* (Walsingham), paratype (BM slide 8200); Molokai, above 3,000 feet. Middle, *semifusa* (Walsingham), paratype (BM slide 8196); Molokai, about 4,000 feet. This species was wrongly described as a member of *Neelysia*; it belongs to *Hyposmocoma sensu stricto*. Bottom, *tischeriella* (Walsingham), paratype (BM slide 8429); Kaholuamano, 4,000 feet, Kauai.



Figure 816—*Hyposmocoma* ("Aphthonetus"), wing venations. Top, *albocinerea* (Walsingham), paratype (BM slide 7561); Kauai, 3,000 to 4,000 feet. Upper middle, *elegans* (Walsingham), paratype (BM slide 7585); Haleakala, 5,000 feet, Maui. Lower middle, *lichenalis* (Walsingham), paratype (BM slide 7559); Lanai, 2,000 feet. Bottom, *punctiplicata*, paratype (BM slide 7584); Kona, 4,000 feet, Hawaii.

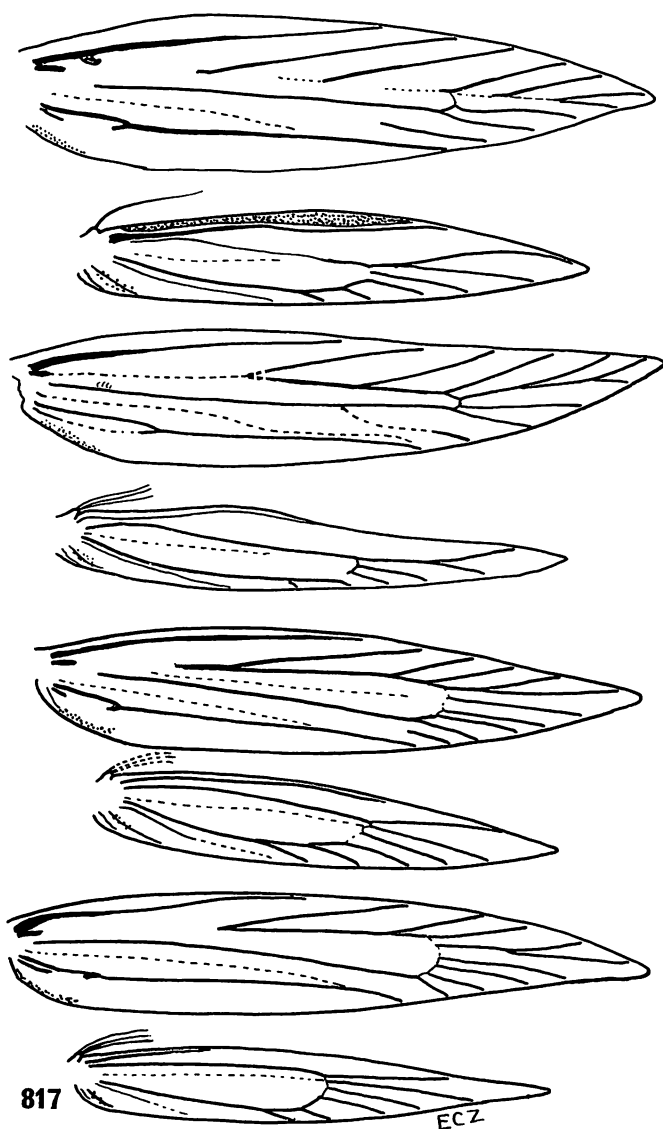


Figure 817—Wing venations of *Hyposmocoma* (*Euperissus*). Top, (*"Aphthonetus"*) *empetra* (Meyrick); Koolau Mts., Oahu; undesignated paratype (BM slide 16349). Upper middle, (*"Aphthonetus"*) *eleuthera* (Walsingham); Hilo, 2,000 feet, Hawaii; paratype (BM slide 16333). Lower middle (*"Neelysia"*) *incongrua* (Walsingham); Haleakala, 5,000 feet, Maui; allotype (BM slide 7725). Bottom, (*"Neelysia"*) *subaurata* (Walsingham); Kaholuamano, 4,000 feet, Kauai; allotype (BM slide 7716); note that there is no trace of vein 2 in the forewing.

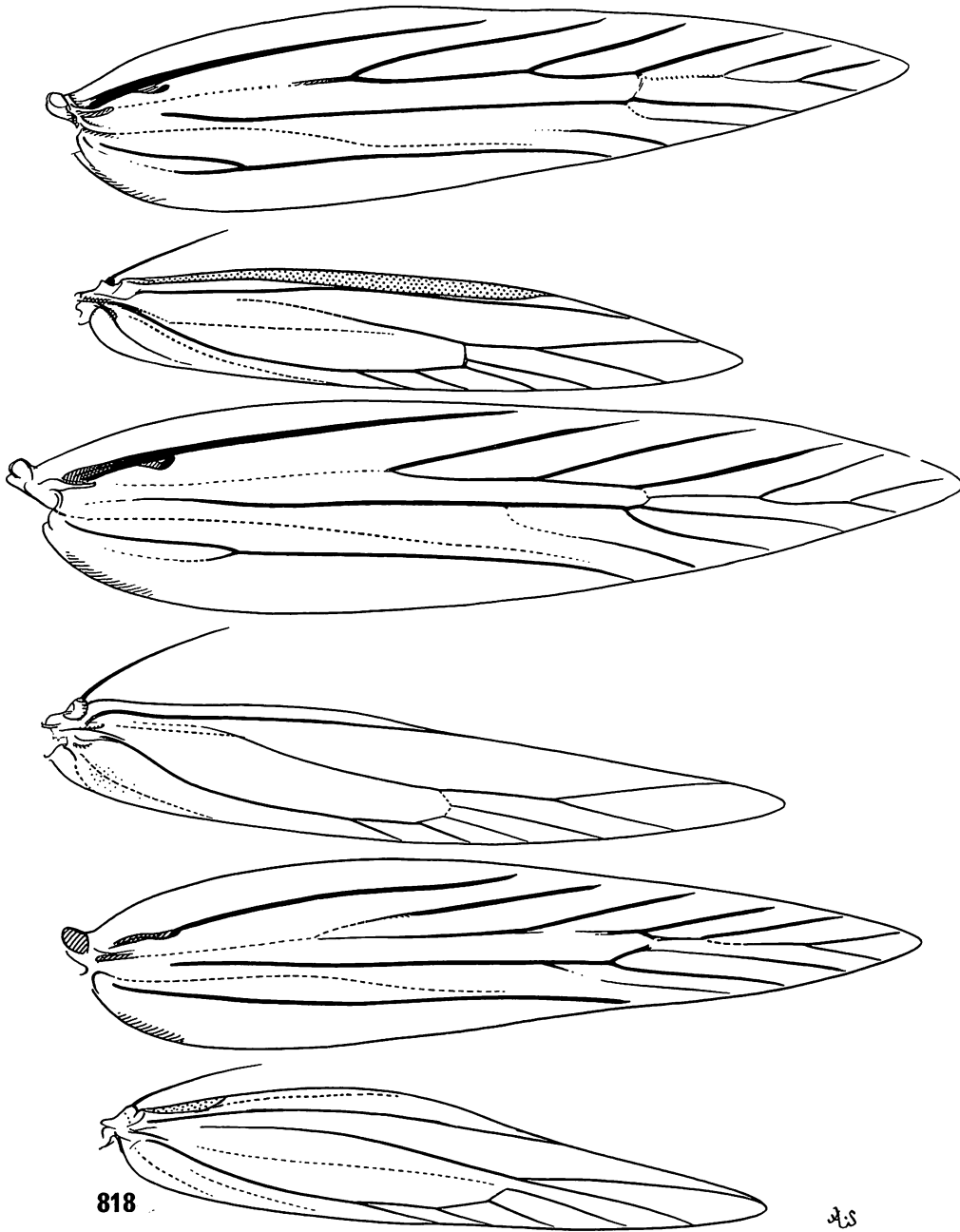


Figure 818—Wing venations of *Hyposmocoma* ("Aphthonetus"). Top, *aspersa* (Butler); Waianae Mts., Oahu (BM slide 7586). Middle, *bitincta* (Walsingham), paratype (BM slide 7581); Haleakala, 5,000 feet, Maui. Bottom, *columbella* (Walsingham), paratype (BM slide 7576); Molokai, above 3,000 to 4,000 feet.



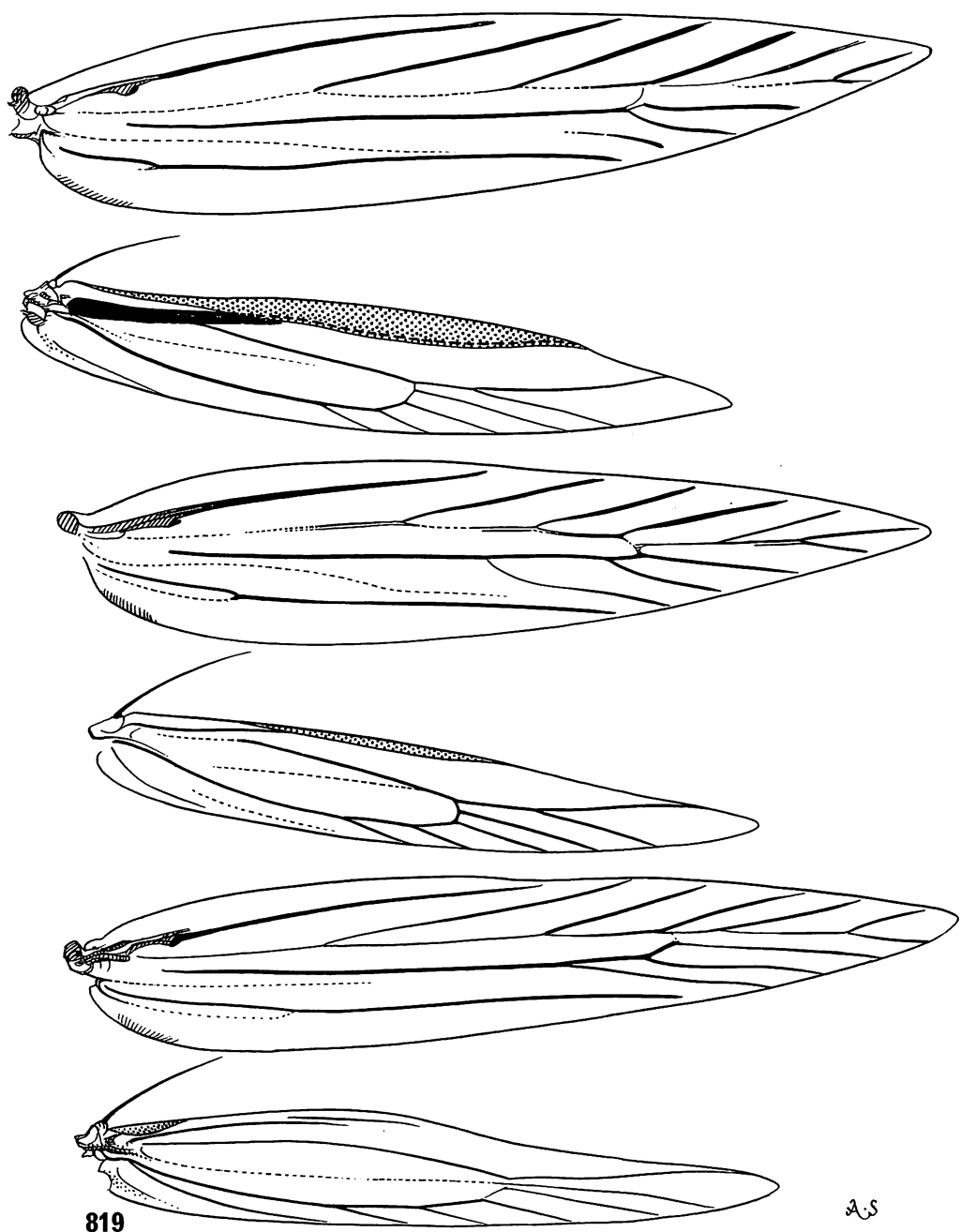


Figure 819—*Hypsmocoma* ("Aphthonetus"), wing venations. Top, *corticolor* (Walsingham), paratype (BM slide 7578); Haleakala, 5,000 feet, Maui. Middle, *digressa* (Walsingham), paratype (BM slide 7579); Haleakala, 5,000 feet, Maui. Bottom, *exsul* (Walsingham), determined by Walsingham, (BM slide 5457); Kilauea, Hawaii. Note that veins 6 and 7 in the hindwing of *exsul* are not stalked; compare this with the other species. Note also the variation in vein 2 in the forewings.

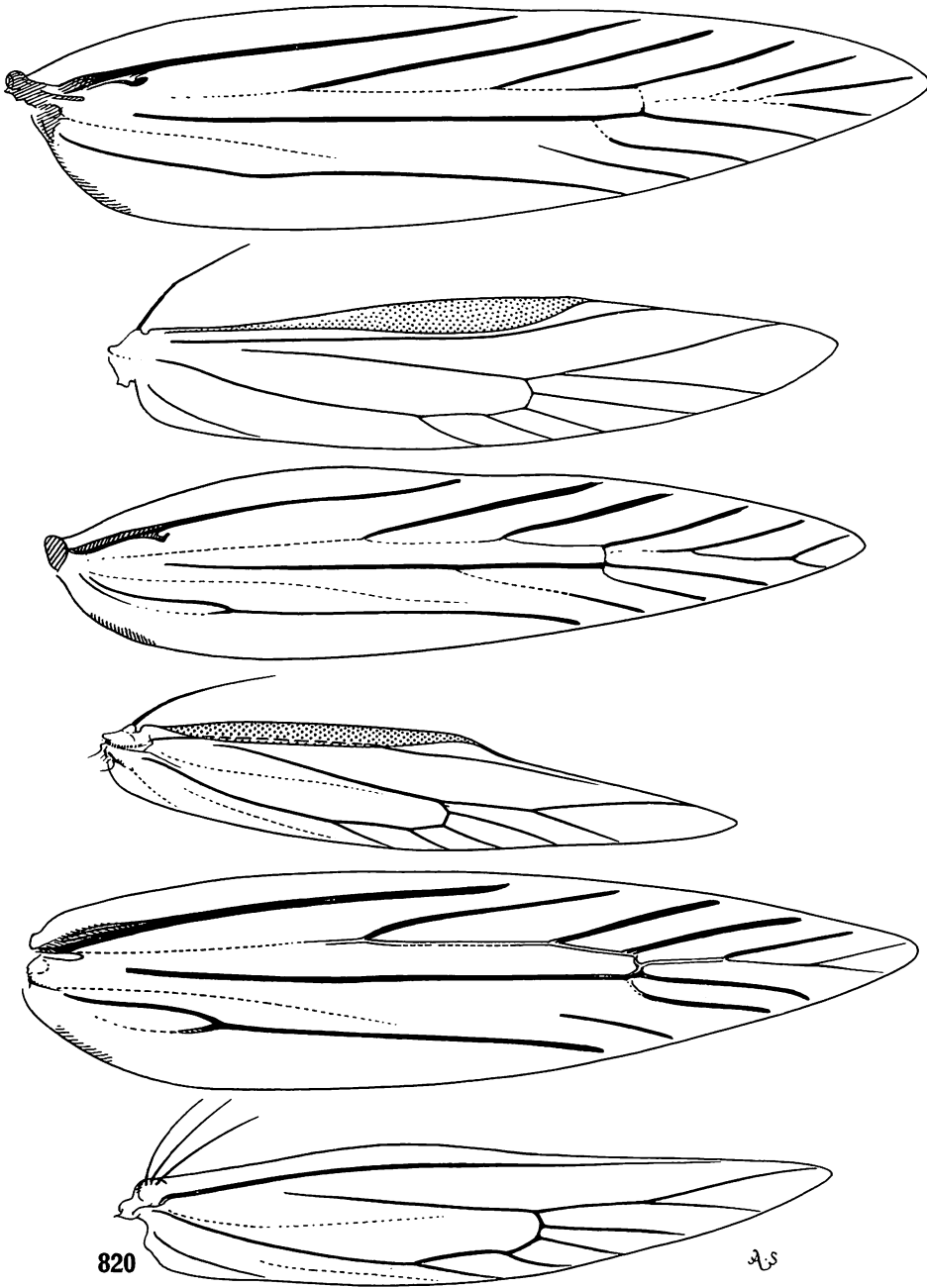


Figure 820—Wing venations of *Hypsoscocoma* ("Aphthonetus"). Top, *fluctuosa* (Walsingham), paratype (BM slide 7580); Halemanu, 4,000 feet, Kauai. Middle, *fugitiva* (Walsingham), paratype (BM slide 7577); Kaholuamano, 4,000 feet, Kauai. Bottom, *hirsuta* (Walsingham), paratype (BM slide 7562); Kauai, 3,000 to 4,000 feet.

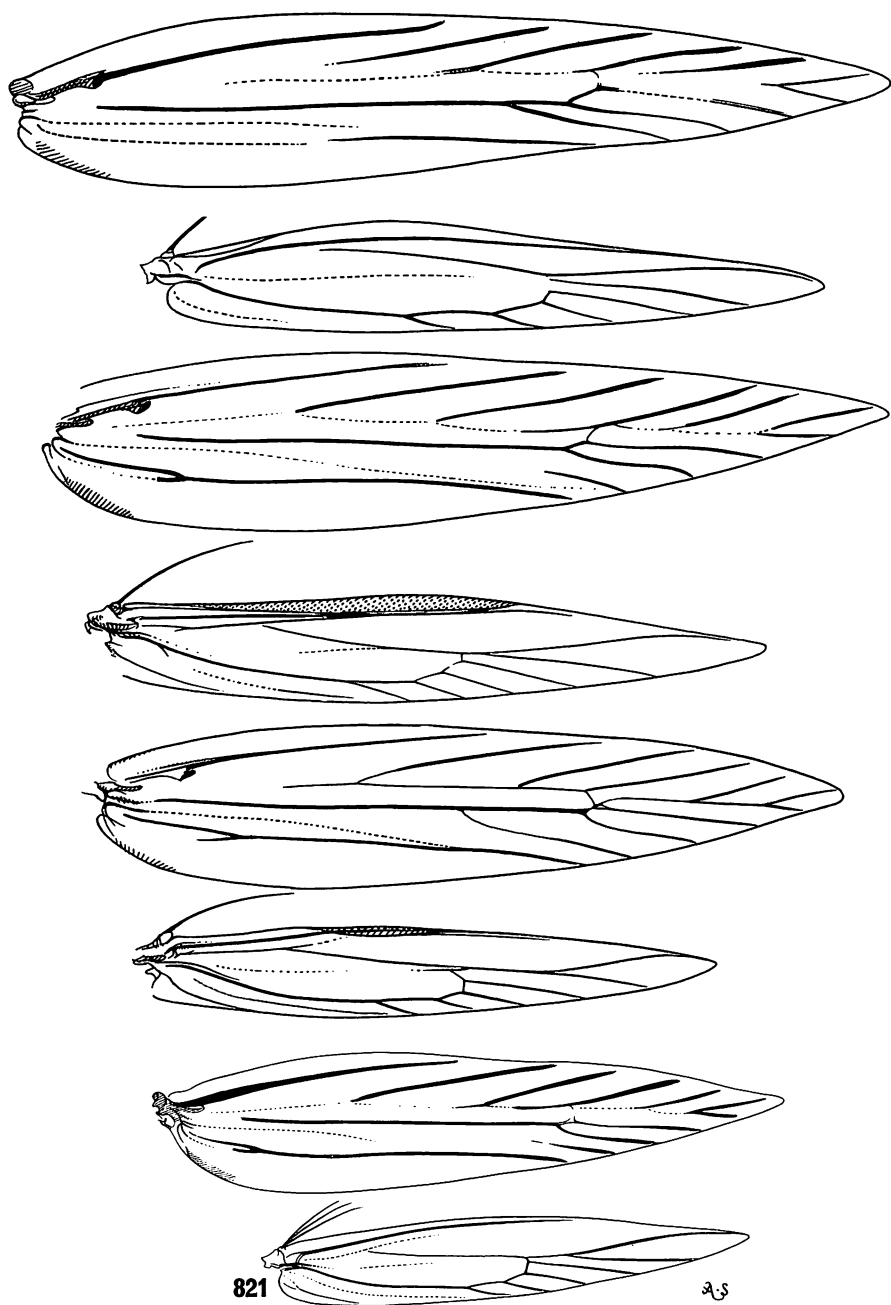


Figure 821—*Hypsoscoma* ("Aphthonetus"), wing venations. Top, *humarella* (Walsingham), paratype (BM slide 7563); Haleakala, 5,000 feet, Maui. Upper middle, *kauaiensis* (Walsingham), paratype (BM slide 5456); Halemanu, Kauai. Lower middle, *mediocris* (Walsingham), paratype (BM slide 5455); Olinda, Maui. Bottom, *polia* (Walsingham), allotype (BM slide 7564); Halemanu, 4,000 feet, Kauai.

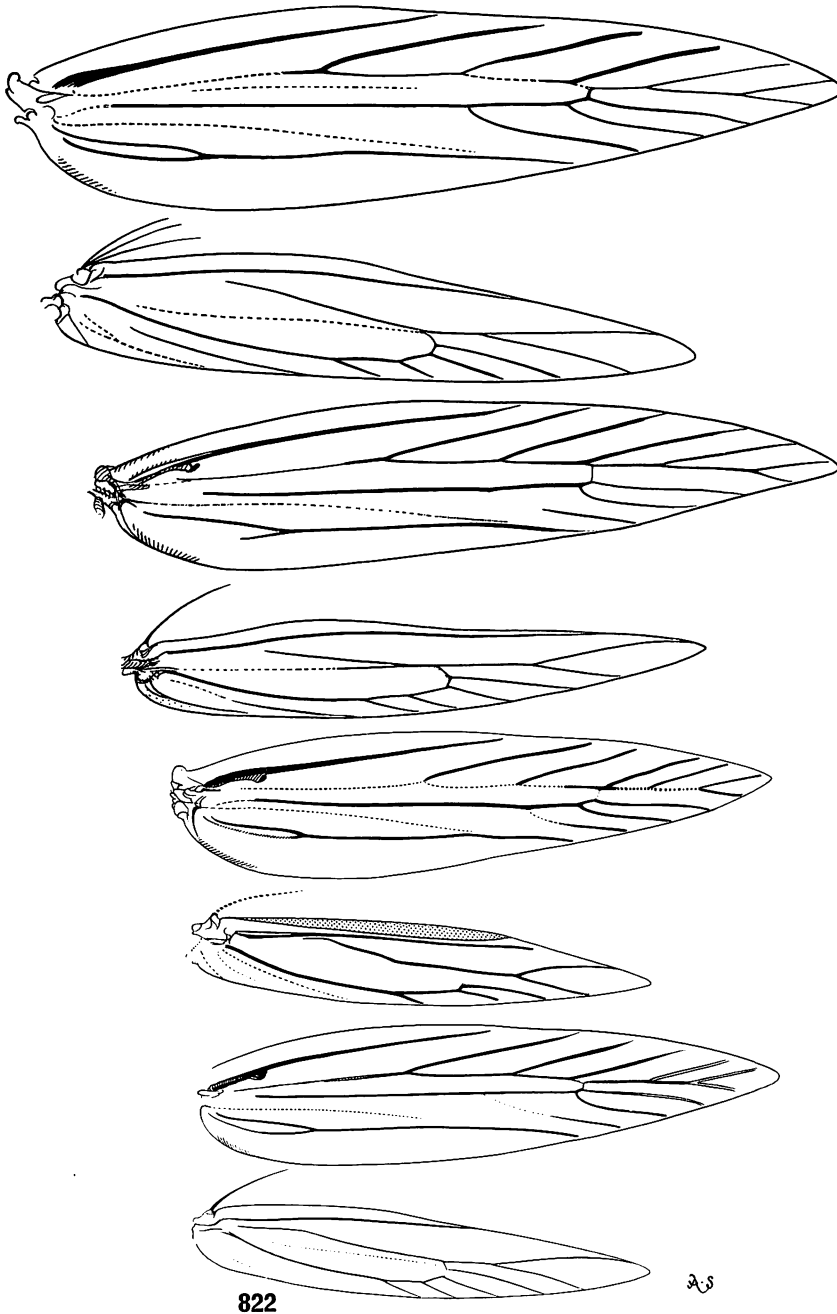


Figure 822—Wing venations of *Hypsoscyma* ("Aphthonetus"). Top, *prae fracta* (Meyrick), paratype (slide Z-XII-62-1); Kumuwela, Kauai. Upper middle, *sagittata* (Walsingham), paratype (BM slide 5454); Kaholuamano, 4,000 feet, Kauai. Lower middle, *sideroxyloni* (Swezey), Oahu (Busck slide 153); above Puu Peahinaia, Koolau Mts.; note that there are only seven veins in the hindwing. Bottom, *subocellata* (Walsingham), paratype (BM slide 7583); Haleakala, 4,000 to 5,000 feet, Maui.

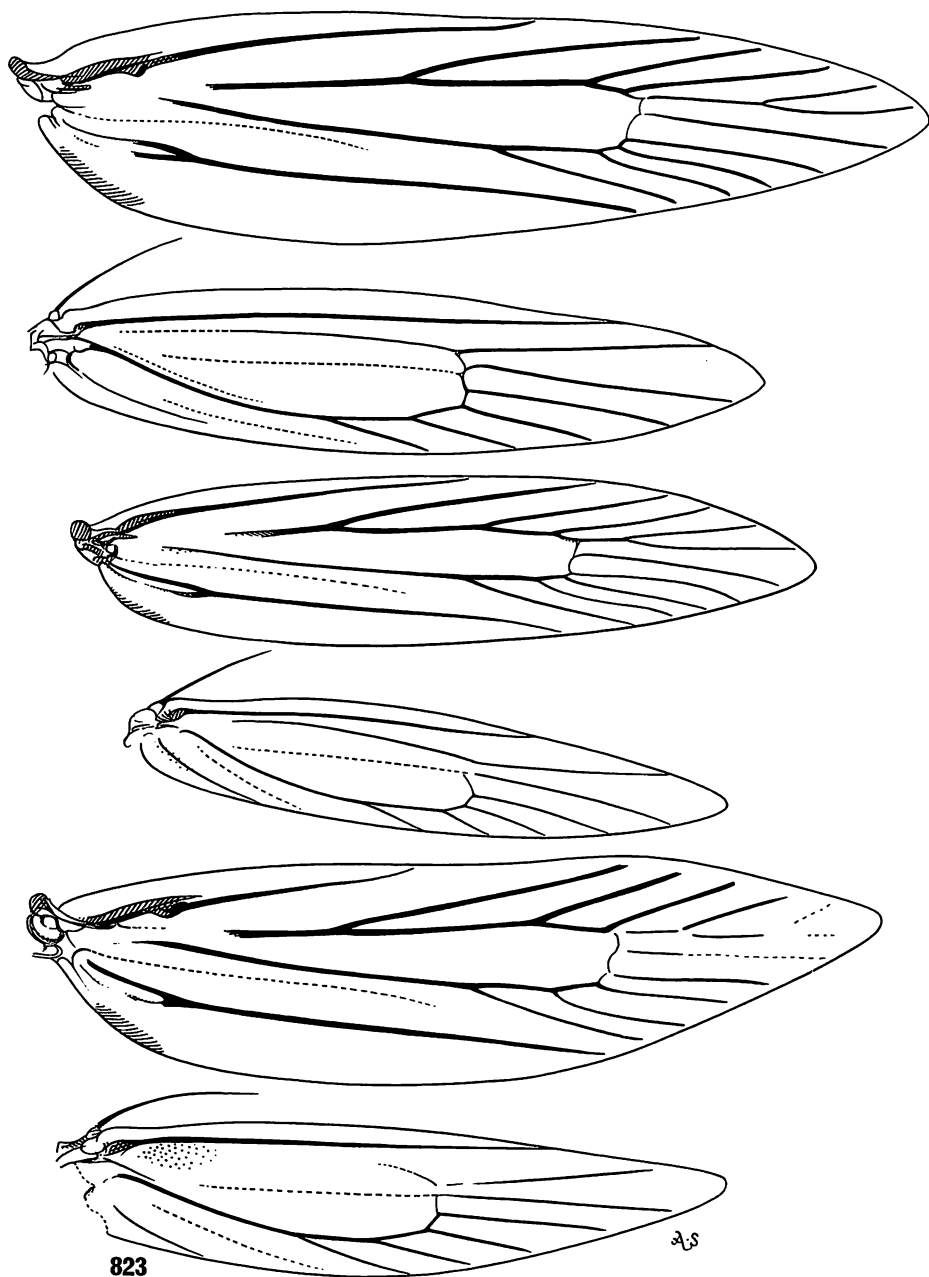


Figure 823—*Hyposmocoma*, wing venations. Top, (*H.*) *abjecta* (Butler); northwest Koolau Mts., Oahu (BM slide 7874); determined by Walsingham. Middle, a species confused with (*E.*) *adelphella* Walsingham, paratype (BM slide 8024); Kauai, 3,000 to 4,000 feet (see the main text for discussion). Bottom, (*H.*) *admirationis* Walsingham, paratype (BM slide 8025); Molokai, over 3,000 feet.

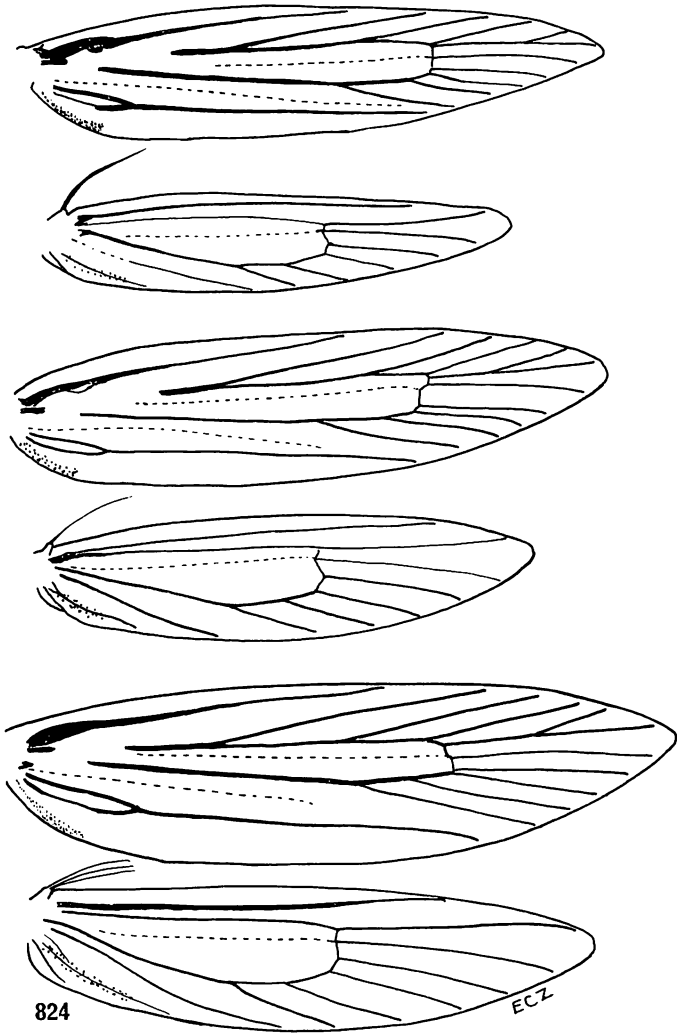


Figure 824—Wing venations of *Hypsoscoma* (*Euperissus*). Top, *alticola* Meyrick; Honolulu (BM slide 16345). Middle, *caecinervis* Meyrick; Mt. Kaala, Oahu (BM slide 5555). Bottom, *chloraula* Meyrick; Summit Camp, Kauai (BM slide 16348). These specimens are evidently all undesignated paratypes.

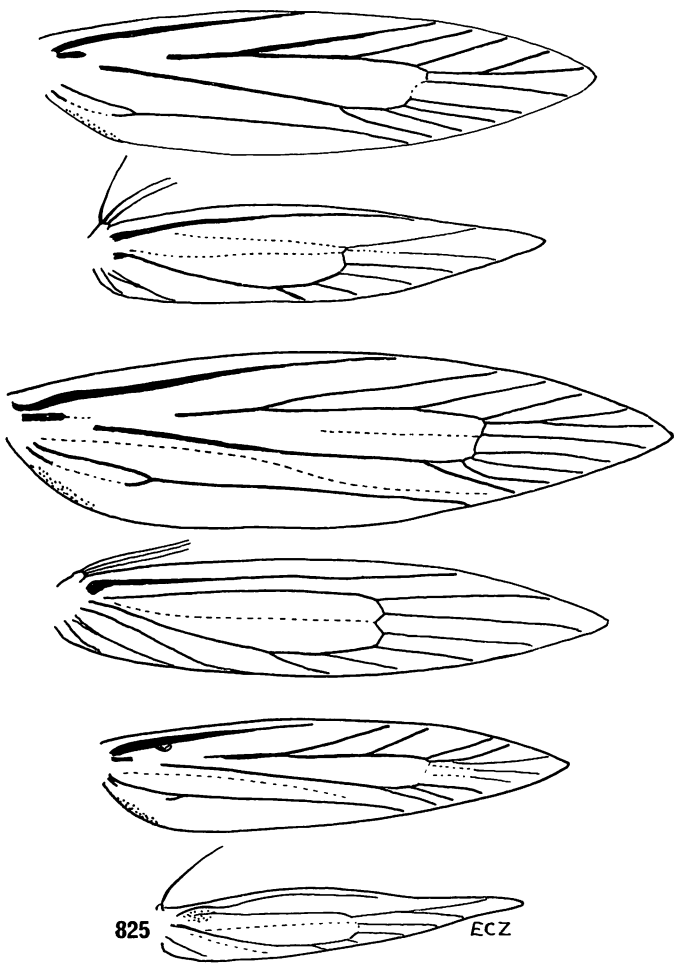


Figure 825—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *albonivea* Walsingham; Koolau Mts., Oahu (BM slide 16341); note that vein 1c in the hindwing is wanting. Middle, *prophantis* Meyrick; Koolau Mts., Oahu (BM slide 16340). Bottom, *triptila* Meyrick; Koolau Mts., Oahu (BM slide 16347).

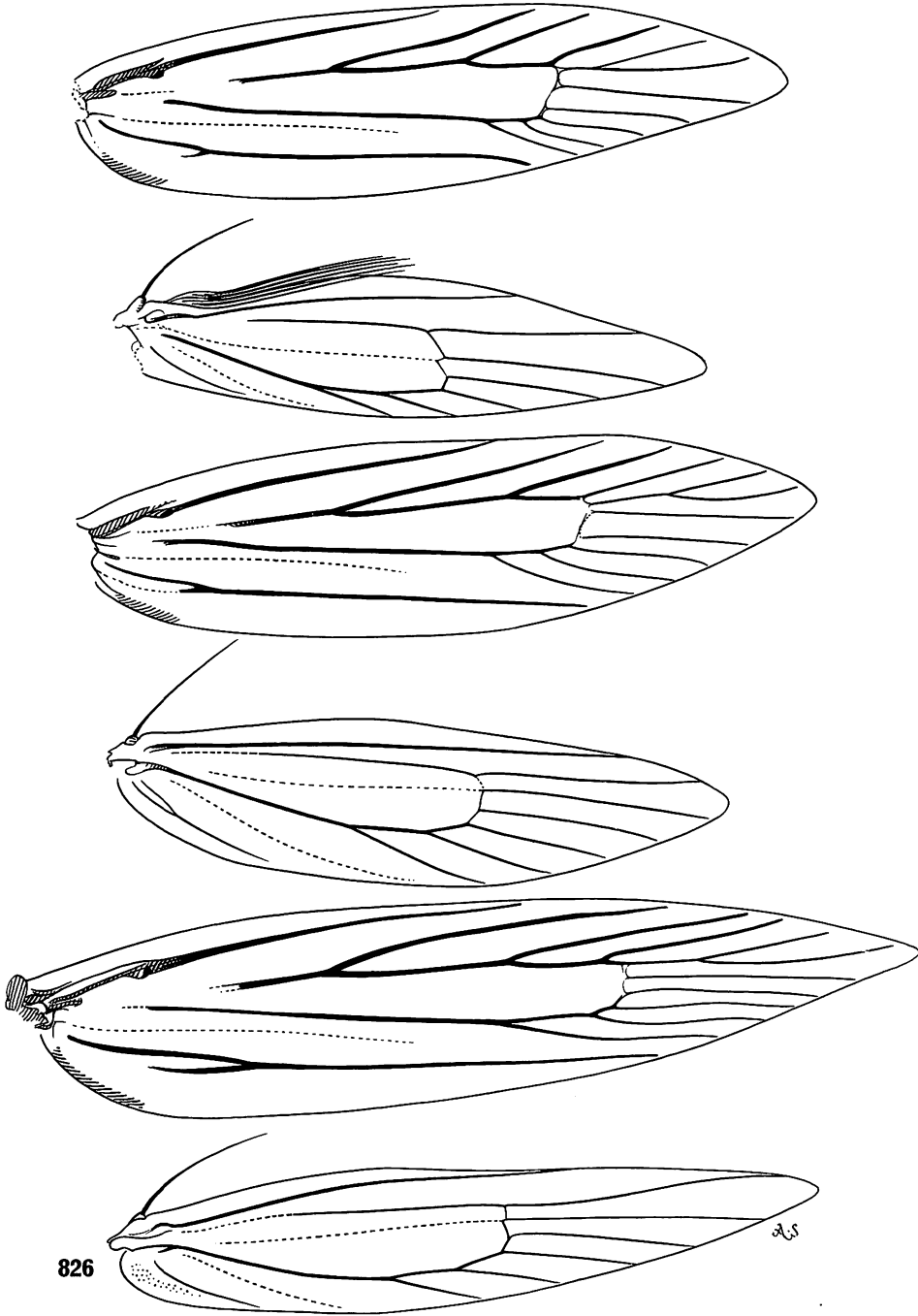


Figure 826—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *alliterata* Walsingham, paratype (BM slide 7331); Kona, about 5,000 feet, Hawaii. Middle, *arenella* Walsingham, paratype (BM slide 8041); Kona, 3,000 feet Hawaii. Bottom, *argentea* Walsingham, paratype (BM slide 8042); Molokai, 4,000 feet.





Figure 827—Wing venations of *Hypsmocoma*. Top, (*H.*) *auripennis* (Butler), determined by Walsingham (BM slide 7887); Haleakala, 5,000 feet, Maui. Middle, (*E.*) *auroargentea* Walsingham, paratype (BM slide 7885); Haleakala, over 5,000 feet, Maui. Bottom, (*H.*) *auropurpurea* Walsingham, allotype (BM slide 8469); Waianae Mts., 2,000 feet, Oahu.

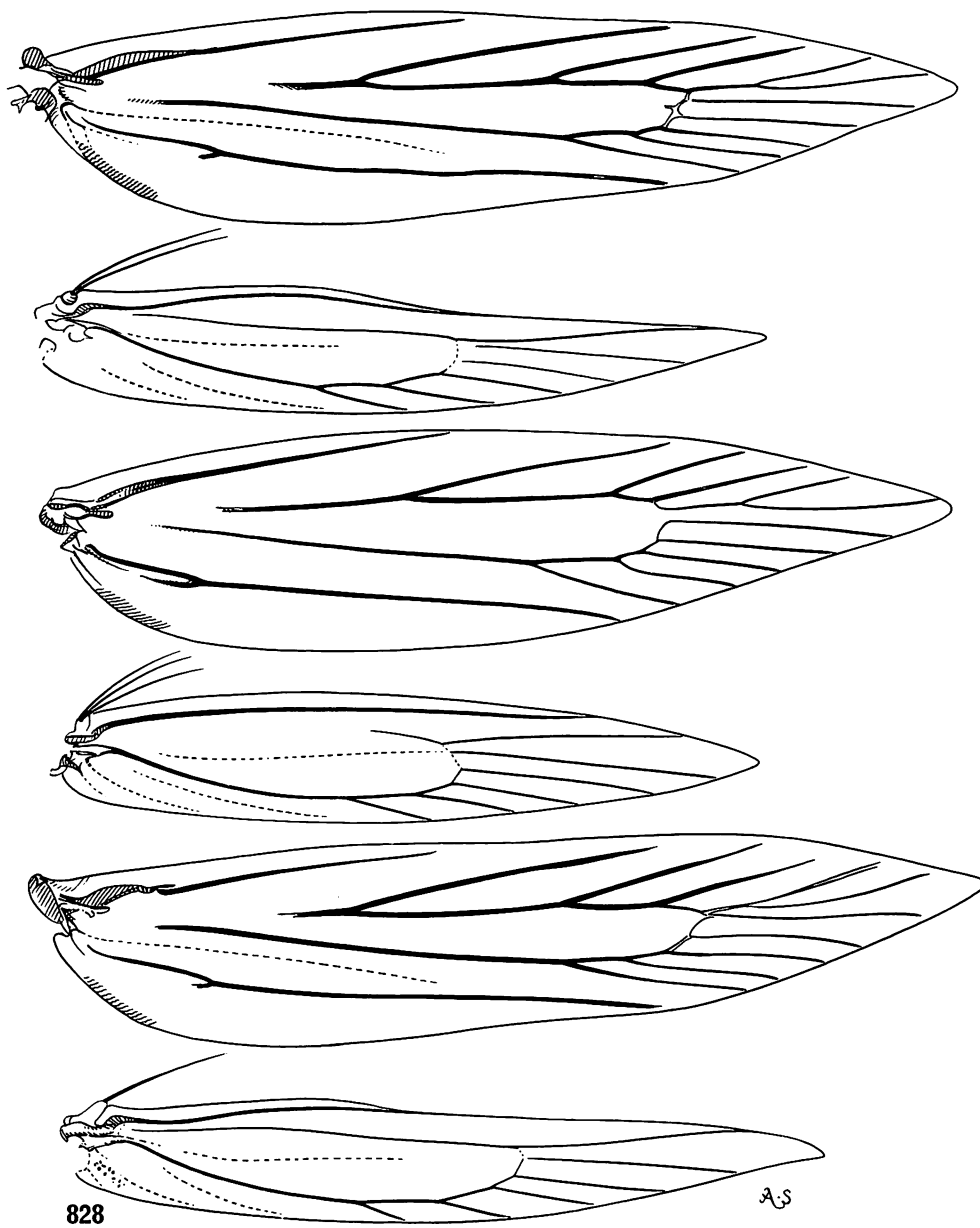


Figure 828—*Hypsomocoma*, wing venations. Top, (*H.*) *bacillella* Walsingham, paratype (BM slide 8436); Kauai, 3,000 to 4,000 feet. Middle, (*H.*) *bilineata* (Walsingham), paratype (BM slide 8470); Waiānāe Mts., 2,000 feet, Oahu. Bottom, (*E.*) *brevistrigata* Walsingham, paratype (BM slide 8437); Kauai, 3,000 to 4,000 feet.



Figure 829—Wing venations of *Hypsoscoma* (*Hypsoscoma*). Top, *butalidella* Walsingham, paratype (BM slide 8442); Haleakala, about 6,000 feet, Maui. Middle, species?, formerly considered as *candidella* Walsingham, paratype (BM slide 7338); Kauai, 3,000 to 4,000 feet. Bottom, *canella* Walsingham, paratype (BM slide 5476); Molokai, above 3,000 feet. Compare the origins of vein 6 in both forewings and hindwings.

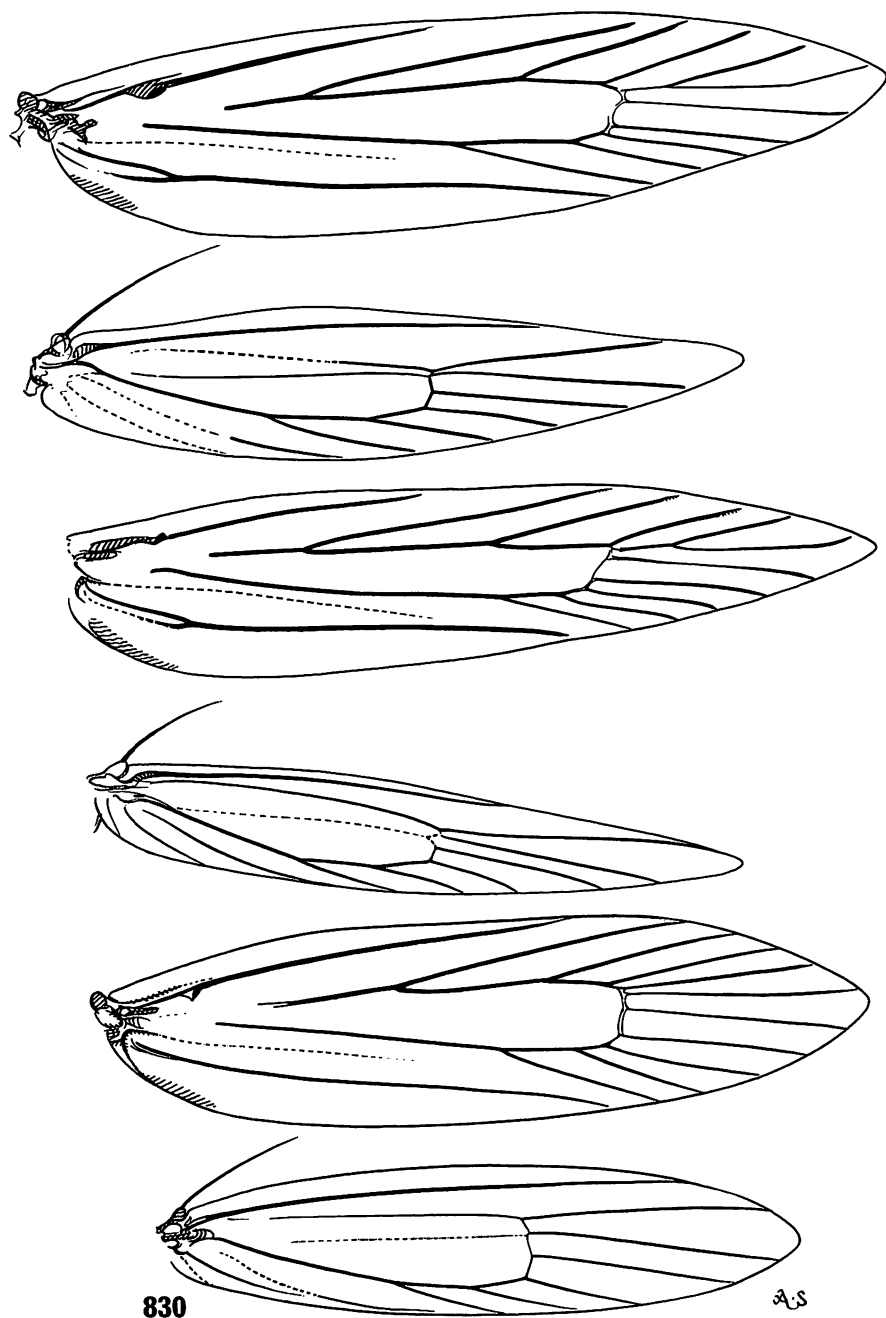


Figure 830—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *carbonenotata* Walsingham, paratype (BM slide 8443); Kauai, 3,000 to 4,000 feet. Middle, *ctnereosparsa* Walsingham, paratype (BM slide 8444); Kauai, 3,000 to 4,000 feet. Bottom, *commensella* Walsingham, paratype (BM slide 5452); Kilauea, Hawaii. Note that 7 and 8 are free veins in the forewing, and compare this with other species. This is not a constant character, however. See the text for details.



Figure 831—Wing venations of *Hypsmocoma* (*Hypsmocoma*). Top, *conditella* Walsingham, paratype (BM slide 6466); Kauai, 3,000 to 4,000 feet. Middle, *corvina* (Butler), determined by Walsingham (BM slide 7872); Olinda, 4,000 feet, Maui. Bottom, *costimaculata* Walsingham, paratype (BM slide 5463); Molokai, 3,000 feet.

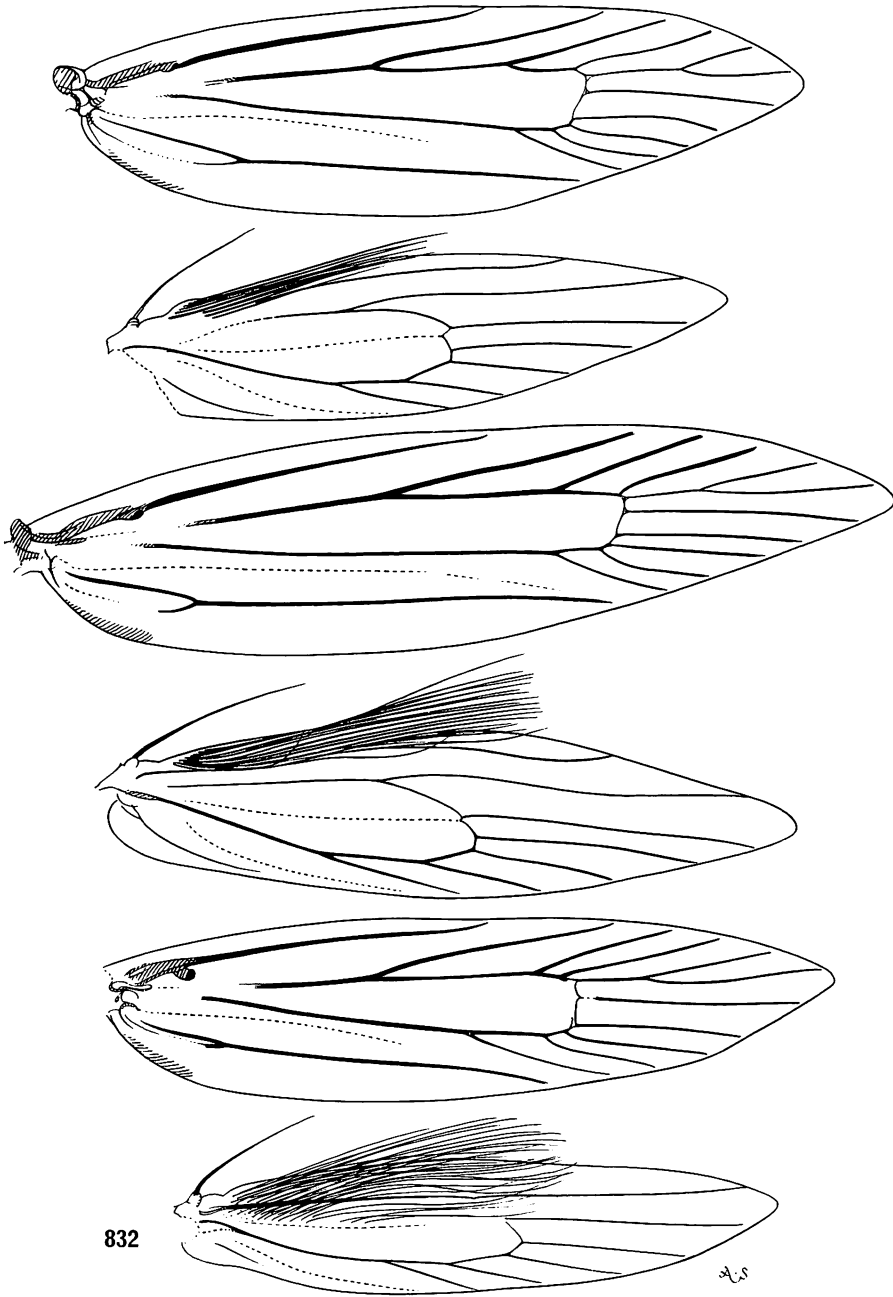


Figure 832—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *discella* Walsingham, paratype (BM slide 4873); Kaholuamano, 4,000 feet, Kauai. Middle, *divisa* Walsingham, paratype (BM slide 6465); Kauai, 3,000 to 4,000 feet. Bottom, *domicolens* (Butler), paratype (BM slide 6458); Makawao, Maui.

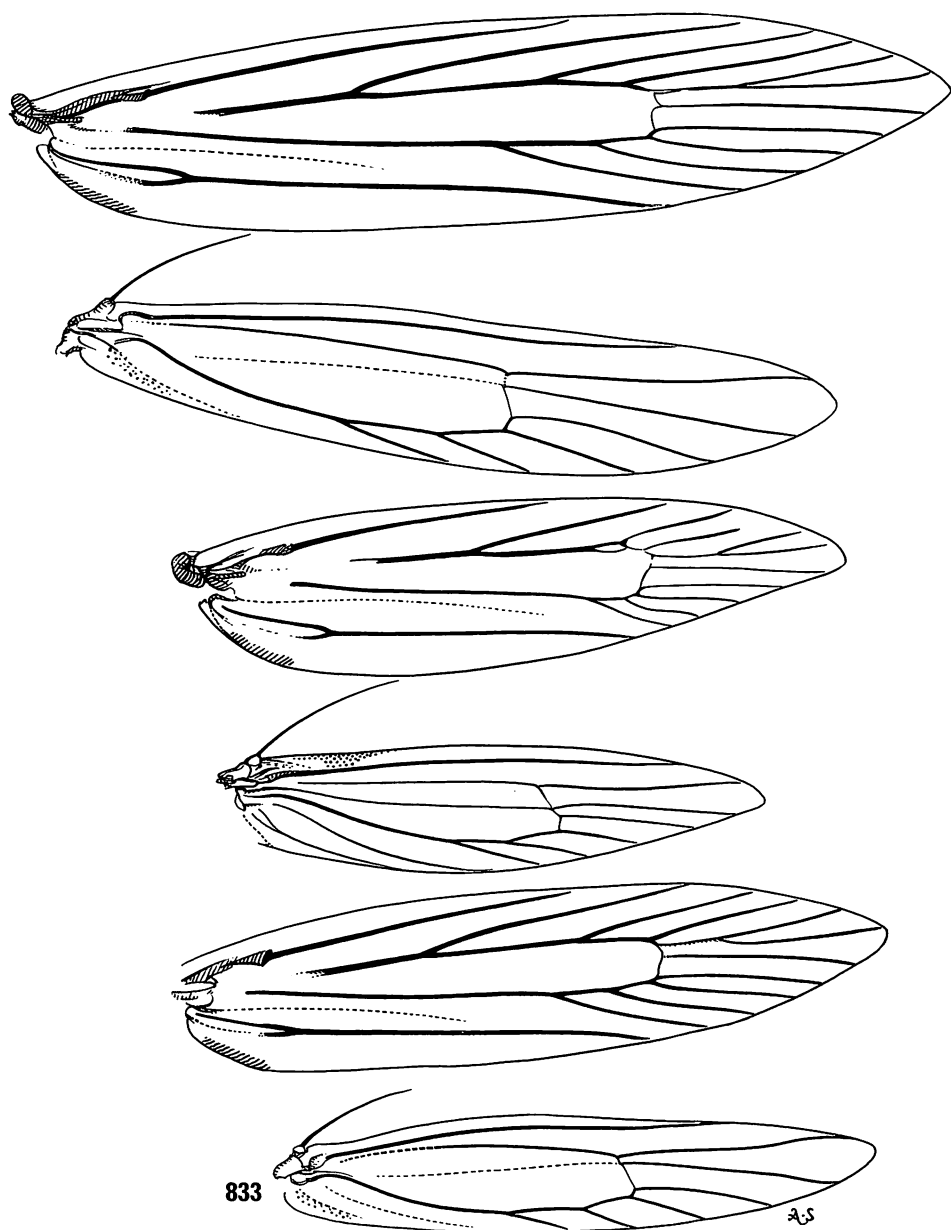


Figure 833—Wing venations of *Hyposmocoma*. Top, (*E.*) *emendata* Walsingham, paratype (BM slide 8445); Haleakala, 5,000 feet, Maui. Middle, (*H.*) *empedota* Meyrick (BM slide 5477); Honolulu, Oahu. Bottom, (*E.*) *enixa* Walsingham, paratype (BM slide 8446); Kaholuamano, 4,000 feet, Kauai.

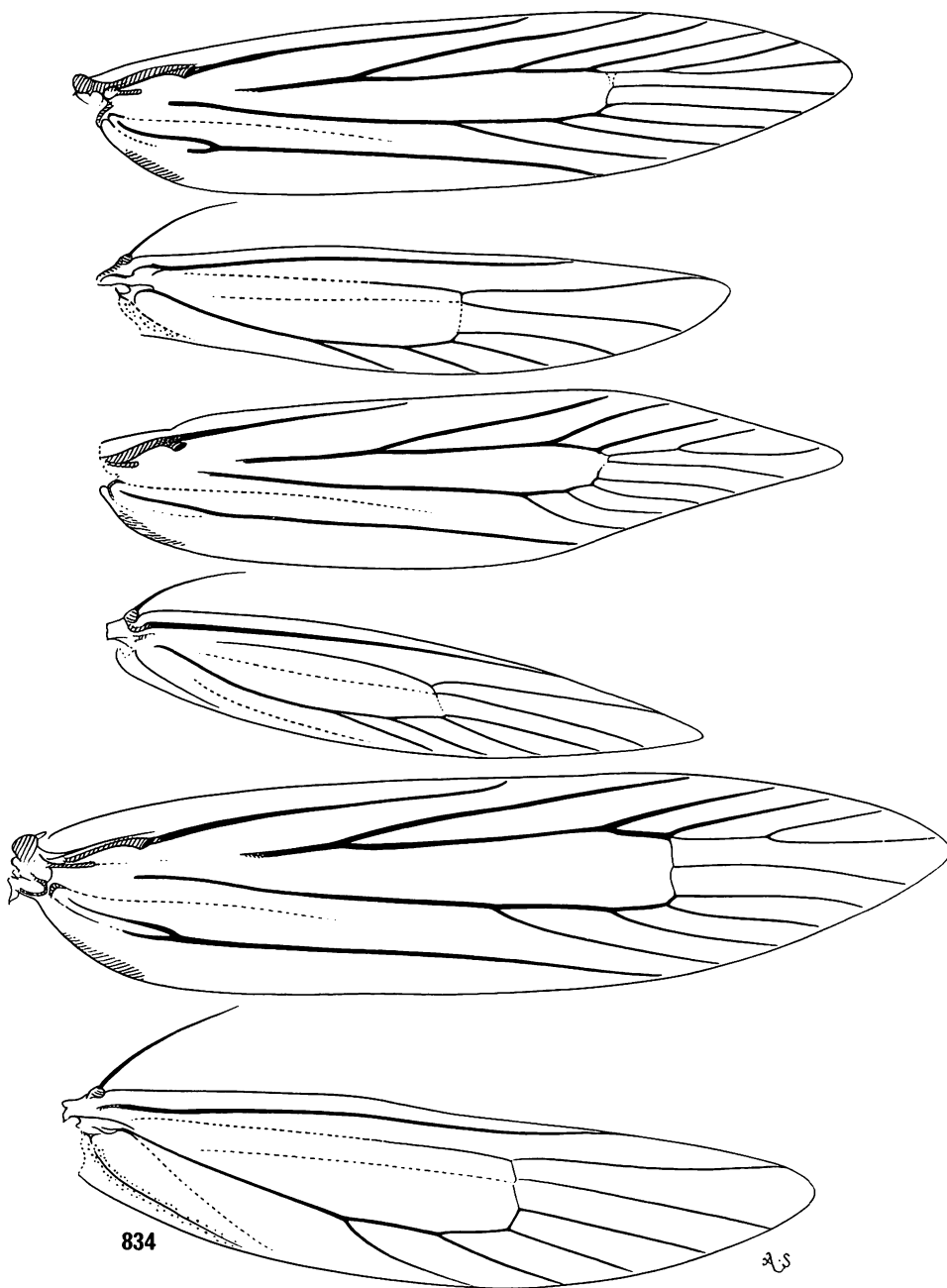


Figure 834—*Hypsoscocoma*, wing venations. Top, (*E.*) *ensifer* Meyrick, paratype (BM slide 8448); Kilauea, Hawaii. Middle, (*H.*) *evanescens* Walsingham, paratype (BM slide 7980); Haleakala, 5,000 feet, Maui. Bottom, (*E.*) *exornata* Walsingham, paratype (BM slide 7869); Kona, 4,000 feet, Hawaii.



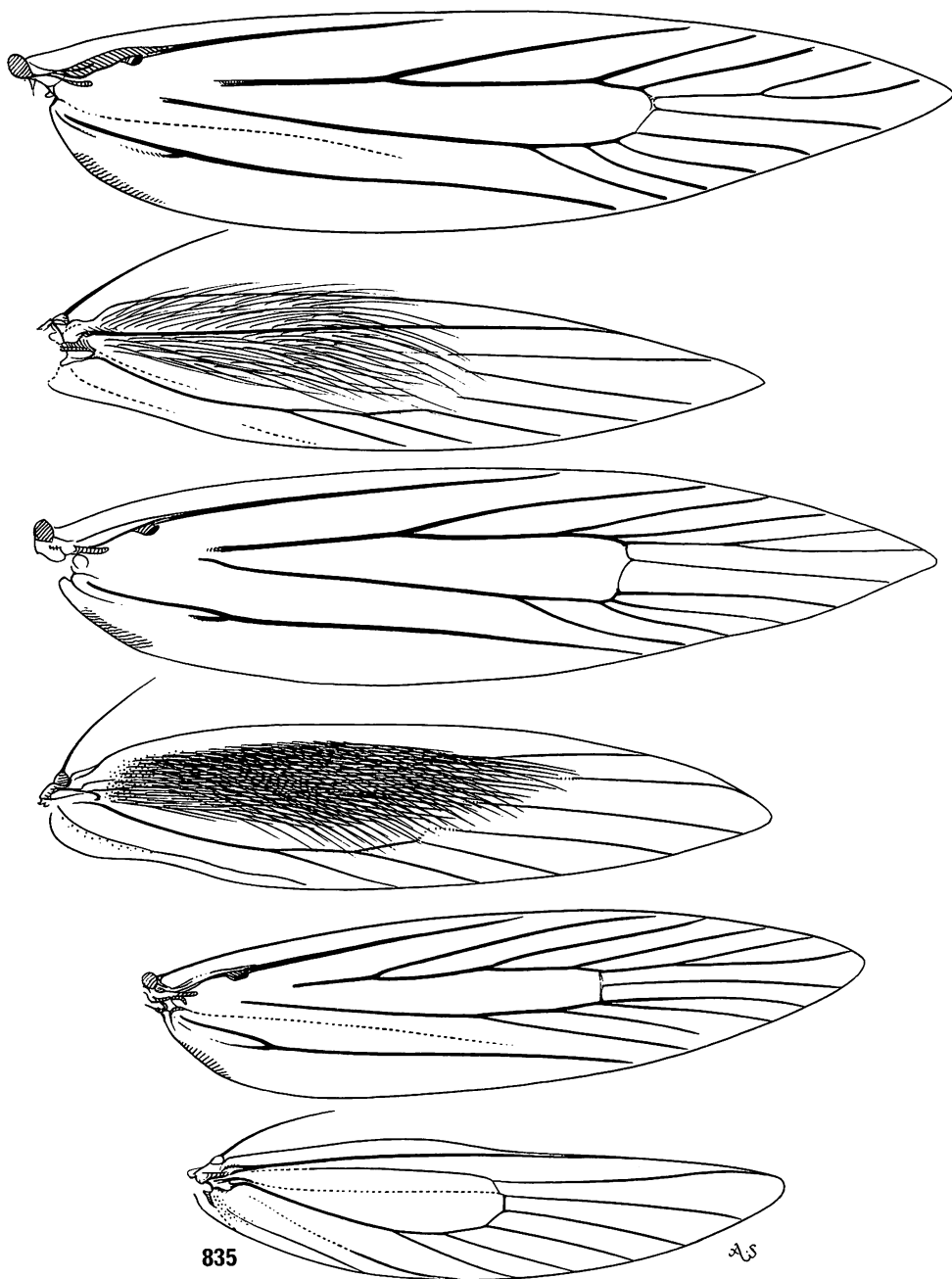


Figure 835—Wing venations of *Hypsimocoma*. Top, (*H.* *fractinubella* Walsingham, paratype (BM slide 8449); Olinda, 4,000 feet, Maui (compare female in figure 1351). Middle, (*H.* *fractistriata* Walsingham, paratype (BM slide 8455); Waianae Mts., Oahu. Bottom, (*E.* *fulvida* Walsingham, paratype (BM slide 5465); Kauai, 3,000 to 4,000 feet.

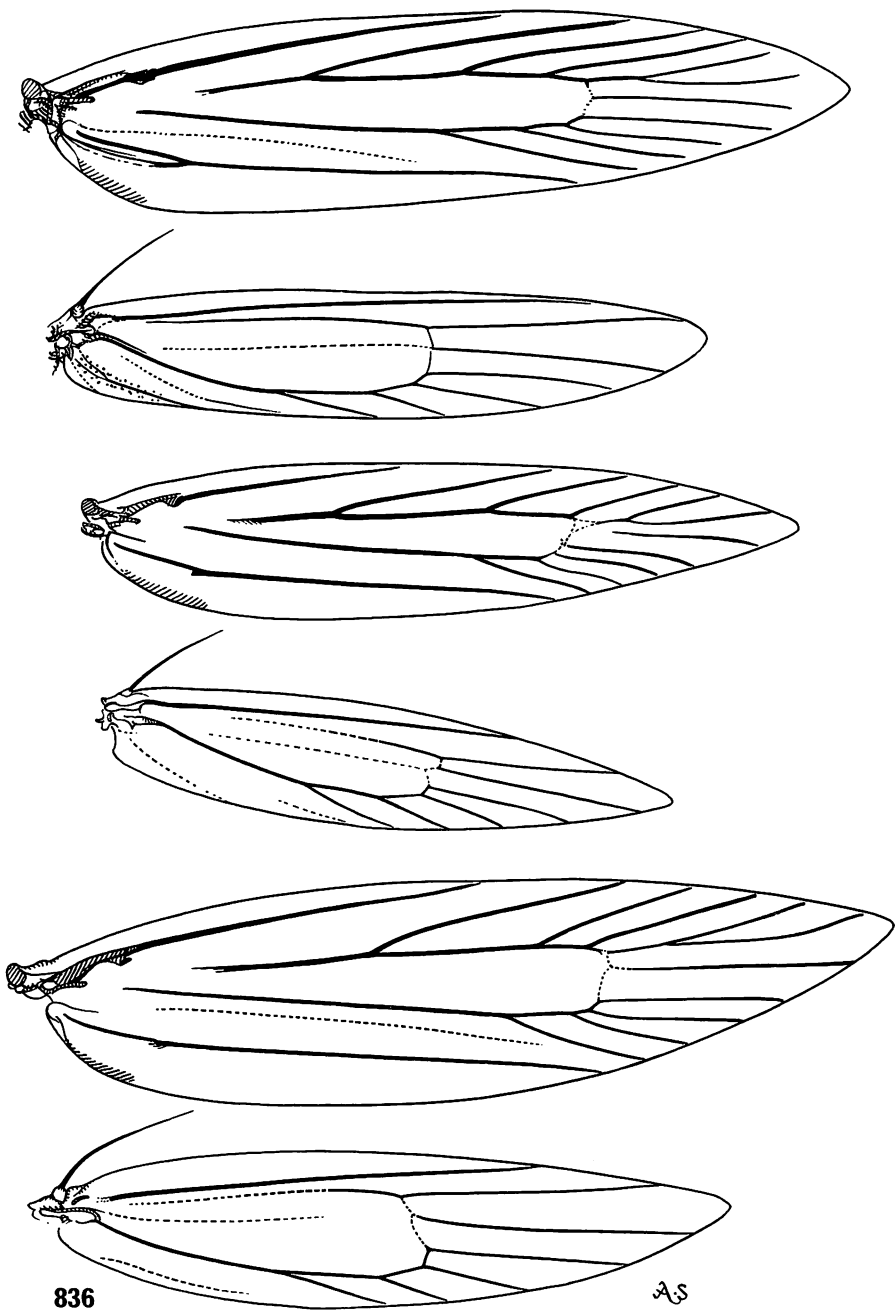


Figure 836—*Hyposmocoma*, wing venations. Top, (*E.*) *fulvocervina* Walsingham, paratype (BM slide 5468); Kauai, 4,000 feet. Middle, (*H.*) *fuscopurpurea* Walsingham, paratype (BM slide 8450); Haleakala, 5,000 feet, Maui. Bottom, (*H.*) *geminella* Walsingham, paratype (BM slide 8454); Halemanu, 4,000 feet, Kauai.

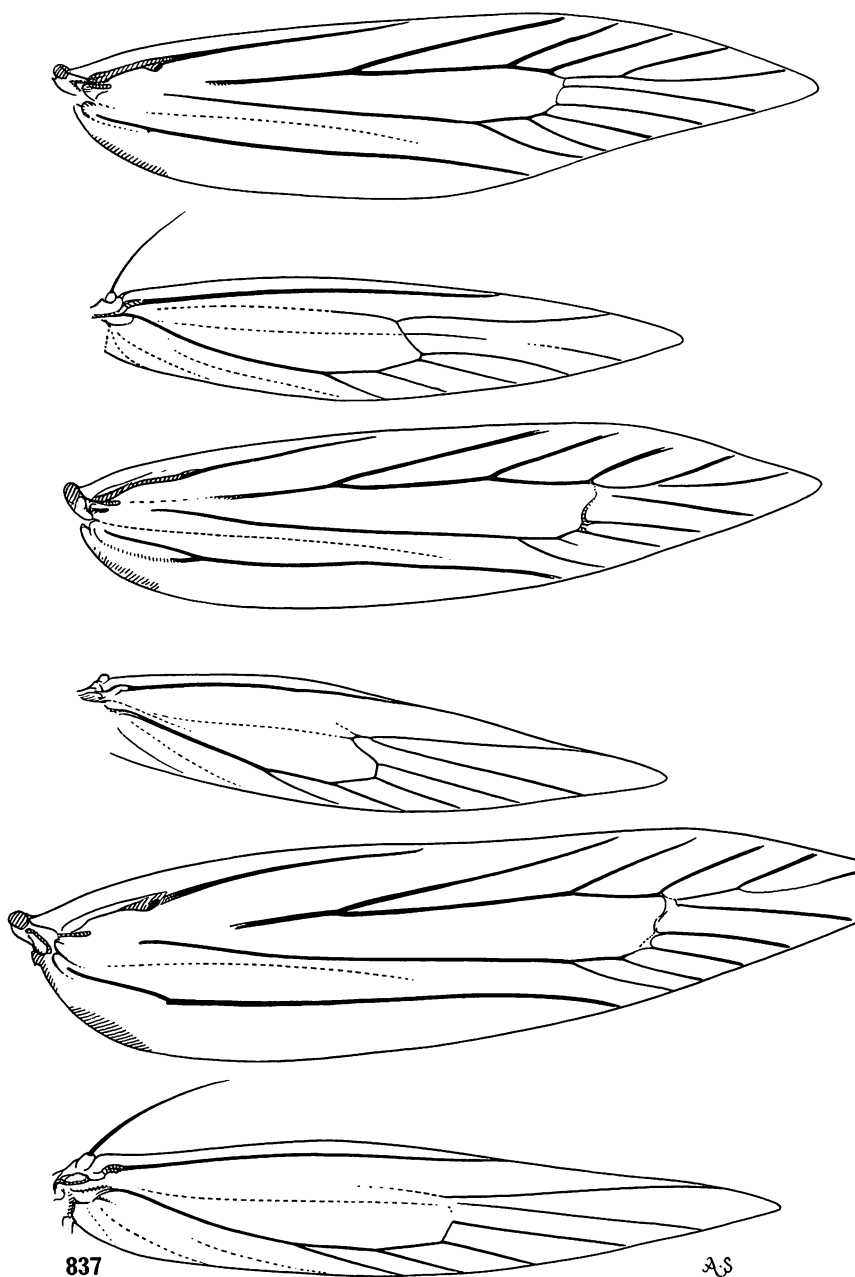


Figure 837—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *haleakalae* (Butler), determined by Walsingham (BM slide 6467); Haleakala, 5,000 feet, Maui. Middle, *illuminata* Walsingham, paratype male (BM slide 7886); Haleakala, 5,000 feet, Maui. Note the weak vein 3 in the forewing. Bottom, *indicella* Walsingham, paratype (BM slide 8459); Haleakala, 5,000 feet, Maui.



Figure 838—Wing venations of *Hyposmocoma* (*Euperissus*). Top, *insinuatix* Meyrick; Kainalu, Molokai (BM slide 16338). Middle, *latiftua* Meyrick; Puu Kalena, Oahu (slide Z-70-15). Bottom, *malacopa* Meyrick; Koolau Mts., Oahu (BM slide 16334).



Figure 839—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *iodes* Meyrick, paratype (BM slide 8465); Molokai, over 3,000 feet. Middle, *lacertella* Walsingham, paratype (BM slide 8460); Haleakala, 5,000 feet, Maui. Bottom, *lactea* Walsingham, paratype (BM slide 8487); Kauai, 3,000 to 4,000 feet. Note the variable developments of the subcostal brushes on the hindwings.



Figure 840—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *lebetella* Walsingham, paratype (BM slide 8047); Haleakala, 5,000 feet, Maui. Middle, *leporella* Walsingham, allotype (BM slide 8546); Lihue, 4,000 feet, Kauai. Bottom, *lineata* Walsingham, paratype (BM slide 8461); Haleakala, 5,000 feet, Maui.



Figure 841—*Hypsmocoma* (*Hypsmocoma*), wing venations. Top, *liturata* Walsingham, paratype (BM slide 5475); Kona, 4,000 feet, Hawaii. Middle, *lixiviella* Walsingham, paratype (BM slide 5517); Kauai, 3,000 to 4,000 feet. Bottom, new species 19, formerly confused as a paratype of *lixiviella* (BM slide 5473); Kauai, 3,000 to 4,000 feet. Note the differences in the wing shapes and venation.



Figure 842—Wing venations of *Hypsoscocoma*. Top, new species 20, erroneously included as a paratype of (*E.*) *longitudinalis* Walsingham (BM slide 8490); gulch leading into Opaepala, Halemano, about 2,000 feet, Oahu. Middle, (*H.*) *ludificata* Walsingham, paratype (BM slide 8500); Haleakala, 5,000 feet, Maui. Bottom, (*H.*) *lupella* Walsingham, paratype (BM slide 5466); Kauai, 4,000 feet.



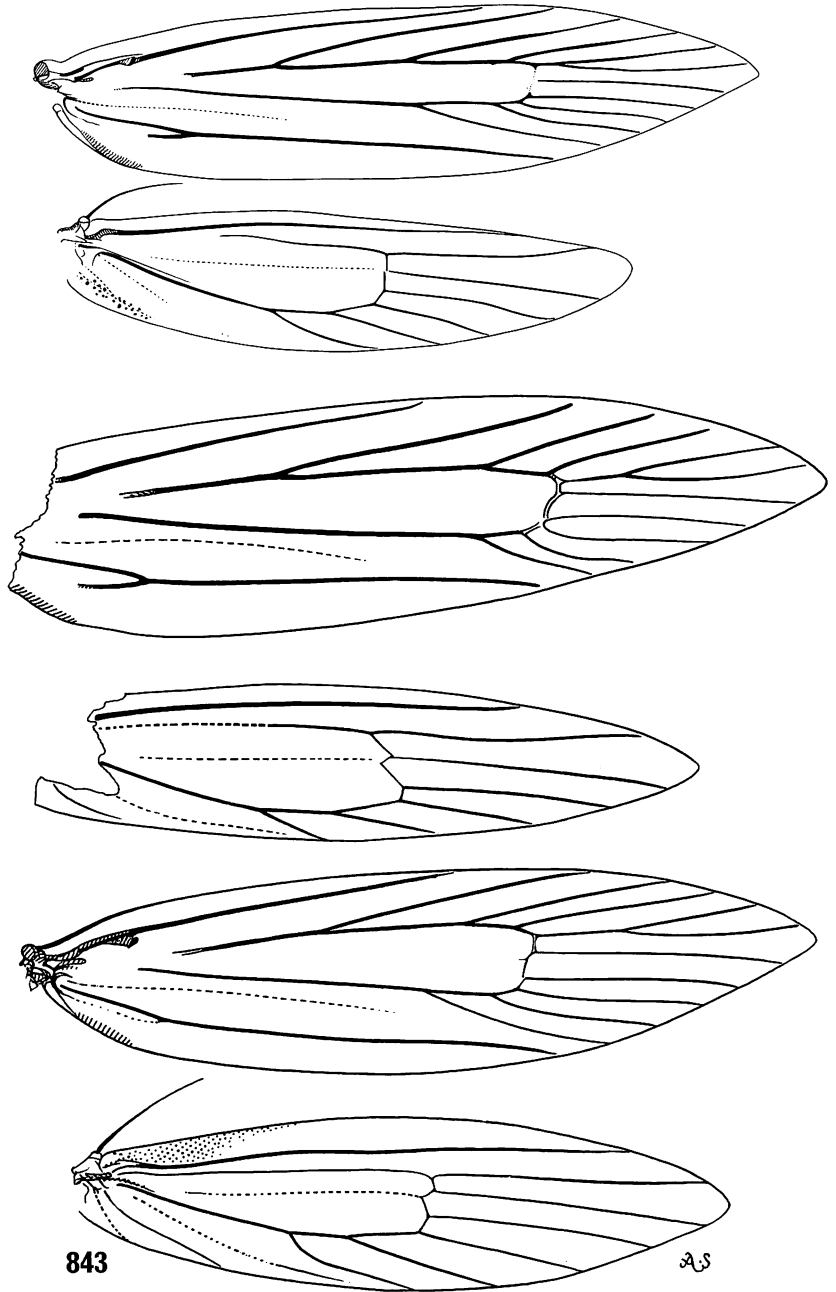
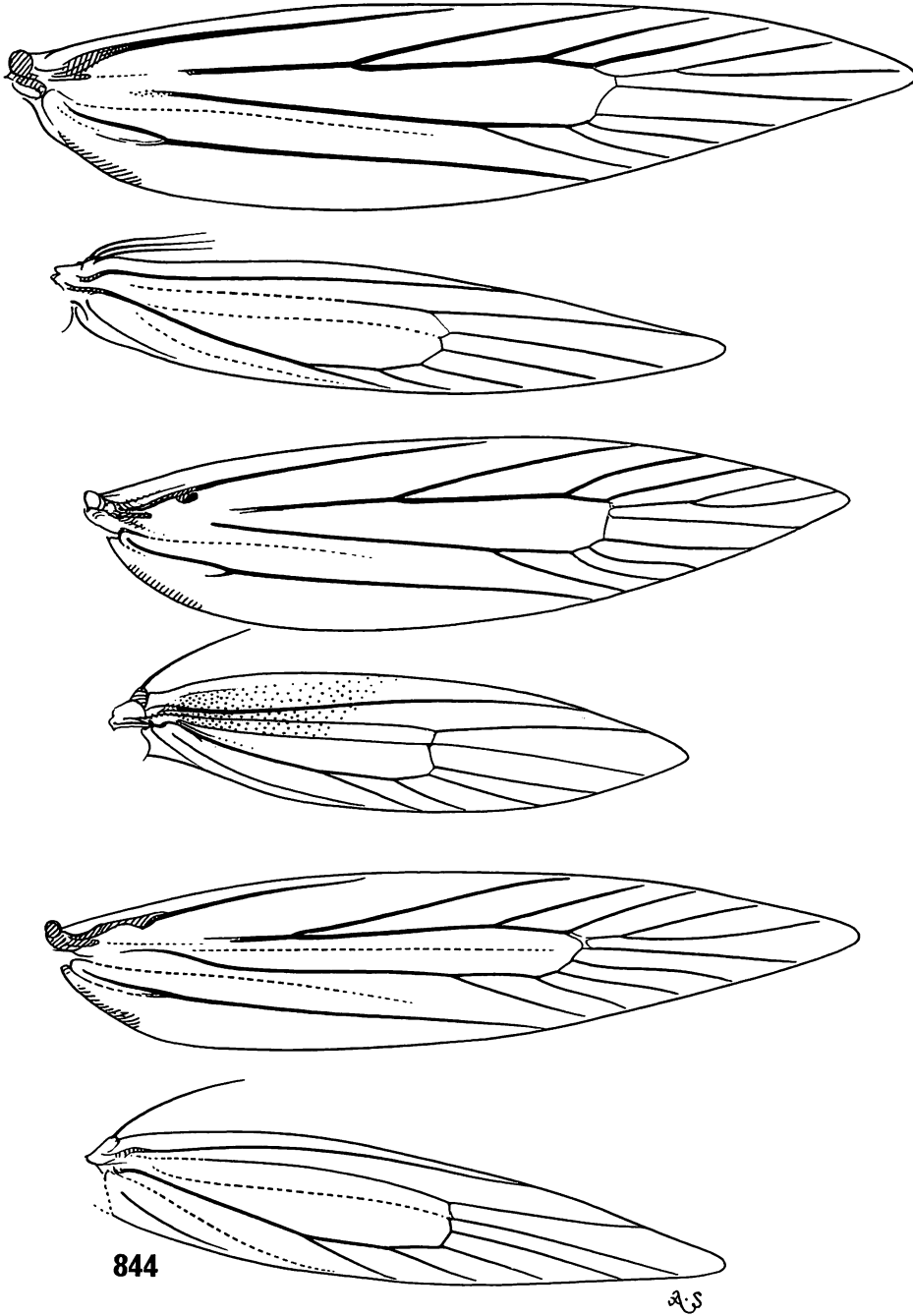


Figure 843—*Hyposmocoma*, wing venations. Top, (*E.*) *maestella* Walsingham, paratype (BM slide 8522); Kaholuamano, 4,000 feet, Kauai. Middle (*H.*) *malornata* Walsingham (BM slide 7504); Molokai, above 3,000 feet. This figure is misleading because the subcostal hairbrush has been broken away from the hind-wing; see figure 845 and the discussion in the text. Bottom, (*H.*) *marginenotata* Walsingham, paratype (BM slide 5453); Kaholuamano, Kauai.



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Figure 844—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *mediella* Walsingham, paratype (BM slide 7934); Waianae Mts., Oahu. Middle, *mediospurcata* Walsingham, paratype (BM slide 5474); Hilo, 2,000 feet, Hawaii. Bottom, *metallica* Walsingham, paratype (BM slide 7982); Hualalai, 5,000 feet, Hawaii.



Figure 845—*Hypsmocoma* (*Hypsmocoma*), wing venations. Top, a specimen of *malornata* Walsingham, erroneously included as a paratype of *metrosiderella* Walsingham (BM slide 7508); Waianae Mts., Oahu. Middle, *mimema* Walsingham, paratype (BM slide 8466); Haleakala, 4,000 feet, Maui. Bottom, *mimica* Walsingham, paratype (BM slide 8467); Molokai, over 3,000 feet.



Figure 846—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *modesta* Walsingham, paratype (BM slide 8508); Kauai, 3,000 to 4,000 feet. Middle, *montivolans* (Butler), paratype (BM slide 8563); mountains near Honolulu. Bottom, *nebulifera* Walsingham (BM slide 5448); determined by Walsingham; northwest Koolau Mts., Oahu.



Figure 847—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *nephelodes* Walsingham, paratype (BM slide 7346); Olinda, 4,000 feet, Maui. Middle, *nigralbida* Walsingham, paratype (BM slide 7871); Kauai, 3,000 to 4,000 feet. Bottom, *nigrescens* Walsingham, paratype (BM slide 8512); Kilauea, Hawaii; this specimen was labeled by Walsingham as a variety—it may not be true *nigrescens*.



Figure 848—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *nigrodentata* Walsingham, holotype (BM slide 7965); Kauai, 3,000 to 4,000 feet. Middle, *nividorSELLa* Walsingham, paratype (BM slide 5449); Kauai, 3,000 to 4,000 feet; note the wide space between veins 6 and 7 in the hindwing. Bottom, *notabilis* Walsingham, allotype (BM slide 7903); Molokai, above 3,000 feet.

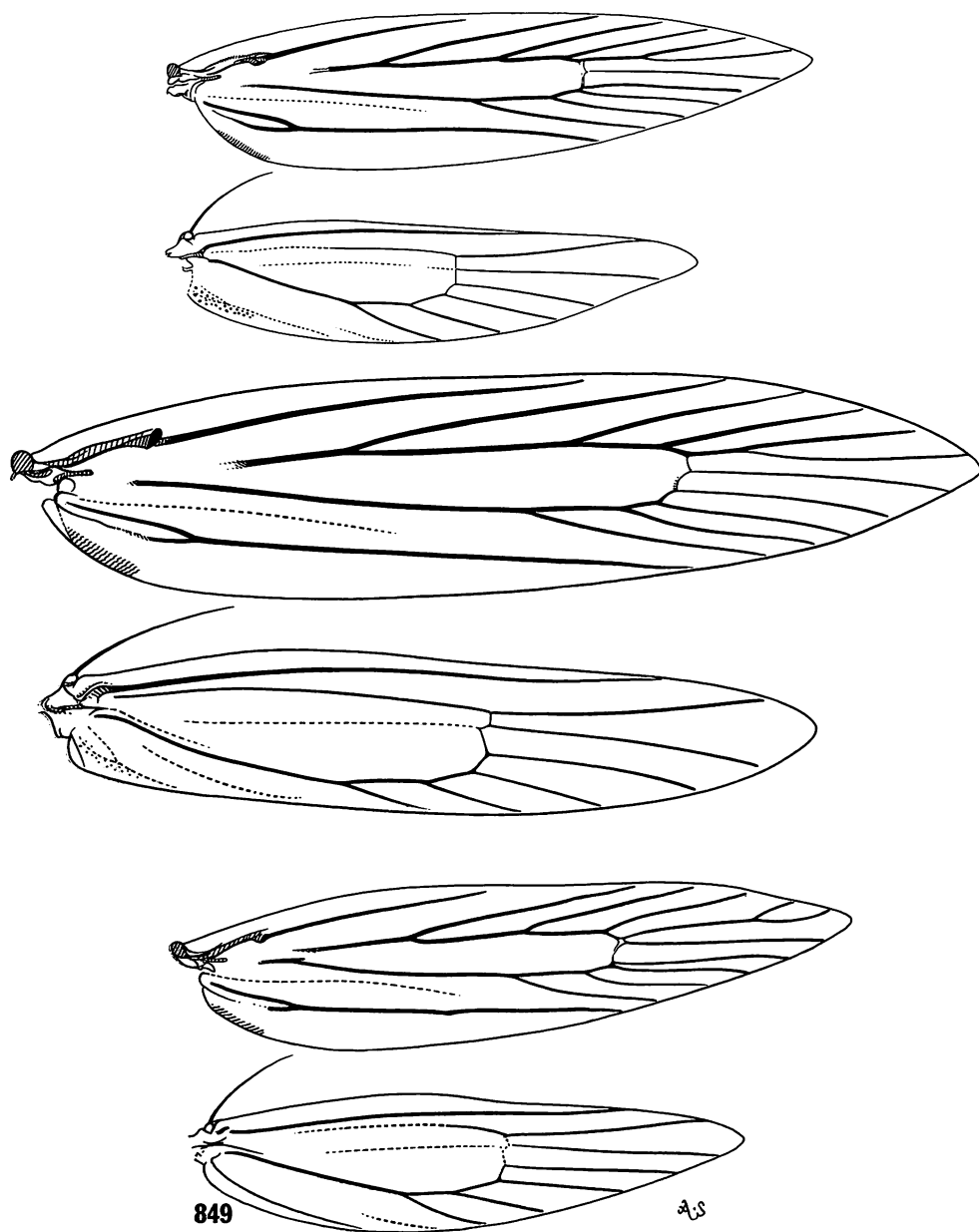


Figure 849—*Hyposmocoma*, wing venations. Top, (*E.*) *obscura* Walsingham, paratype (BM slide 8504); Haleakala, 5,000 feet, Maui. Middle, (*E.*) *ocellata* Walsingham, paratype (BM slide 8607); Kaholuamano, 4,000 feet, Kauai. Bottom, (*H.*) *ochreocervina* Walsingham, paratype (BM slide 8468); Waianae Mts., about 3,000 feet, Oahu. Note the long stem of veins 7 and 8 in the forewing of *ochreocervina*, and compare the places of origin of vein 6 in the three species.

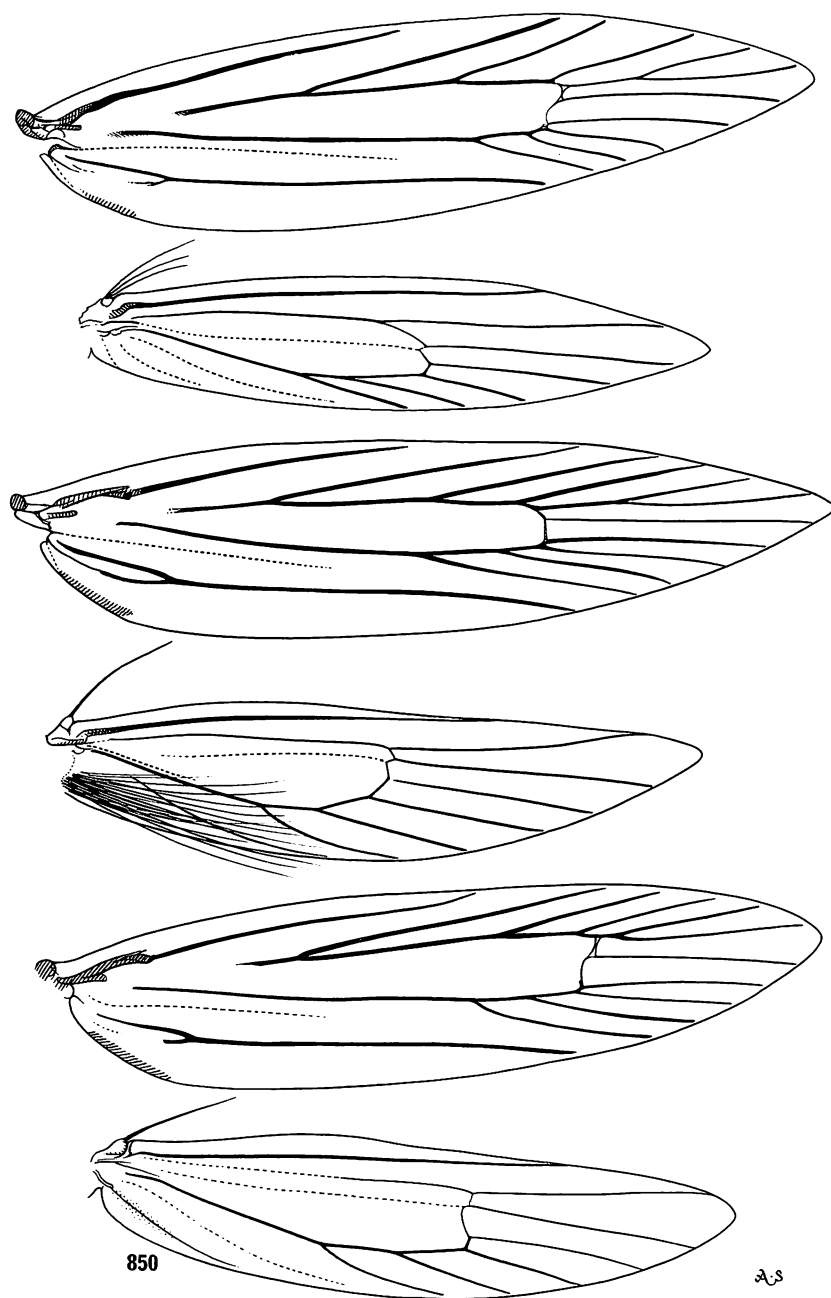


Figure 850—Wing venations of *Hyposmocoma*. Top, (*H.*) *ochreociliata* Walsingham, allotype (BM slide 8549); Kilauea, Hawaii. Middle, (*E.*) *ochreovittella* Walsingham, paratype (BM slide 8517); Kona, 4,000 feet, Hawaii. This drawing is somewhat misleading—there is long hair along the base of veins 1a and 1b on the hindwing, a heavy brush arises from beneath the inner corner of the vannus, and vein 1b is not shown on the drawing. Bottom, (*E.*) *oculifera* Walsingham, paratype (BM slide 7870); Kauai, 3,000 to 4,000 feet.



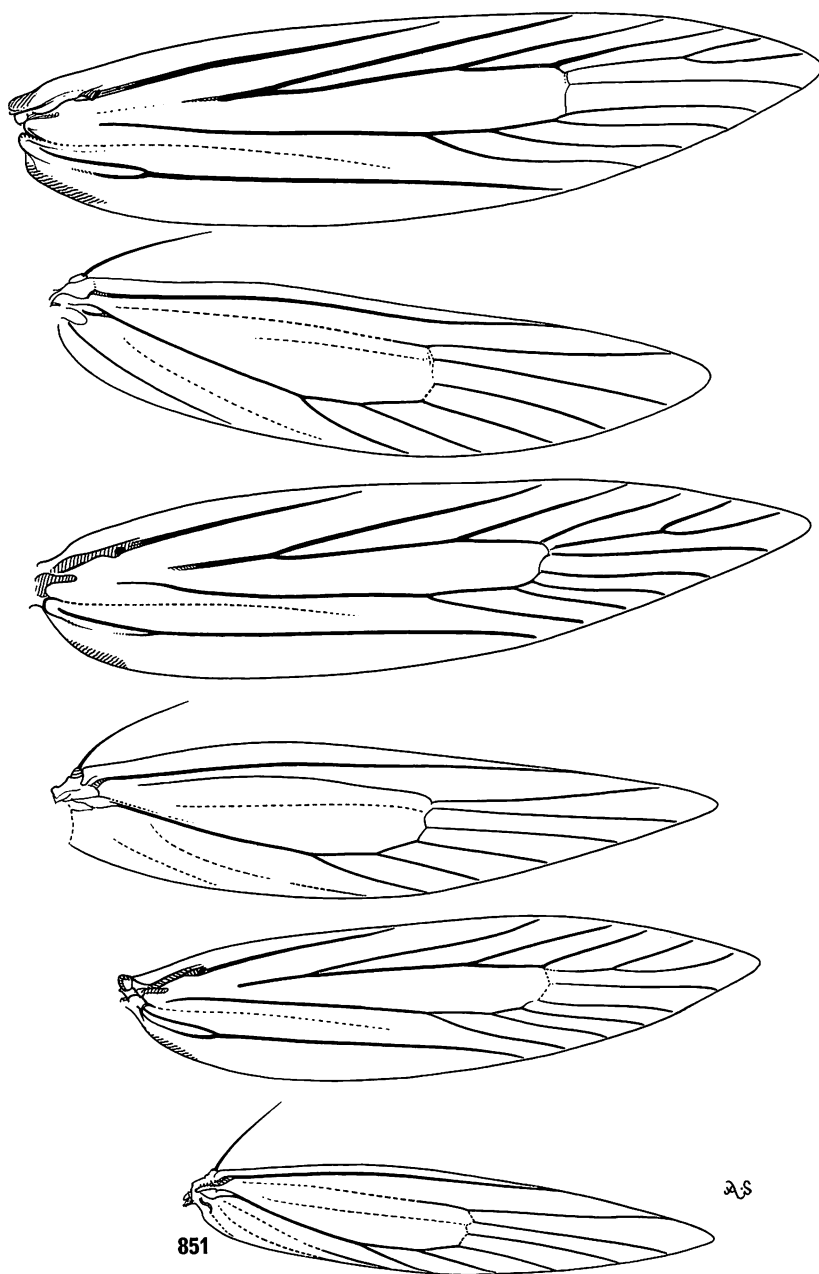


Figure 851—*Hypsmocoma*, wing venations. Top, (*E.*) *ossea* Walsingham, paratype (BM slide 8488). Middle, new species 24, previously confused as a paratype of (*H.*) *paradoxa* Walsingham (see text); Molokai, over 3,000 feet (BM slide 7502). Bottom, (*H.*) *persimilis* Walsingham, paratype (BM slide 8489); Kona, 4,000 feet, Hawaii.

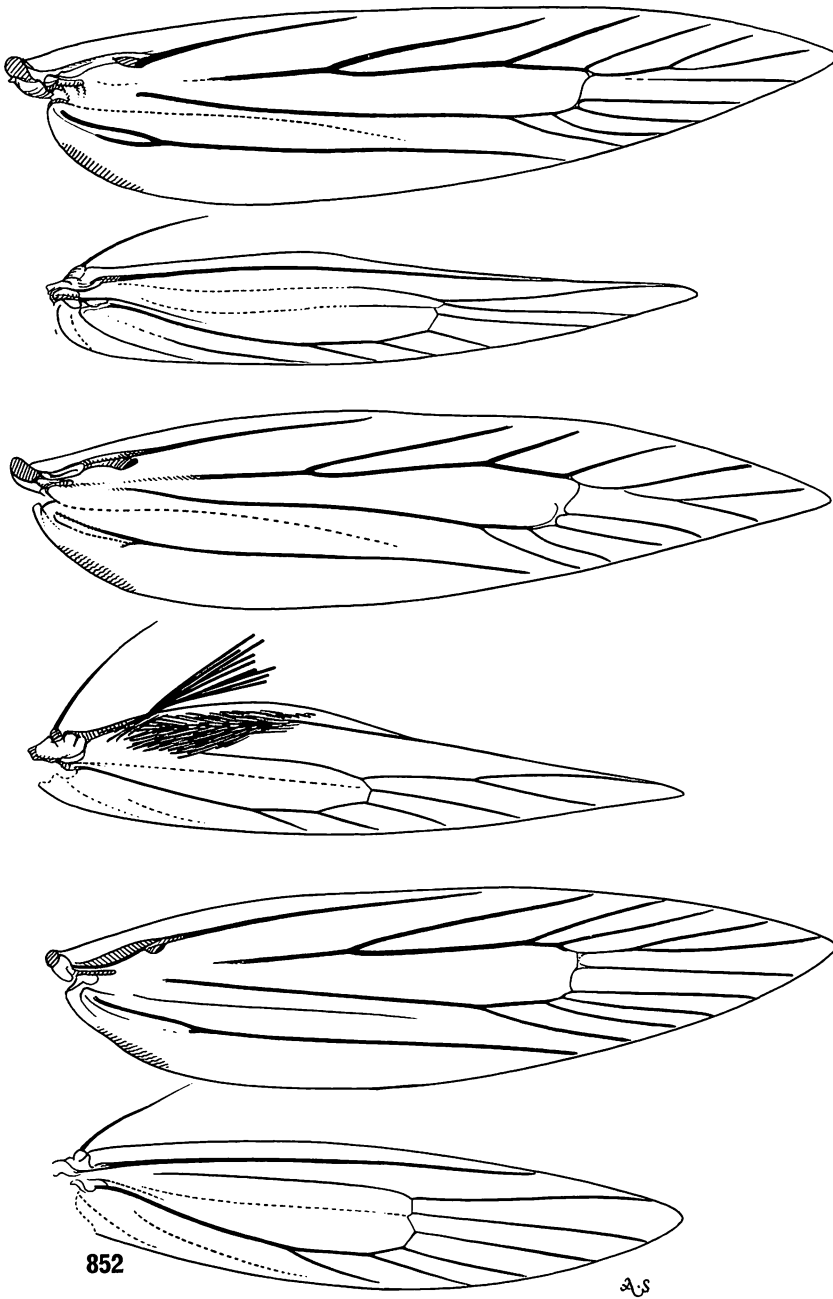


Figure 852—Wing venations of *Hypsmocoma* (*Hypsmocoma*). Top, *petrosia* Meyrick, paratype (BM slide 5478); Koolau Mts., Oahu. Middle, *phalacra* Walsingham, paratype (BM slide 8577); Kauai, 3,000 to 4,000 feet. Bottom, possibly a subspecies of *picticornis* Walsingham (see the text for discussion) (BM slide 7330); Olinda, 4,000 feet, Maui. Note the places of origin of vein 6 in the forewings of these species, and also note the differences in the shape and venation of the hindwing.

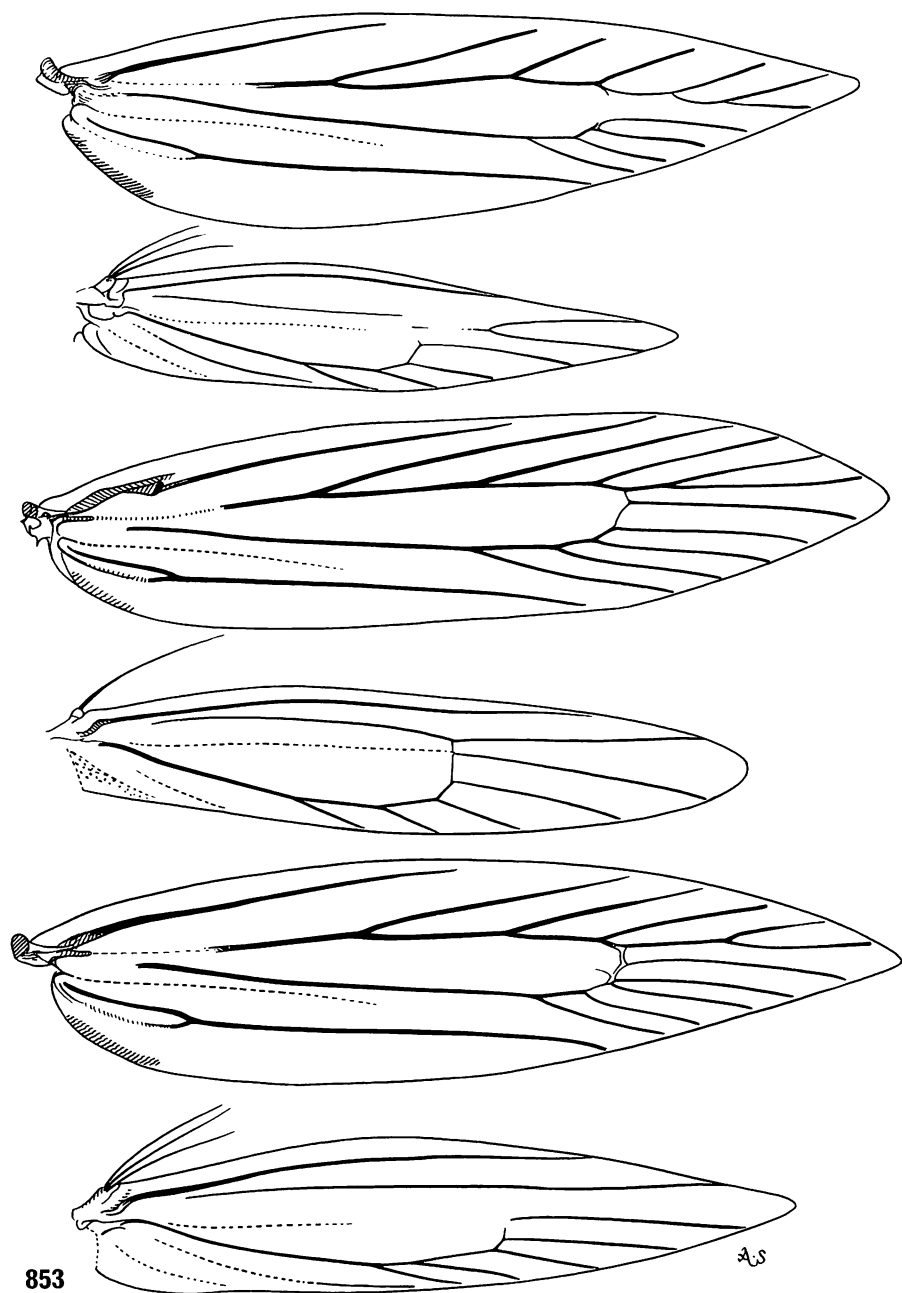


Figure 853—*Hyposmocoma*, wing venations. Top, (*H.*) *pseudolita* Walsingham, paratype (BM slide 8484); Kona, 2,000 feet, Hawaii. Middle, (*E.*) *pucciniella* Walsingham, paratype (BM slide 8575); Kilauea, Hawaii. Bottom, (*H.*) *quinquemaculata* Walsingham, allotype (BM slide 8006); Kona, 4,000 feet, Hawaii. Note especially vein 6 and the forking of 7 and 8 in the forewings of these species.

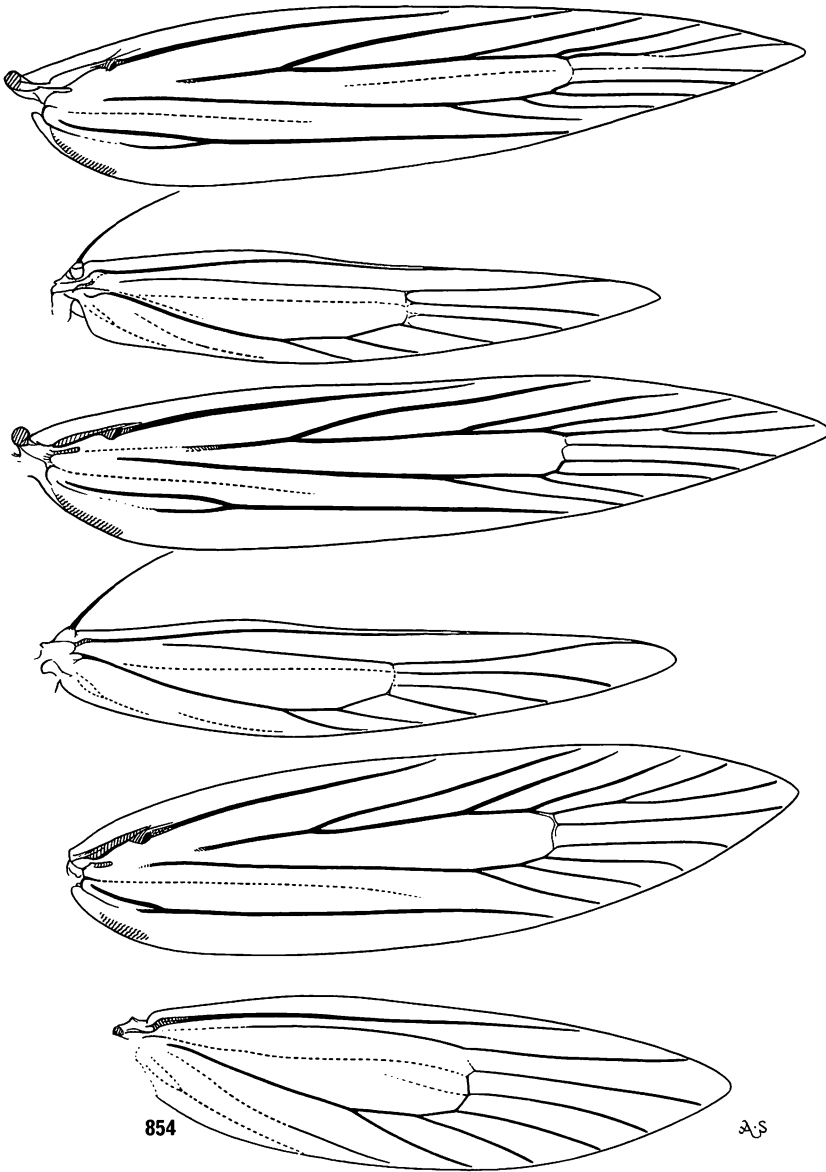


Figure 854—Wing venations of *Hyposmocoma*. Top, (*E.*) *radiatella* Walsingham, paratype (BM slide 8602); Hilo, 2,000 feet, Hawaii. Middle, (*E.*) *roseofulva* Walsingham, paratype (BM slide 8506); Kauai, 3,000 to 4,000 feet. Bottom, (*H.*) *rubescens* Walsingham, paratype (BM slide 6459); Kaholuamano, 4,000 feet, Kauai. Note particularly the differently shaped hindwings, and compare the distances between the bases of veins 3 and 4 and 4 and 7.

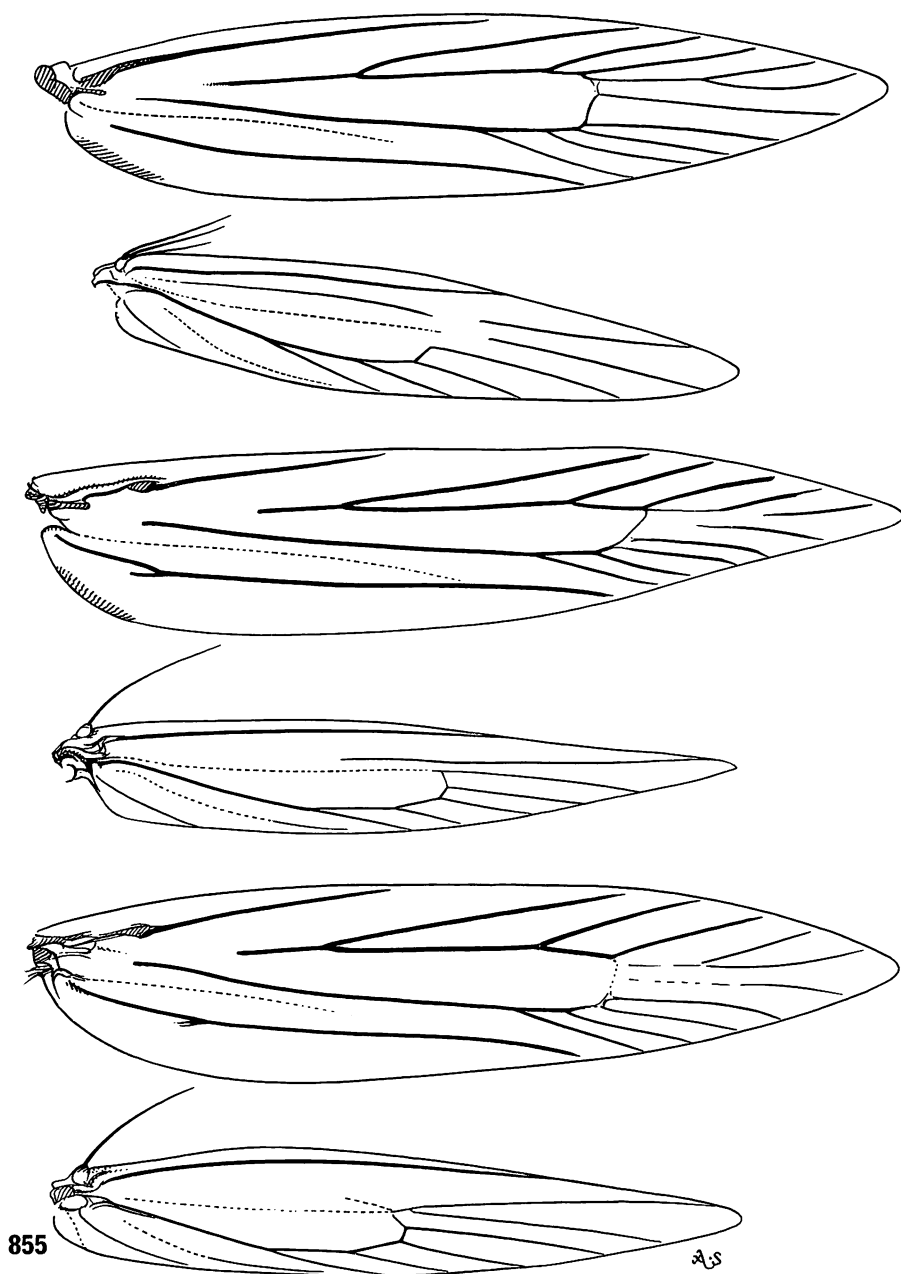


Figure 855—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *sabulella* Walsingham, paratype (BM slide 7935); Halemanu, 4,000 feet, Kauai (part of the membrane of the end of the cell in the hindwing has been torn away). Middle, new species 26, formerly confused as a paratype of *saccophora* Walsingham (BM slide 5472); near head of Kawaioloa Gulch, Oahu. Bottom, *saliaris* Walsingham, paratype (BM slide 5451); Kona, 4,000 feet, Hawaii. Compare the position of the origin of vein 2 in the hindwings of these and other species.

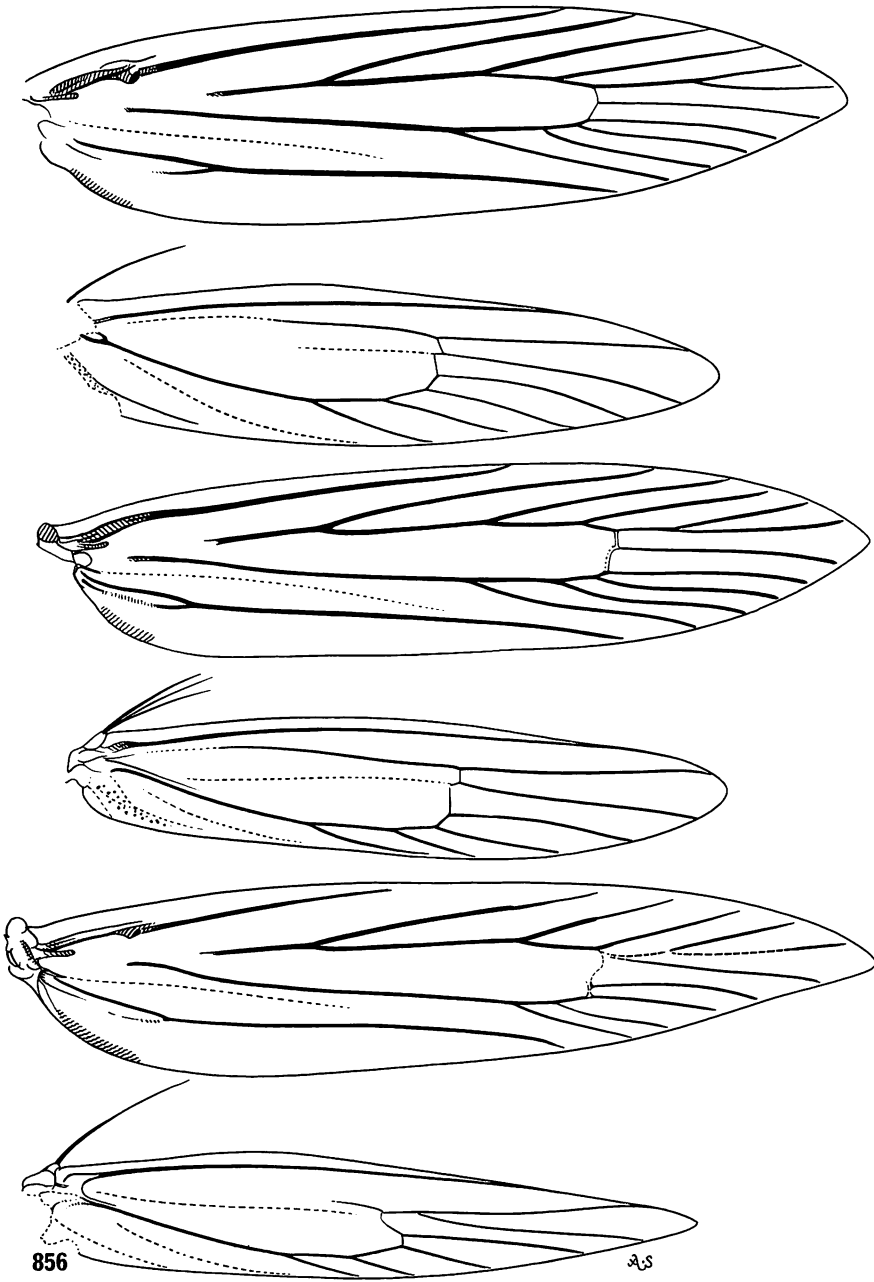


Figure 856—Wing venations of *Hypsimocoma*. Top, (*E.*) *scandens* Walsingham, paratype (BM slide 8519); Kauai, 3,000 to 4,000 feet. Middle, (*E.*) *scepticella* Walsingham, allotype (BM slide 7940); Olinda, 4,000 feet, Maui. Bottom, (*H.*) *schismatica* Walsingham, paratype (BM slide 8507); Kaholuamano, 4,000 feet, Kauai.



Figure 857—*Hypsoscoma*, wing venations. Top, (*H.*) *scolopax* Walsingham, paratype (BM slide 8578); Kauai, 3,000 to 4,000 feet. Middle, (*E.*) *semifuscata* Walsingham, paratype (BM slide 8571); Kona, 3,000 feet, Hawaii. Bottom, (*H.*) *similis* Walsingham, paratype (BM slide 8536). Compare the points of termination of vein 12 in the forewings.

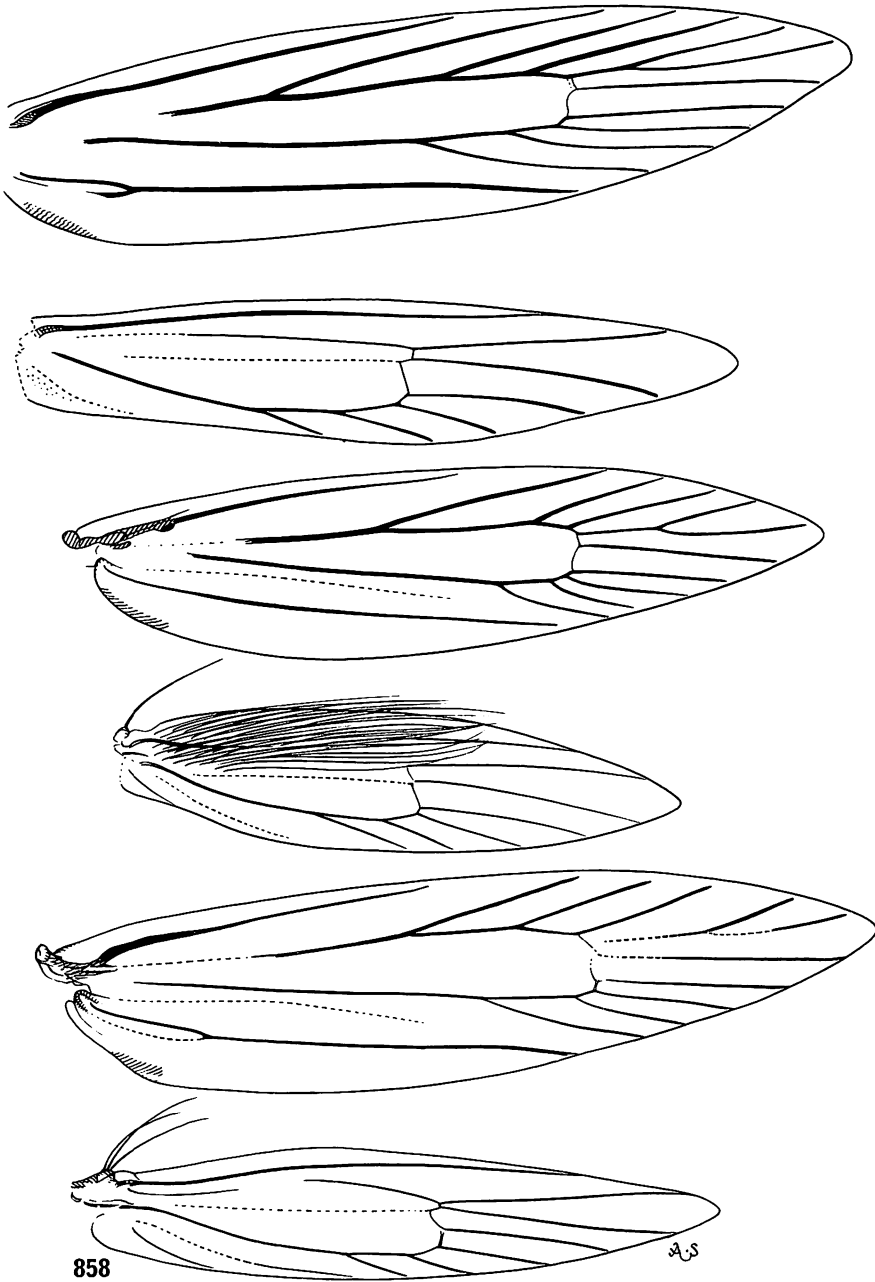


Figure 858—Wing venations of *Hyposmocoma*. Top, (*E.*) *stigmatella* Walsingham, paratype female (BM slide 8535); Molokai, about 4,000 to 5,000 feet. Middle, (*H.*) *straminella* Walsingham, paratype (BM slide 7981); Kona, 4,000 feet, Hawaii. Bottom, (*H.*) *subcitrella* Walsingham, holotype (BM slide 4492); Kaholuamano, 4,000 feet, Kauai.



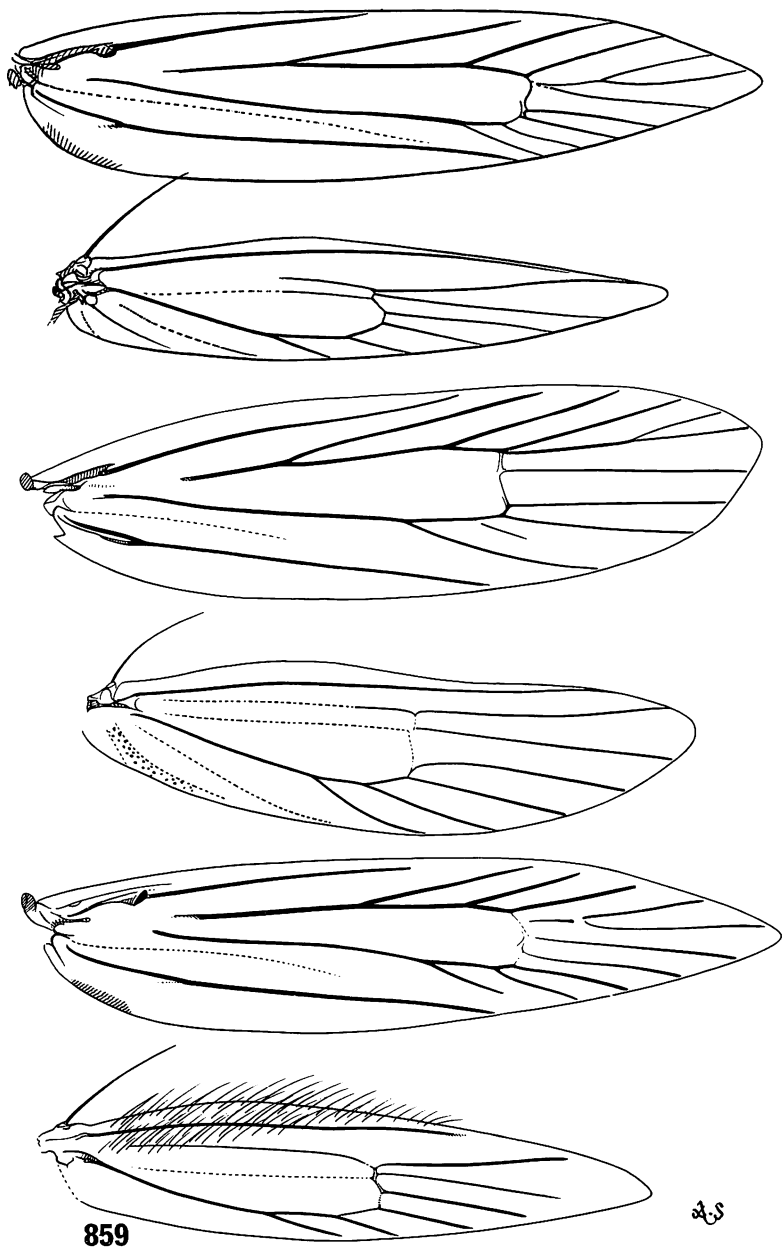


Figure 859—*Hypsmocoma*, wing venations. Top, (*H.*) *subflavidella* Walsingham, paratype (BM slide 5450); Haleakala, 5,000 feet, Maui. Middle, (*E.*) *subnitida* Walsingham, paratype (BM slide 8603); Kona, 4,000 feet, Hawaii. Bottom, (*H.*) *subscelopax* Walsingham, paratype (BM slide 8580); Kona, 4,000 feet, Hawaii.

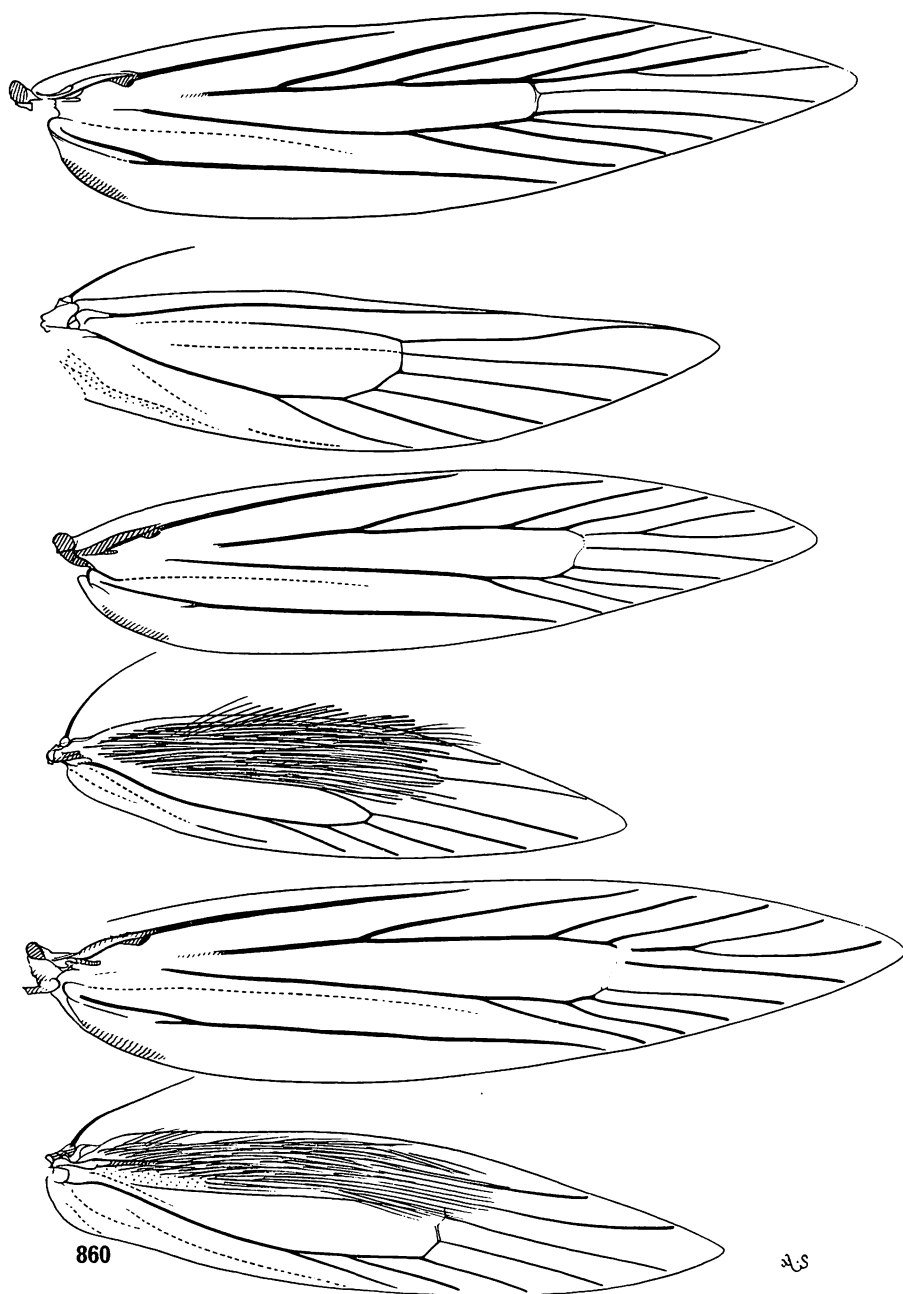


Figure 860—Wing venations of *Hypsmocoma* (*Hypsmocoma*). Top, *sudorella* Walsingham, paratype (BM slide 8518); Kaholuamano, 4,000 feet, Kauai. Middle, *suffusa* (Walsingham), paratype (BM slide 8608); Kilauea, Hawaii. Bottom, *suffusella* (Walsingham), paratype (BM slide 7335); Kaholuamano, 4,000 feet, Kauai.

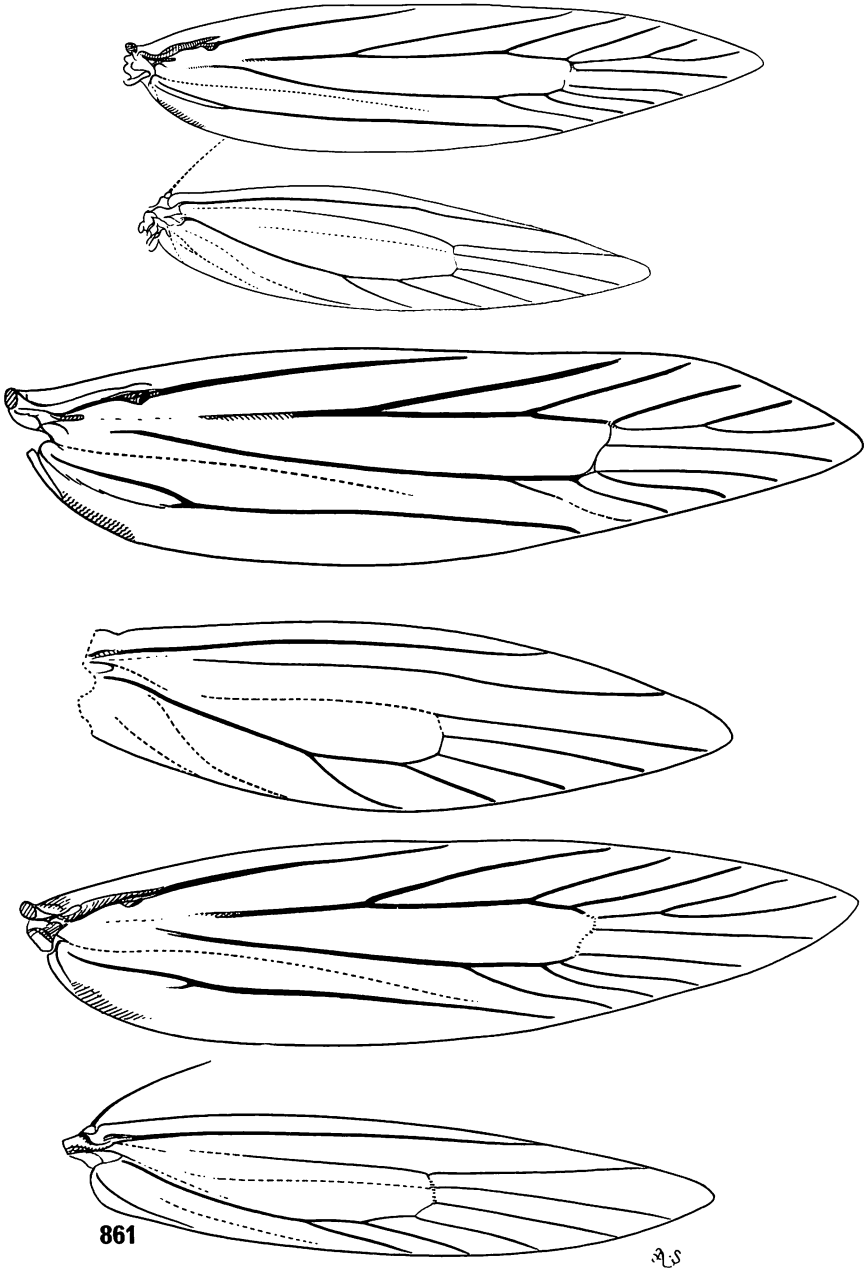


Figure 861—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *syrrhaptus* Walsingham, paratype (BM slide 8561); Kauai, 3,000 to 4,000 feet. Middle, *tarsimaculata* Walsingham, paratype (BM slide 8560); Kauai, 4,000 feet. Bottom, *tenuipalpis* Walsingham, paratype (BM slide 8048); Molokai, 4,500 feet.

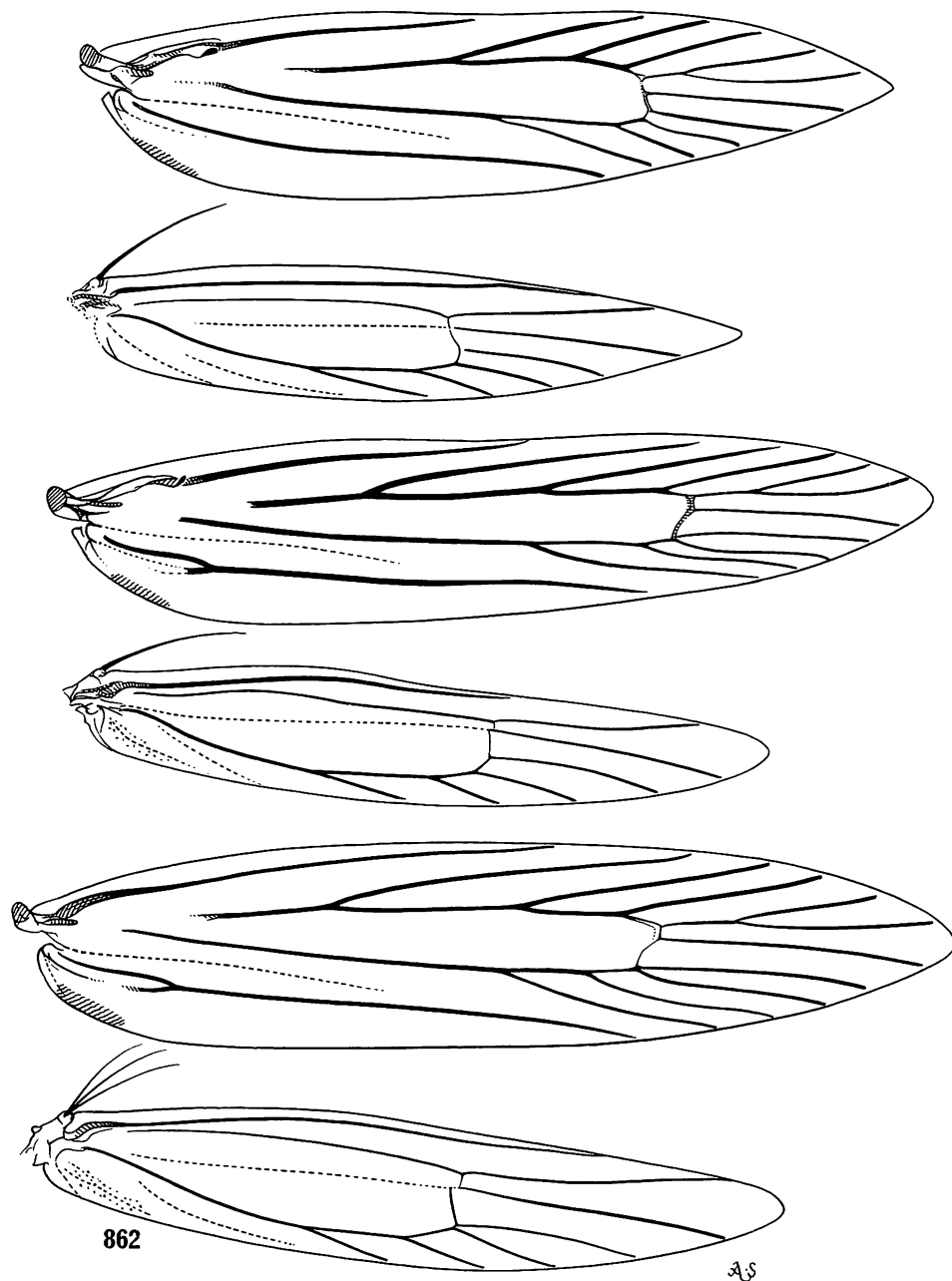


Figure 862—Wing venations of *Hyposmocoma* (*Hyposmocoma*). Top, *tetraonella* Walsingham, paratype (BM slide 8581); Kilauea, Hawaii. Middle, *tricincta* Walsingham, paratype (BM slide 6469); Kilauea, Hawaii. Bottom, *trilunella* Walsingham, paratype (BM slide 8089); Haleakala, 5,000 feet, Maui.

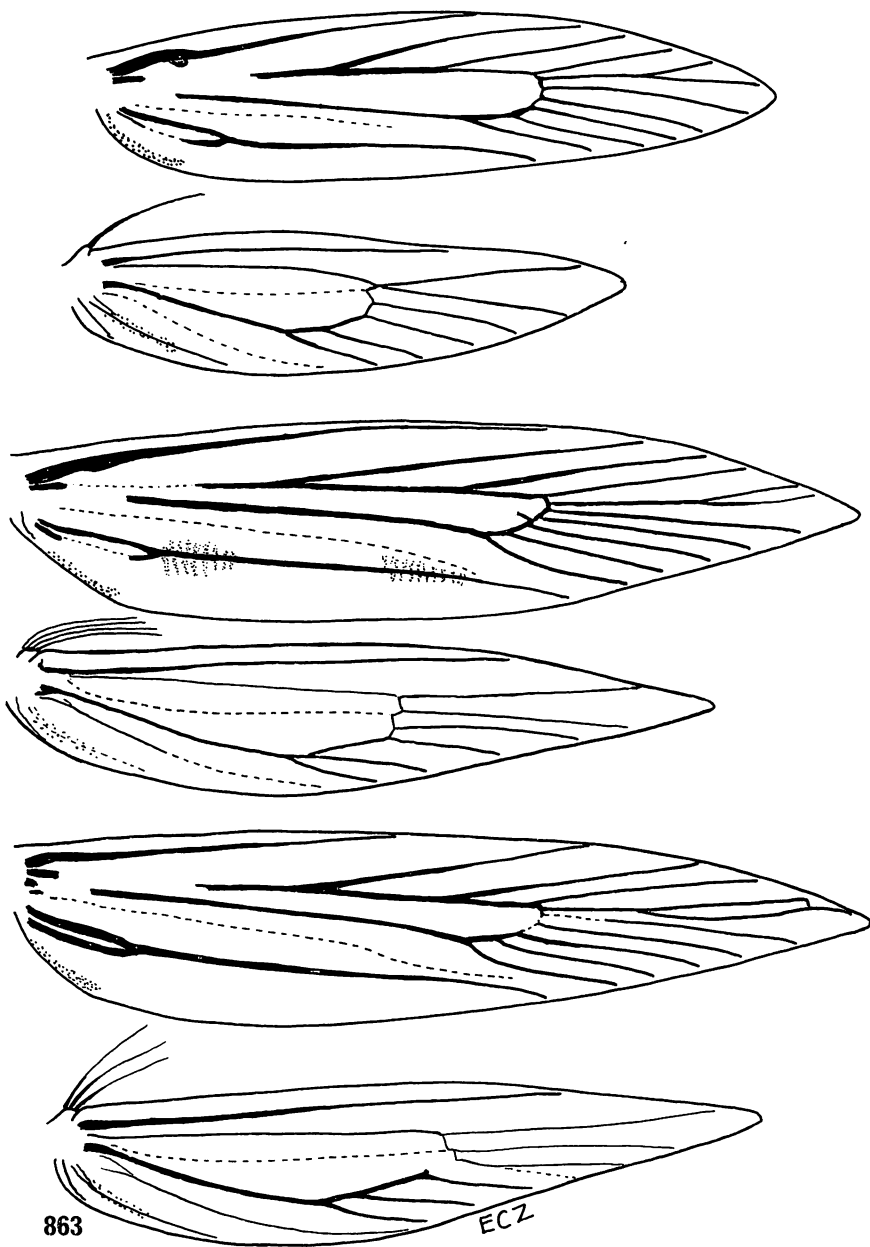


Figure 863—Wing venations of *Hypomocoma* (*Euperissus*). Top, *thermoxyla* Meyrick; Honolulu (BM slide 16346). Middle, left wings drawn reversed, and with the sockets of the scales in the raised patches indicated, of *palmivora* Meyrick; Kumuwela, Kauai (BM slide 16343). Bottom, another specimen of *palmivora* showing individual variations; Kalalau, Kauai (BM slide 16339). Note that the female illustrated in the middle has an abnormal four setae in the frenulum.

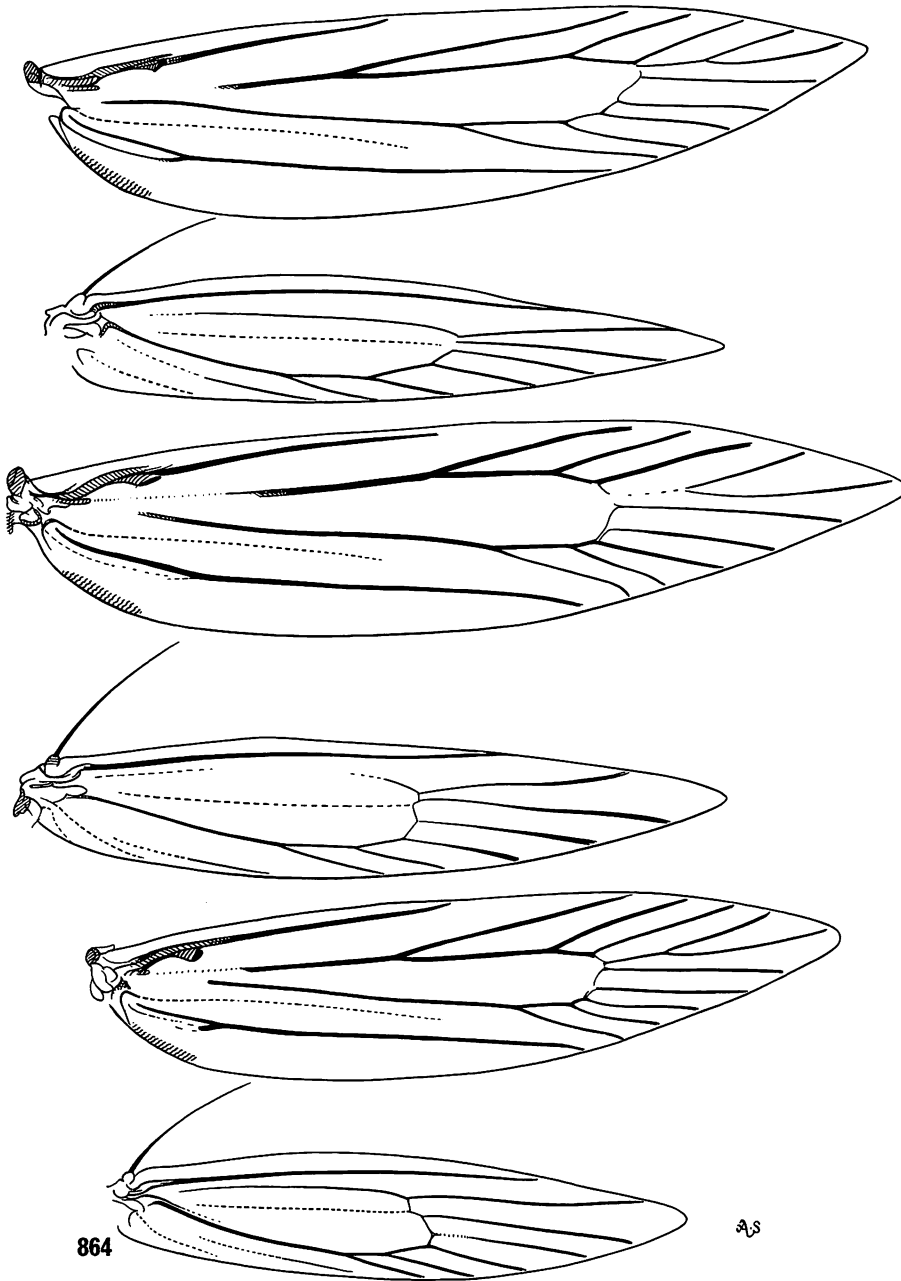


Figure 864—*Hyposmocoma* (*Hyposmocoma*), wing venations. Top, *trimaculata* Walsingham from a specimen determined by Dr. Swezey and not verified (BM slide 8605); Waianae Mts., Oahu. Middle, *turdella* Walsingham, paratype (BM slide 8601); Lanai, 2,000 feet. Bottom, *unistriata* Walsingham, paratype (BM slide 8511); Molokai, over 4,500 feet.

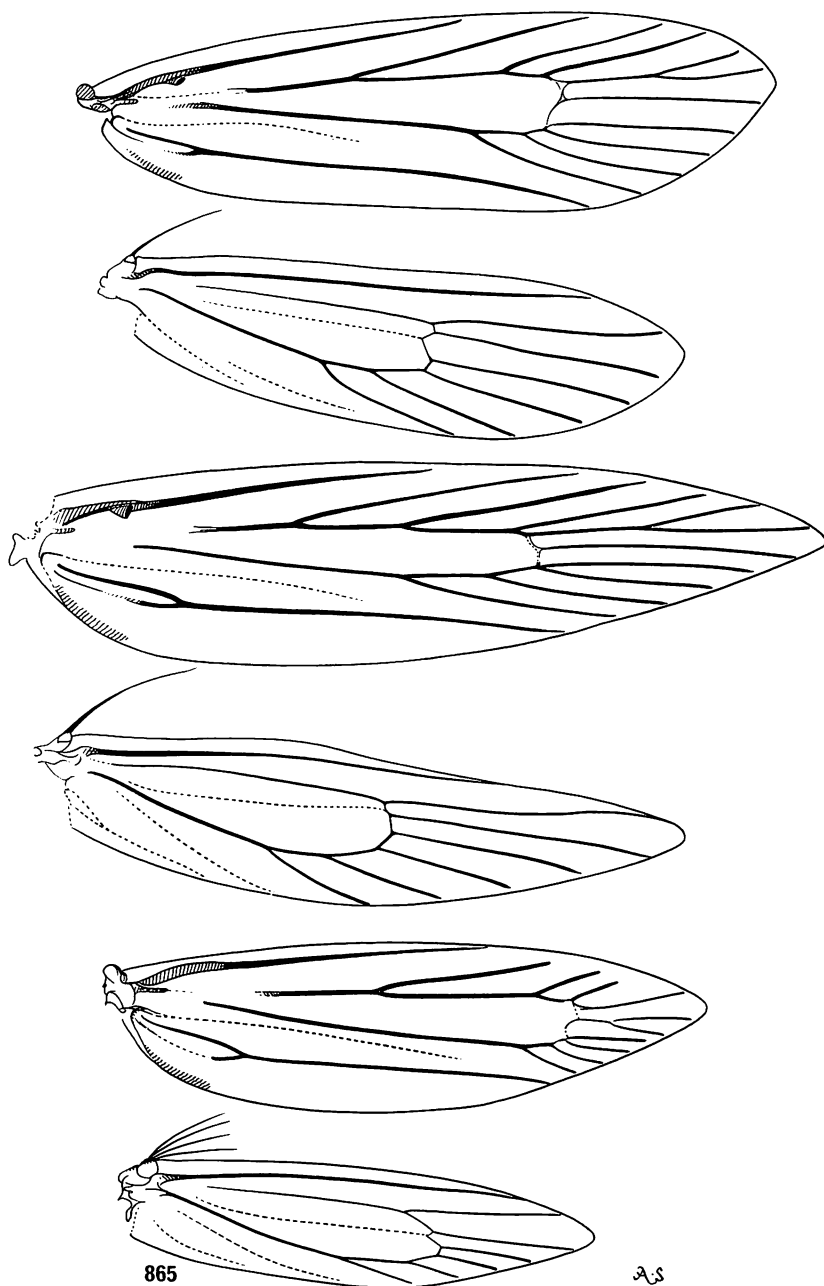


Figure 865—Wing venations of *Hyposmocoma*. Top, (*H.*) *vermiculata* Walsingham, paratype (BM slide 8513); Kaawaloa, Kona, 2,000 feet, Hawaii. Middle, (*E.*) *vicina* Walsingham, paratype (BM slide 8505); Waianae Mts., 1,700 feet, Oahu. Bottom, (*H.*) *vinicolor* Walsingham, paratype (BM slide 7059); Waianae Mts., 3,000 feet, Oahu. Note the differences in the shapes of the wings of these species. Note also that the specimen of *vinicolor* is abnormal, because veins 6 and 7 in the forewing arise from a common stalk. On the left wing of this specimen, and on the holotype, vein 7 runs normally out of 8 to costa.

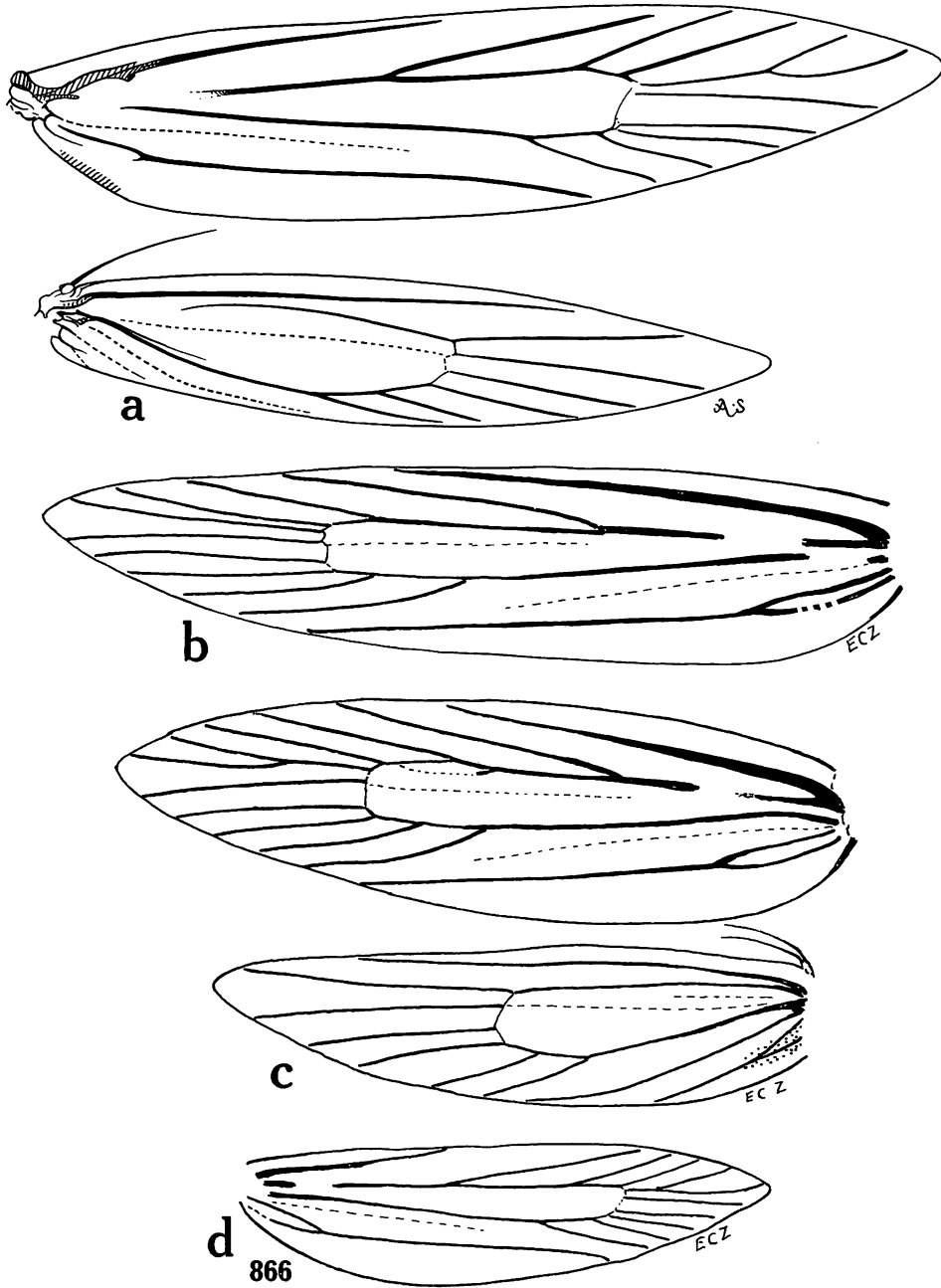


Figure 866—Wing venations of *Hypsoscymoma*. *a*, (*H.*) *virgata* Walsingham, paratype (BM slide 5467); Haleakala, 5,000 feet, Maui. This may represent a subspecies of *virgata*; see illustration of the male genitalia of this specimen in figure 1194. *b*, forewing of the holotype female of (*E.*) *homopyrrha* (Meyrick), the type-species of *Phthoraula* Meyrick; Nuuanu, Oahu (slide Z-70-2); note the loss of vein 8; the left hindwing of the unique holotype was lost before I examined the specimen, and I have thus not been able to make a slide preparation of the hindwing. *c*, (*E.*) *argomacha* Meyrick, holotype (slide Z-70-4); Kilauea, Hawaii. *d*, forewing of (*H.*) *oxypetra* Meyrick, female holotype (slide Z-70-3); Pacific Heights, Oahu. The right hindwing of this specimen was lost before I examined it, and I have not been able to prepare a hindwing for illustration. These specimens have not been drawn to the same scale.



(Continued from page 1158.)

1. A major difference is whether the vestiture of the vannal area of the hindwing is clothed with squamae only or whether there are long hairs along vein 1b or between veins 1b and 1a. I have found that these differences will divide the huge genus in two approximately equal parts which correlate almost completely with differences in the male genitalia (but see the exceptional "*Diplosara*" *lignivora*), as I have detailed below. I have used these characters to divide the genus into what I have called subgenus *Euperissus* and subgenus *Hypsmocoma sensu stricto*.

It is noteworthy that no previous worker realized that the genus could be divided so nicely by these characters, although Walsingham did use the nature of what he called the "limbal hair-pencil" for the differentiation of some of the species he studied. The fact that the complex can be divided into two nearly equal major divisions is of great assistance to the formulation of a key, and we are most fortunate that this primary division can be made. An interesting fact is that all of the known species whose larvae are case makers belong to *Hypsmocoma sensu stricto*, and all whose larvae are known to be naked belong to subgenus *Euperissus*.

2. The male genitalia (figures 789–791, for example) usually exhibit many remarkable differential features. All parts of the genitalia may display good characters which can be used to distinguish species: the character of the genital "flaps" (see figures 791–793, 1039, for example); the nature of the sclerotization of the seventh and eighth abdominal sternites and tergites; development of the tegumen; shapes of the brachia; anellus lobe differences; aedeagus; size and shape of the valvae and nature of their vestiture; the presence or absence, number, size, arrangement, and shape of the spurs on the valvae and the kinds of expansions from the costal margins of the valvae; etc.

The female genitalia (figures 794–798, for example) have less conspicuous differences. But some features, especially of the ostium which often displays strong specific differences, serve for species separation. The ovipositor varies specifically in length, there may or may not be signa in the bursa copulatrix, and there are other characters of value as aids to identification.

3. There are specialized features of the abdomen that are useful in differentiating species. These include patches of modified squamae or setae (figure 1097), sclerotized rings and plates (figures 1037, 1062, 1066, 1071, 1119, 1120, 1132, 1133, 1138, for example), sclerotized appendages such as the pseuduncus which is very strongly developed in some species but absent from many (figures 791, 1035, 1050, 1051, 1072, 1075, 1119, for example), the caudal processes typical of most of the males of the "*Aphthonetus*" group, and other modifications.

4. The males of many, but not all species of *Hypsmocoma sensu stricto*, have strongly developed subcostal brushes on the hindwings. One species may appear closely similar to another species, but one will have a subcostal brush whereas the brush is lacking on the other species. All males of subgenus *Euperissus* lack subcostal brushes. The brushes vary in size, structure and color.

5. The forewing in the male may or may not have a costal fold or flap on the underside. The character of the vestiture of other parts of the ventral surface of the wing may be distinctive.

6. There may be patches of raised squamae on the forewings, and these may display specific differences. The shape and character of the squamae elsewhere on the wings may also differ.

7. The hindwing may or may not have a fringe of hair or specialized setae along the posterior edge of the basal part of the cell.

8. Wing shape and comparative breadths of the wings vary.

9. Wing venation may be used (with caution).

10. Some species have brushes of hair in the posterior axils of the hindwings or on the metapleura beneath the anterior corners of the hindwings. There are often sexual differences in these brushes when they are present. Most of the true "*Neelysia*" group and some other species have strong metapleural brushes which cross over the abdomen where they are held by clusters of greatly enlarged, specialized squamae (figure 878, top). I have not seen any of these conspicuous brushes on any of the "*Aphthonetus*" group, but some species have incipient or vestigial patches of hairs as do various species of other groups. Other features of the pleura such as the sizes and shapes of the squamae are also useful for differentiation.

11. Various characters of the antennae may be important. Sexual characters are often evident—the males of some species (*cristata*, for example) have long hairs on the underside basad of the middle. The shape of the first antennal segment and the nature of the pecten if one is present vary.

12. The nature of the vestiture of the head, thorax and abdomen differs. The metascutum may have broad squamae, long narrow squamae or hairs, or combinations of vestiture.

13. Characters of the palpi, such as size, shape and vestiture can be significant. For example, the palpi are diagnostic of the *lignivora* group as are the palpi of the two species formerly placed in *Euhyposmocoma*; see figures 778–787.

14. The vestiture of the legs, especially that of the posterior tibiae, and the tarsal chaetotaxy differ.

15. The color and color pattern of all parts, bearing in mind the considerable individual variation in some species, are, of course, valuable for species discrimination.

16. Locality may be used. However, caution is necessary in the light of how little is known concerning distributions. Some apparently wide distributions may actually involve sibling species clusters.

The discrimination of the multitude of species of *Hyposmocoma* is complex and very difficult. Specimens that may appear externally closely similar may have widely different genitalia. This external resemblance of species in clusters led previous authors to lump as many as seven or more species together under one name. Other species that have closely similar genitalia may be conspicuously different in external appearance. The male genitalia of *evanescentes* (figure 1072), *haleakalae* (figure 1083), and *lacertella* (figure 1092), for example, are closely similar, but externally these moths are very distinct. Externally, *marginenotata* (figure 929) and *vermiculata* (figure 988) are closely

similar, and the genitalia of the males are also similar. But, astonishingly, the male of *marginenotata* (Kauai) has a well-developed subcostal brush on the hindwing whereas the male of *vermiculata* (Hawaii) lacks a subcostal brush. Similarly, *lineata* (figure 922) and *ludificata* (figure 924), both from Maui, have such extraordinarily similar black and white color patterns that one could easily consider them to be the same. However, *lineata* lacks a subcostal brush on the hindwing of the male whereas the male of *ludificata* has a strongly developed yellow subcostal brush and, in addition, it has enlarged, specialized squamae on the wing caudad of the brush. The male genitalia are very similar, but they are distinctive. The male genitalia of *illuminata* (figure 1086) and *indicella* (figure 1080, 1088), both of Maui, are closely similar, but externally the moths are so extremely different (figures 914, 915) that one can hardly believe that they are close allies if one does not examine the genitalia. The reader is referred to other discussions below under the species headings *Hypsmocoma blackburnii*, *longitudinalis*, and *lupella* and to the figures which accompany those discussions.

Some of the species of *Hypsmocoma* that may be grouped together because of their generally similar male genitalia are such externally distinctive moths that Walsingham and Durrant were led to separate them widely in their treatment of the genus. The cluster of species allied to *iodes*, for example, was placed as number 3 (*nigralbida*), 11 (*nebulifera*), 100 (*alliterata*), 140 (*ochreociliata*), 143 (*conditella*), 145 (*iodes*), and 146 (*literata*) in their arrangement. The male genitalia of some of these species are so similar that they might appear at first sight to represent the same species, but the moths are very different organisms. Compare my figures 937, bottom, of *nigralbida*, 870, top, of *alliterata*, and 917, top, of *iodes*, for example.

Similarly, the *admirationis* group of *Hypsmocoma* includes 15 or more species most of which have closely similar male genitalia. Some of these have almost identical genitalia. Many of the moths are, however, conspicuously different. Some of the species, such as *admirationis*, *alveata*, *carbonenotata*, *irregularis*, *propinqua*, *scolopax*, *subcitrella*, *subscolopax*, *torella*, and *trimaculata*, have subcostal brushes on the hindwings of the males. One could logically conclude that the subcostal brush would be a character of the group. Surprisingly, however, some of the closely associated species having the same pattern of male genitalia, such as *oxyetra*, *persimilis*, *somatodes*, *tetraonella*, and *turdella*, lack subcostal brushes. Moreover, some of these species have a pseuduncus (*admirationis*, *carbonenotata*, *irregularis*, *oxyetra*, *propinqua*, *scolopax*, *somatodes*, *subcitrella*, *subscolopax*, *tetraonella*, *torella*, *trimaculata*, *turdella*), whereas other species lack the pseuduncus (*alveata*, *persimilis*). Some of the species that have the subcostal brushes on the hindwings of the males have a pseuduncus while others do not. The reverse is also true—some species that lack the subcostal brushes have a pseuduncus and others lack a pseuduncus.

Thus, there are complexes within complexes of *Hypsmocoma* to confuse and to bewilder the observer. One cannot predict what one will find next as he studies more and more species of this astounding assemblage of sibling species, species swarms, and superspecies. Although prolonged field studies and careful rearings will enlighten some spots in the darkness, it is safe to say that *Hypsmocoma* can never be more than slightly understood.

## KEY TO THE SUBGENERA OF HYPOSMOCOMA

1. Terminal segment of labial palpus with the vestiture expanded on the inner (upper) side, thus making the segment appear distinctly widened, as in figure 761; vannus (the inner posterior corner area; the anal area) of hindwing with a conspicuous tuft of hair in the area of vein 1b; hindwing with a subcostal brush; forewings with distinct patches of raised squamae; large species whose larvae make large cases. The species placed here have genitalia and other characters of subgenus *Hyposmocoma*, but they have hindwing vannus hair tufts of subgenus *Euperissus*, and they are thus unusual. No other known species group combines so clearly the characters of the two subgenera. . . . .  
 . . . . *lignivora* species group of ***Hyposmocoma*** *sensu stricto*.  
 Terminal segment of labial palpus not thus expanded, most often slender or very slender (see figures 778 to 787); other characters variable. . . . . 2
2. Hindwings of both sexes with the dorsal surface of vannus with a variable development of long hairs usually confined along the base of vein 1b or along and between veins 1b and 1a. There may be only a few long hairs or there may be a lesser or greater tuft or area of long, slender, fine-pointed hair (*not* blunt tipped, flattened, elongate squamae) on the area. Some of these hairs extend distinctly beyond the wing margin and overlap the cilia (fringe).

The specimens must be examined, very carefully— if the wing is partly abraded or there are only a few of the long hairs present they might easily be overlooked. These hairs must not be confused with the submarginal, marginal or axillary hairs, or the cilia. The hairs in question are always on the dorsal surface along the anal veins and inserted away from the edges of the wing and are not those on the curled-over basal edge of the wing. When strongly developed as a brush, it is what Walsingham called the “limbal hair-pencil”.

The highly unusual *marginenotata* and its close ally *vermiculata* may cause confusion here because *the males only* have a large area or mat of very elongate squamae on the vannus in the area where the hairs described above are located. These elongate squamae tend to lie subparallel to the long axis of the wing so that they are

mostly directed toward the wing apex and are not normally directed back across the wing and do not cross the cilia, although the tips of some of the submarginal squamae, especially when erected, may partly overlap the bases of the cilia. However, these species belong to subgenus *Hypsmocoma sensu stricto*. They have strongly developed spurs on the male genital valvae, and they have a well-developed pseuduncus. The male of *fractistriata*, another member of subgenus *Hypsmocoma*, has a subbasal cluster of elongate, slanting erect squamae and a few erect hairs, but these are entirely subbasal and far removed from the wing margin and thus should not cause confusion here.

Hindwings of males lack subcostal brushes. Valvae of male genitalia *never* have strongly differentiated or spurlike enlarged setae along the dorsal (costal) or apical margins (but do not confuse the *Diplosara* species group described above); abdomen never has a pseuduncus (except in *nemoricola*?); right brachium of male genitalia is usually rather similar to the kind shown in figures 789, 1034, 1069. . . . . subgenus **Euperissus**.

Hindwing with dorsal surface of vannus clothed entirely with squamae and never with long hairs along ven 1b or along and between veins 1a and 1b and never with any tendency toward the development of a vannal hair tuft or brush. However, note the development of masses of very elongate, slender squamae on the males of *marginenotata* and *vermiculata* and the subbasal cluster of slanting erect squamae on the male of *fractistriata* as described just above, and see also the exceptional *lignivora* group described above.

Valvae almost invariably have highly developed spurs or specialized, differentiated, enlarged, strong setae on dorsal (costal) or apical margins. Evidently these spurs are usually aborted on such species as *arenella* and *nephelodes*, but the setal sockets remain, and each of these species has developed a pseuduncus. Many species have the pseuduncus developed to a lesser or greater degree. Many males have subcostal brushes on the hindwings. . . . . subgenus **Hypsmocoma sensu stricto**.

All 23 species known to me whose larvae are proven casemakers belong to *Hypsmocoma sensu stricto*, including the anomalous "*Diplosara*" *lignivora* species group. There is, of course, a large number of other species whose larvae are

casemakers, but they have not been reared and are thus not recorded as case-makers. Many larval cases of a variety of forms have been found which have never been associated with their moths. *Hyposmocoma* larval cases are common objects in Hawaiian forests, but they are mostly overlooked by collectors. It would appear that all the members of *Hyposmocoma sensu stricto* are case-makers.

All 33 species thus far reared from larvae which are naked stem- or wood-borers, or fern-eaters, or make silken tunnels in moss belong to subgenus *Euperissus*. Perhaps all species of *Euperissus* have naked larvae.

The species of *Euperissus* are generally more difficult to discriminate than are those of *Hyposmocoma sensu stricto* because of the greater similarities of their genitalia, especially because of their lack of spurs and marginal processes on the valvae.

### A NOTE ON THE ARRANGEMENT OF THE ILLUSTRATIONS

Most of the several hundred illustrations of *Hyposmocoma* were made before my detailed studies began. To facilitate study and to enable the illustrations to be easily located when needed, most of them were arranged as nearly as possible in alphabetical order. Although this arrangement has served the purpose intended and has saved much time in handling such a mass of detail, the end result is an arrangement with little regard to relationship. This may be considered a fault in the text and may attract criticism. After my studies were completed, and a new classification slowly evolved through a series of many changes, a new arrangement of illustrations should have been made. Such a change would have been very costly, and I have been unable to accomplish it. When beginning a complicated study such as this, one cannot always predict how best to arrange various parts of the manuscript.

I have incorporated a large amount of detail in the figure legends instead of placing it under the main species headings in the text so that one can consider the commentary while viewing the all-important illustrations. I have not considered it essential to repeat in the text what may be obtained from a study of the figures and their legends.

Subgenus **EUPERISSUS** (Butler), **new status**

- Euperissus* Butler, 1881:401. Type-species: *Euperissus cristatus* Butler, 1881:402, monotypic. Walsingham, 1907b:643, redescription.
- Aphthonetus* Walsingham, 1907b:517. Type-species: *Aphthonetus diffusa* Walsingham, 1907b:527, by original designation. **New synonym.**
- Rhinomactrum* Walsingham, 1907b:531. Type-species: *Rhinomactrum rutilellum* Walsingham, 1907b:531, by original designation. **New synonym.**
- Neelysia* Walsingham, 1907b:533. Type-species: *Neelysia lignicolor* Walsingham, 1907b:533, by original designation. **New synonym.**
- Dysphoria* Walsingham, 1907b:547. Type-species: *Dysphoria semicolon* Walsingham, 1907b:547, monotypic and by original designation. **New synonym.**
- Bubaloceras* Walsingham, 1907b:548. Type-species: *Bubaloceras subburneum* Walsingham, 1907b:549, monotypic and by original designation. **New synonym.**
- Hyperdasys* Walsingham, 1907b:640. Type-species: *Hyperdasys cryptogamiellus* Walsingham, 1907b:642, by original designation. Homonym. See *Hyperdasysella*.
- Hyperdasysella* T. B. Fletcher, 1940:18, replacement name for *Hyperdasys* Walsingham, 1907b, not Butler, 1891. See *Hyperdasys* above. **New synonym.**
- Semnoprepia* Walsingham, 1907b:644. Type-species: *Semnoprepia fulvogrisea* Walsingham, 1907b:644, by original designation. **New synonym.**
- Euhyposmocoma* Swezey, 1913f:277. Type-species: *Hyposmocoma ekaha* Swezey, 1910d:105, by original designation. **New synonym.**
- Phthoraula* Meyrick, 1935a:65. Type-species: *Phthoraula homopyrrha* Meyrick, 1935a:65, monotypic. **New synonym.**

The distinctive characters of subgenus *Euperissus* are outlined in the foregoing key to the subgenera of *Hyposmocoma* and need not be repeated here.

**Hyposmocoma (Euperissus) adelphella** Walsingham (figs. 867, moth; 1042, male genitalia; 1195?, 1226, female genitalia).

*Hyposmocoma adelphella* Walsingham, 1907b:615, pl. 23, fig. 4.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Walsingham included in his type series a male and a female from Hawaii and a single female (figures 823, wing venation; 1195, female genitalia) from Kauai. I have deleted the Kauai record because I consider it uncertain and possibly erroneous.

**Hyposmocoma (Euperissus) adolescens** Walsingham (figs. 868, moth; 1034, male genitalia).

*Hyposmocoma adolescens* Walsingham, 1907b:587, pl. 20, fig. 27.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

I have seen only the unique male holotype. It is an associate of *enixa*, which see.

(Text continued on page 1348.)

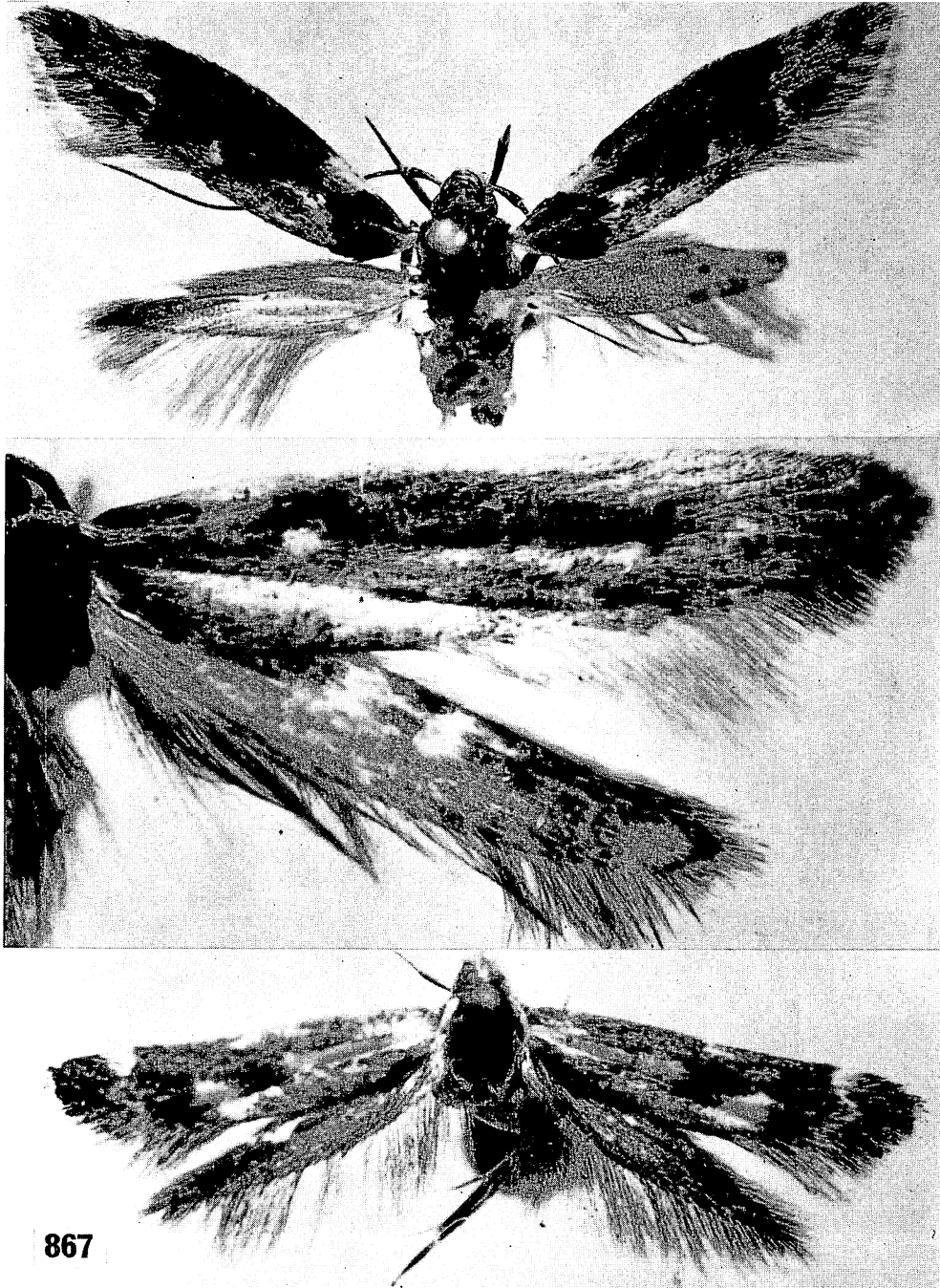


Figure 867—*Hypsmocoma*. Top, (*H.*) *abjecta* (Butler), holotype female (BM slide 4475); Oahu; expanse 13.5 mm.; forewings fuscous and white. Middle, (*E.*) *adelphella* Walsingham, holotype male (BM slide 4353); Kona, 4,000 feet, Hawaii; forewing 6 mm., pale brownish and dirty white with fuscous maculae (the pale rounded spots on the wings are abraded areas and the dark fuscous maculae on the forewings are not adequately revealed in the photograph). Bottom, (*H.*) *admirationis* Walsingham, holotype male (BM slide 4124); Molokai, about 4,000 feet; expanse 8 mm., brownish fuscous with white maculae (too much light has been directed from the front of the specimen). All of these specimens are figured in color in *Fauna Hawaiiensis*.



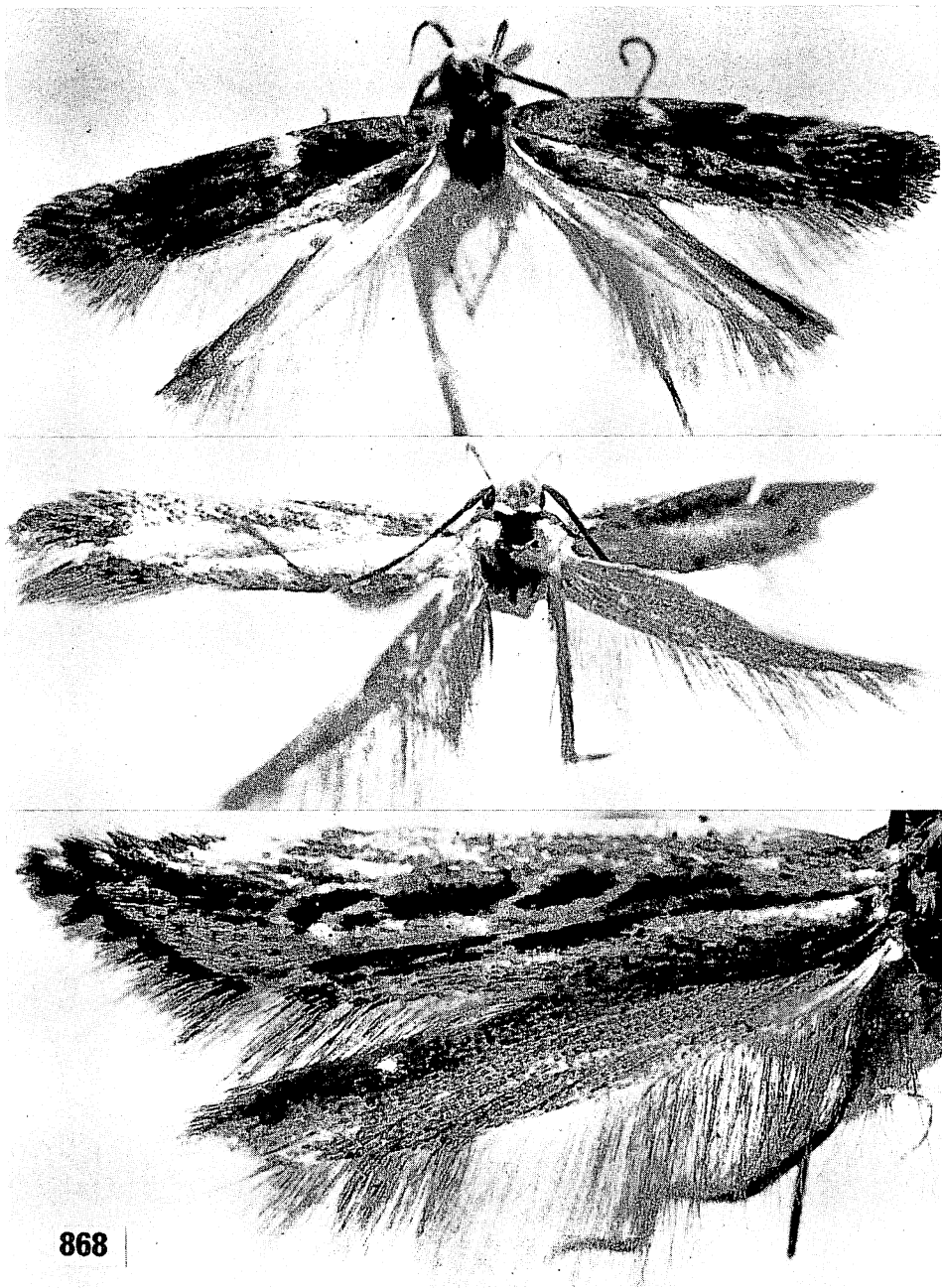


Figure 868—*Hyposmocoma*. Top, (*E.*) *adolescens* Walsingham, holotype male (BM slide 4137); Kilauea, Hawaii; expanse 13.5 mm., basically bronzy brown with three dark maculae (the white-appearing areas are abraded). Middle, (*H.*) *advena* Walsingham, holotype female (BM slide 4532); Molokai, 4,000 feet; forewing 5 mm.; the photograph does not reveal enough contrast between the yellow medial area and the brown costal and posterior areas. Bottom, (*E.*) *agnetella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4432); Olinda, 4,000 feet, Maui; forewing 6.5 mm., white and brownish fuscous with dark fuscous maculae. These three specimens are figured in *Fauna Hawaiiensis*.

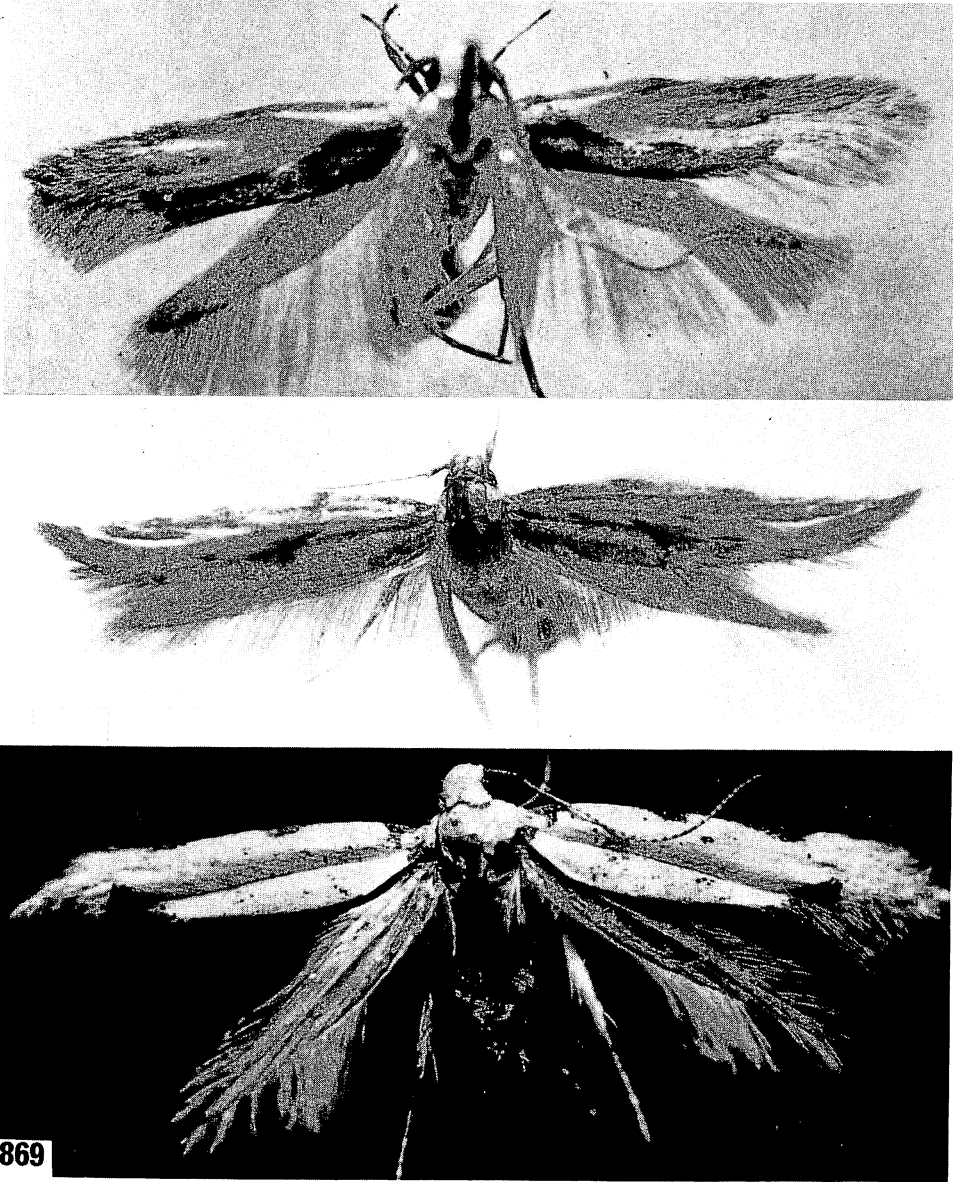


Figure 869—*Hypsmocoma*. Top, (*H.*) *albifrontella* Walsingham, holotype male (BM slide 4100); Molokai, about 4,000 feet; expanse 13 mm.; forewings mostly nearly white with prominent fuscous maculae. Middle, (*E.*) *albocinerea* (Walsingham) ("*Aphthonetus*"), holotype female (BM slide 4753); Kauai, 3,000 to 4,000 feet; expanse 15.5 mm.; forewings with white background with brownish and fuscous scaling that is tipped with ferrugineous coloring. Bottom, (*H.*) *albonivea* Walsingham, holotype female (BM slide 14306); Waianae Mts., Oahu; expanse 10.5 mm.; forewings white with dark fuscous maculae. These three specimens are figured in *Fauna Hawaiiensis*.

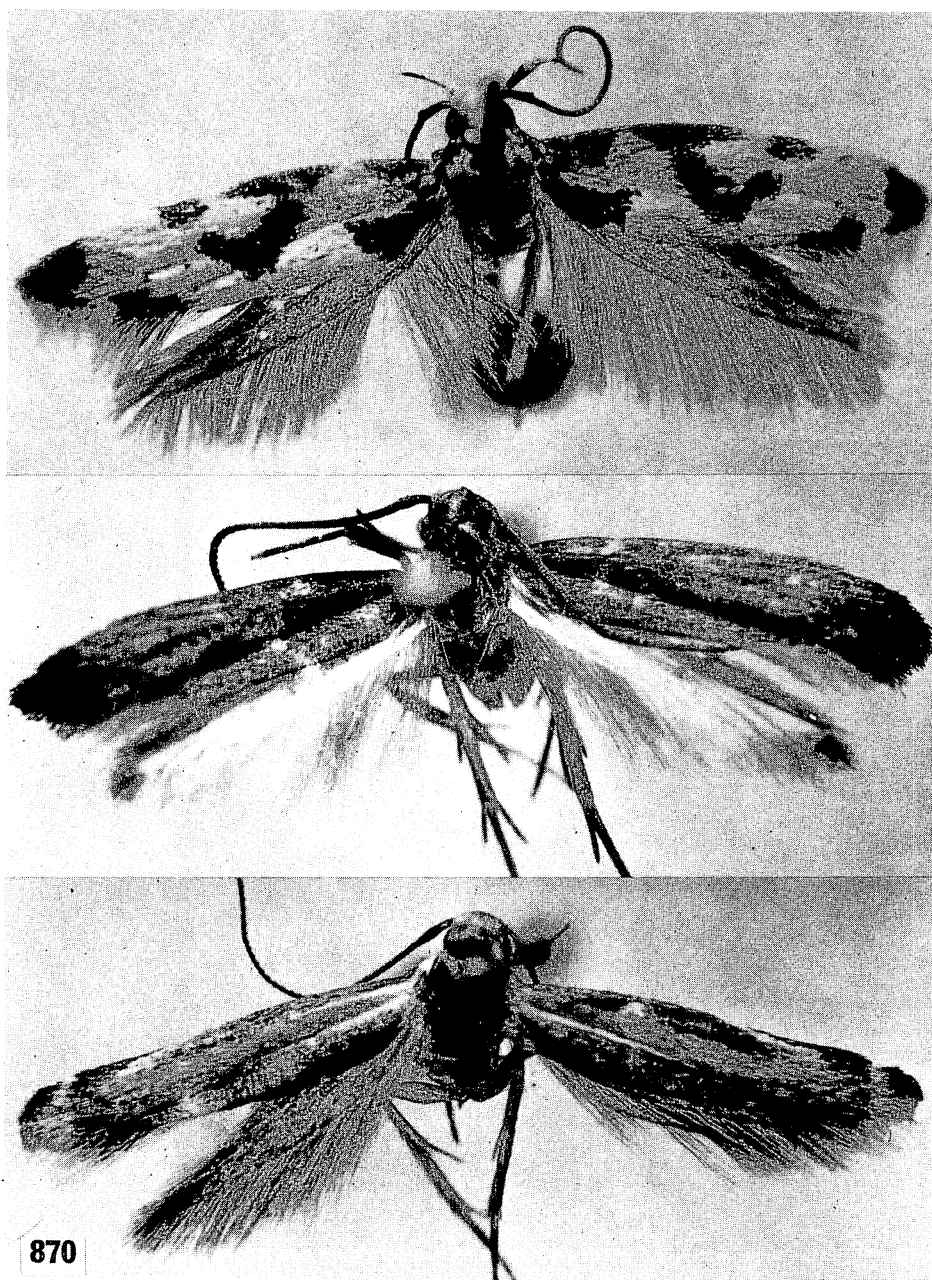
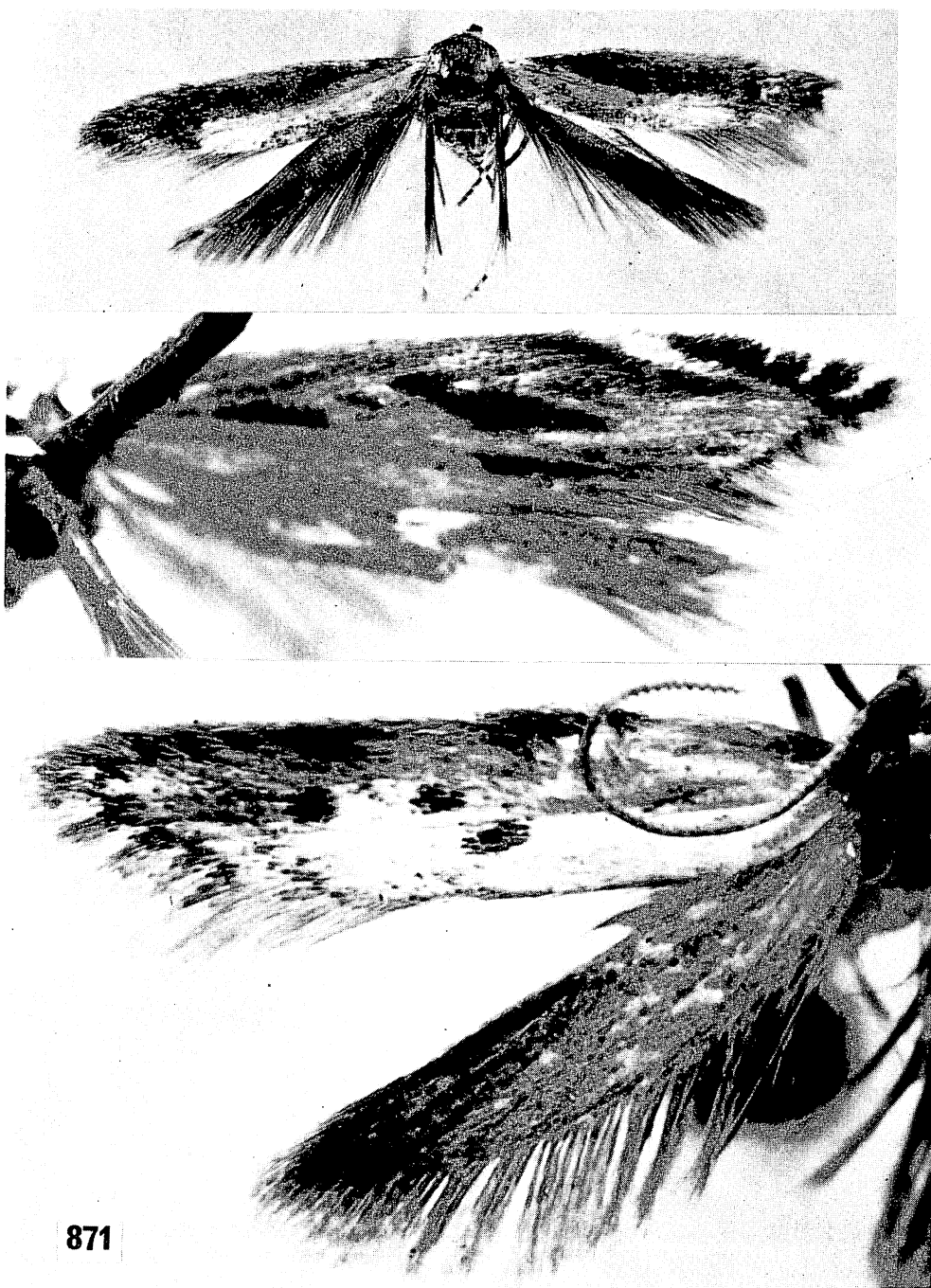


Figure 870—*Hypsmocoma*. Top, (*H.*) *alliterata* Walsingham, holotype male (BM slide 4322); Molokai, 4,000 feet; expanse 11 mm.; forewings white with black maculae. This specimen is figured in *Fauna Hawaiiensis*. Middle, (*E.*) *alticola* Meyrick, lectotype male (BM slide 9559 Clarke); Honolulu; forewing 4.5 mm, mostly fuscous with purplish reflections. Bottom, (*E.*) *alveata* (Meyrick) ("*Neelysia*"), lectotype male (BM slide 9580 Clarke); Koolau Mts., Oahu; forewing 4.75 mm., white with fuscous maculae.



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Figure 871—*Hypsmocoma*. Top (*H. anisoplecta* Meyrick, paratype (a broken specimen); Mt. Kaala, Oahu; forewing 5.5 mm., fuscous with whitish to yellow pale areas. Middle, (*E. anthinella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4436); Lanai, 2,000 feet; forewing 4.5 mm., white and fuscous; there is an incipient brush of a few long scales on the metapleuron beneath the anterior corner of hindwing. Bottom, (*H. arenella* Walsingham, holotype male (BM slide 4486); Kona, 2,000 feet, Hawaii; forewing 6.5 mm., cream-colored and fuscous. The two lower specimens are figured in *Fauna Hawaiiensis*.

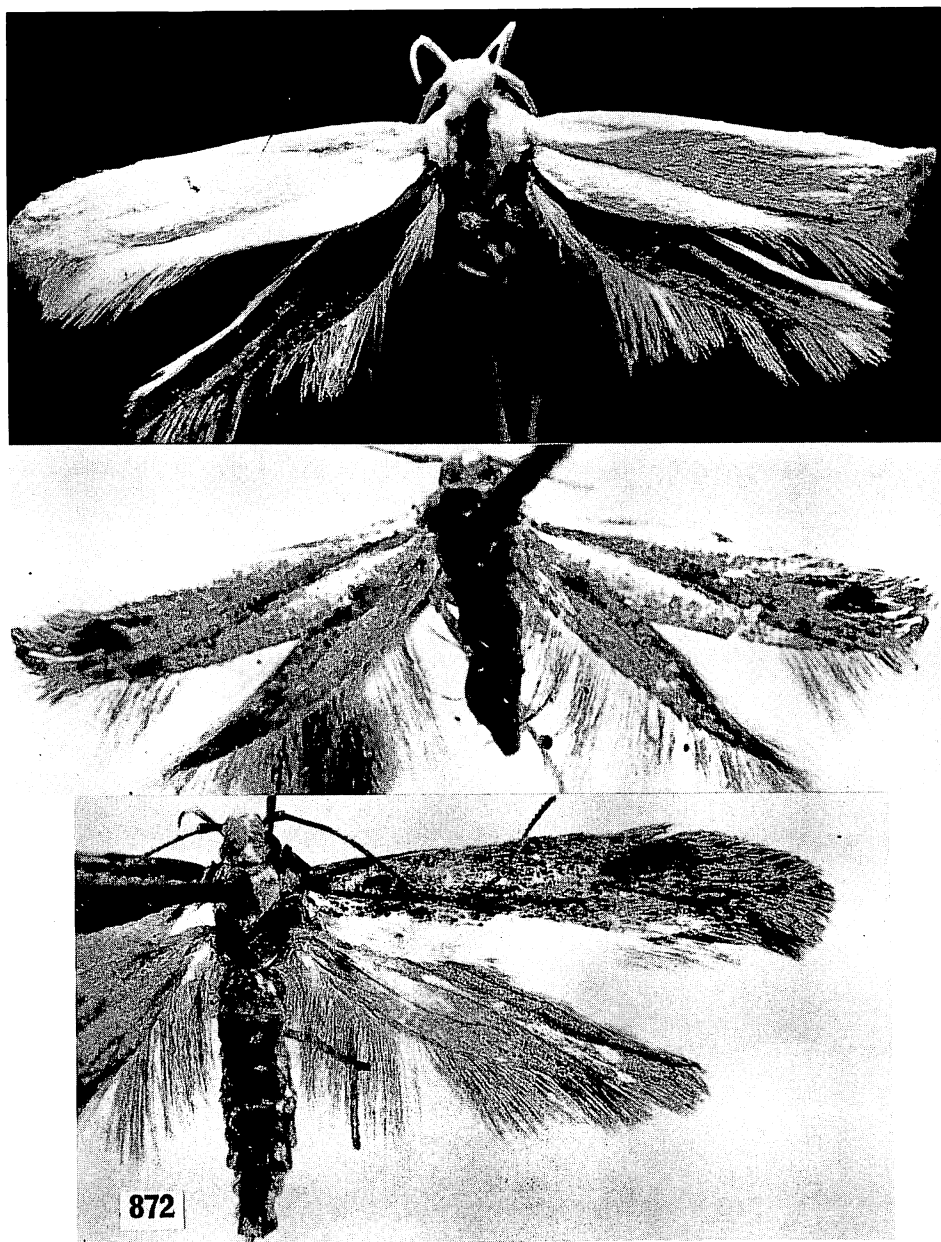


Figure 872—*Hypsoscoma*. Top, (*E.*) *argentea* Walsingham, holotype male (BM slide 4317); Molokai, about 4,000 feet; expanse 16 mm.; forewing pale creamy white. Note the pale tufts of hair coming from the vannal areas of the hindwings. Compare *subargentea*, figure 973. Middle, (*H.*) *argentifera* (Walsingham) ("Agonismus"), holotype female (BM slide 7171); Kilauea, Hawaii; expanse 8.5 mm; forewings submetallic grey to greyish fuscous with a subterminal white fascia (what appear to be subapical dark maculae are shadows). Bottom, (*E.*) *argomacha* Meyrick, holotype female; Kilauea, Hawaii; forewing 10 mm. brownish, fuscous with conspicuous white posterior area.



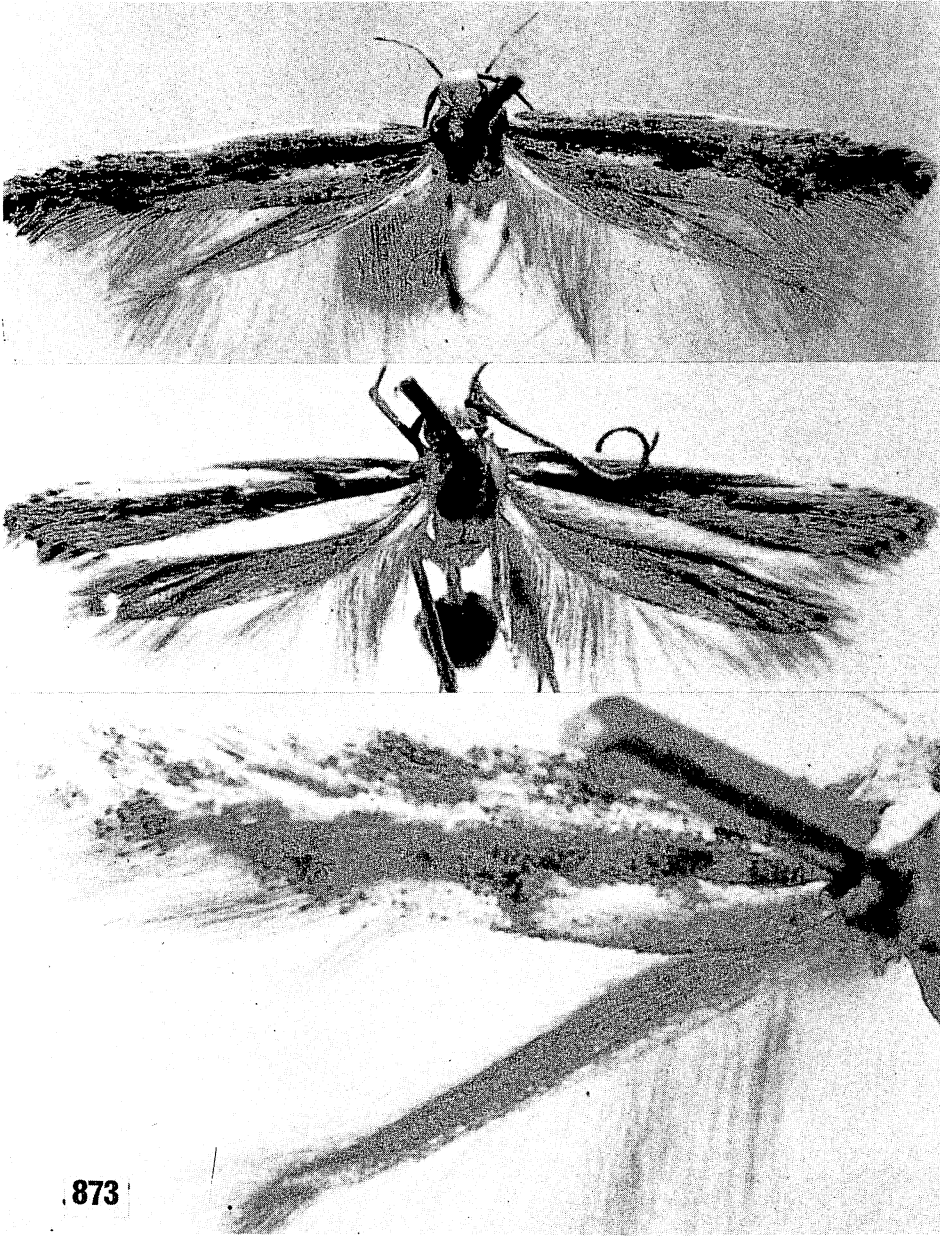


Figure 873—*Hyposmocoma* (*Euperissus*). Top, *argyresthiella* (Walsingham) ("*Neelysia*"), allotype female (BM slide 4465); Kona, 4,000 feet, Hawaii; expanse 11.5 mm.; forewings with white background and yellow, brownish, orange, and fuscous scaling and maculae. Middle, *arundinicolor* (Walsingham) ("*Hyperdasylella*"), holotype male (BM slide 4424); Kauai, 3,000 to 4,000 feet; expanse 15 mm.; forewings buff or ochraceous with fuscous maculae. Bottom, *aspersa* (Butler) ("*Aphthonetus*"), holotype female (BM slide 4412); near Honolulu; forewing 6 mm., white with yellow-tipped and fuscous-tipped scales and maculae. The middle and bottom specimens are figured in *Fauna Hawaiiensis*.

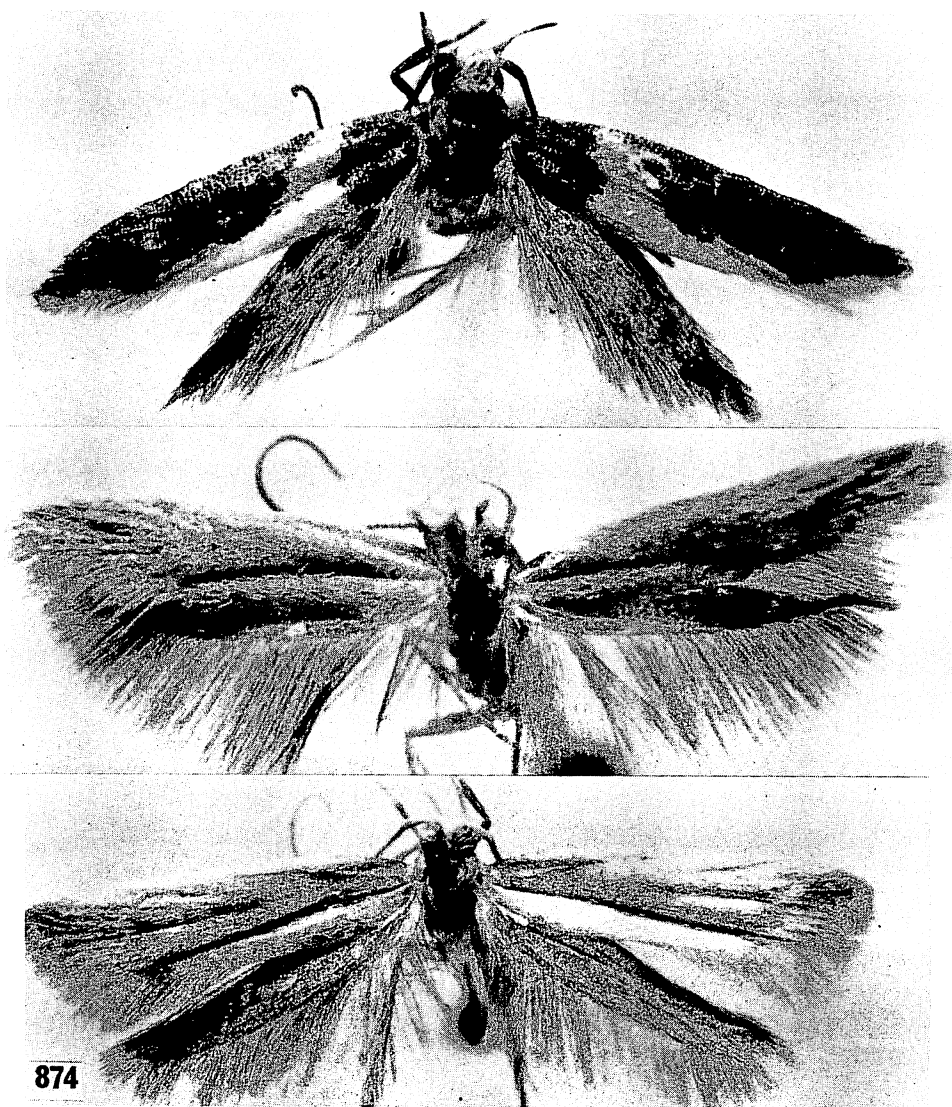


Figure 874—*Hyposmocoma*. Top, (*H.*) *atrovittella* Walsingham, holotype male, abdomen lost; Olaa, Hawaii; expanse 10 mm.; forewings white and dark fuscous. Middle, (*H.*) *auripennis* (Butler), holotype male (BM slide 4109); Haleakala, Maui; expanse 12 mm.; forewings a beautiful, concolorous, golden yellow. Bottom, (*E.*) *auroargentea* Walsingham, holotype male (BM slide 4107); Haleakala, 5,000 feet, Maui; expanse as spread, 16 mm.; forewings mostly shining silvery white with some greyish markings. These three specimens are figured in *Fauna Hawaiiensis*.



Figure 875—*Hyposmocoma*. Top, (*H.*) *auropurpurea* Walsingham, holotype male (BM slide 4352); Waianae Mts., 2,000 feet, Oahu; expanse 8 mm. This specimen was difficult to photograph because of its purplish and coppery submetallic scaling. The dark areas are purplish. The pale vitta along the fold that continues as a preapical fascia is golden. Middle, (*H.*) *bacillella* Walsingham, holotype male (BM slide 4325); Halemanu and Kaholuamano, 4,000 feet, Kauai; expanse 10 mm.; forewings white and fuscous. (The case from which this specimen was reared is shown in figure 800.) Bottom, (*E.*) *barbata* Walsingham, holotype female (BM slide 7175); Molokai, over 3,000 feet; expanse 14.5 mm.; forewings with a white background and yellow and fuscous vittae and maculae. These three specimens are figured in *Fauna Hawaiiensis*.



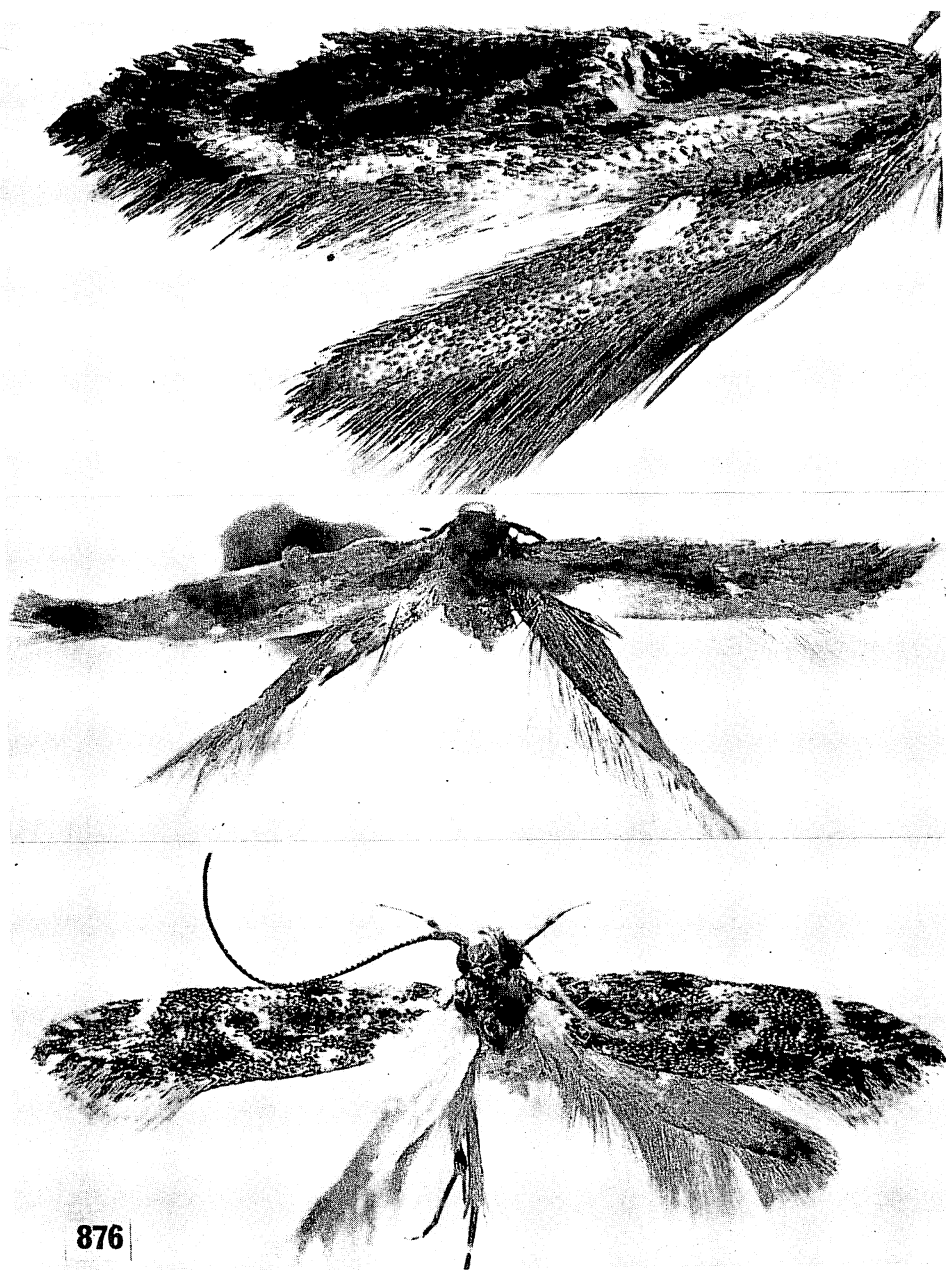


Figure 876—*Hyposmocoma*. Top, (*E.*) *basivittata* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4440); Haleakala, 5,000 feet, Maui; forewing 6 mm., brownish fuscous with white maculae (there is an abraded area between the costa and the end of the white vitta on the fold). Middle, (*H.*) *bella* Walsingham, holotype male (BM slide 4350); expanse 9 mm.; in the forewing the pale scaling is yellow, contrasting sharply with the anterior brown scaling (the pale spots that appear to form a submedial fascia near the middle of the right wing are abraded areas). Bottom, (*H.*) *belophora* Walsingham, holotype male (BM slide 4490); near head of Kawailoa Gulch, Oahu; expanse 14 mm.; forewings are white with dark scales which are golden basad and fuscous distad. All of these specimens are figured in *Fauna Hawaiiensis*.

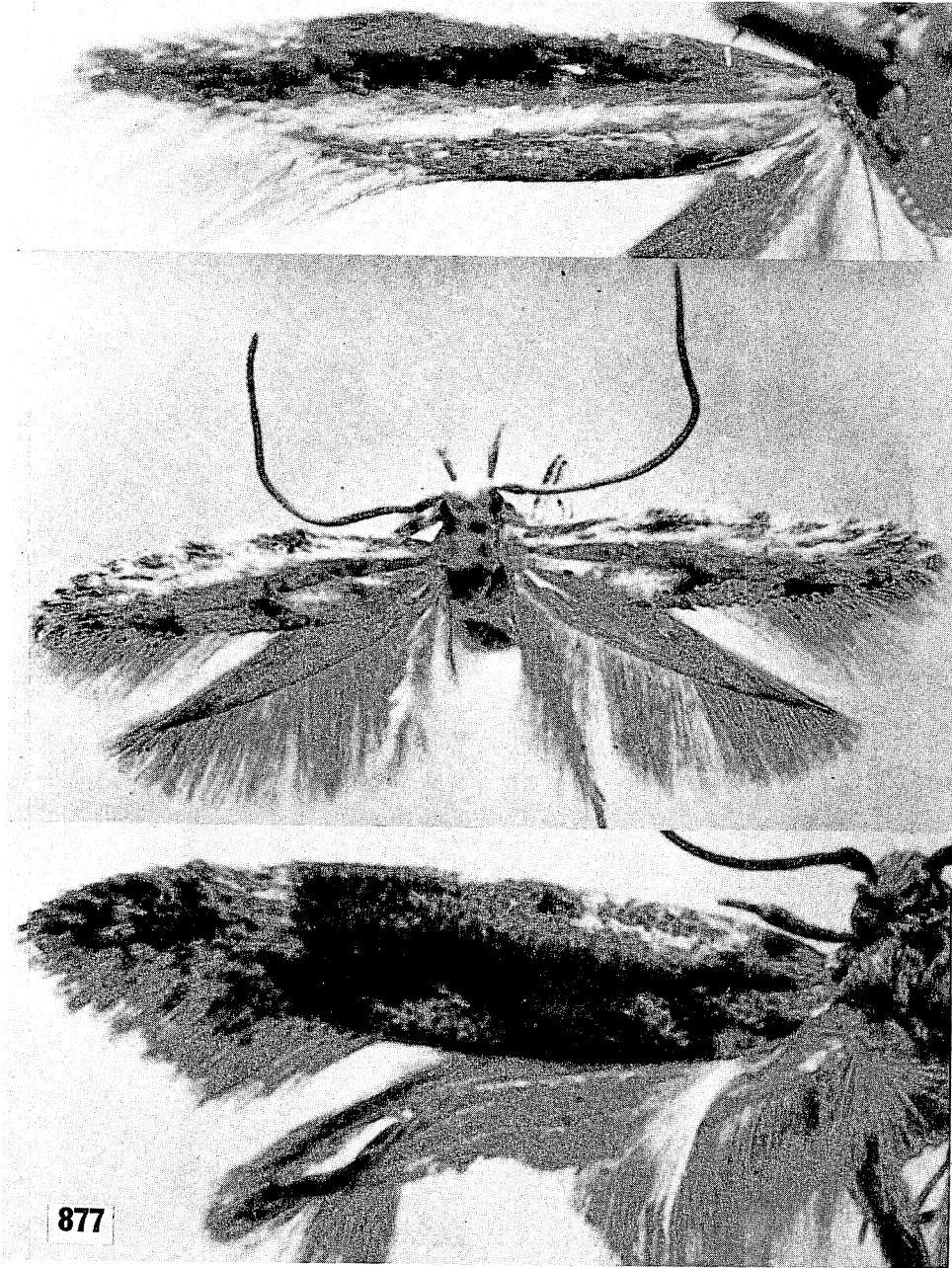


Figure 877—*Hypsoscoma*. Top, (*H.*) *bilineata* Walsingham, holotype female (incorrectly cited as a male); (BM slide 4112); Waianae Mts., 2,000 to 3,000 feet, Oahu; forewing 5.5 mm.; orange with fuscous brown vittae. Middle, (*E.*) *bitincta* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4743); Haleakala, 4,000 feet, Maui; expanse 13 mm.; forewing white with yellow and fuscous maculae. Bottom, (*H.*) *blackburnii* Butler, holotype male (BM slide 4088); forewing 9 mm., brownish fuscous and white. Part of the subcostal brush protrudes across the hindwing. These three specimens are figured in *Fauna Hawaiensis*.

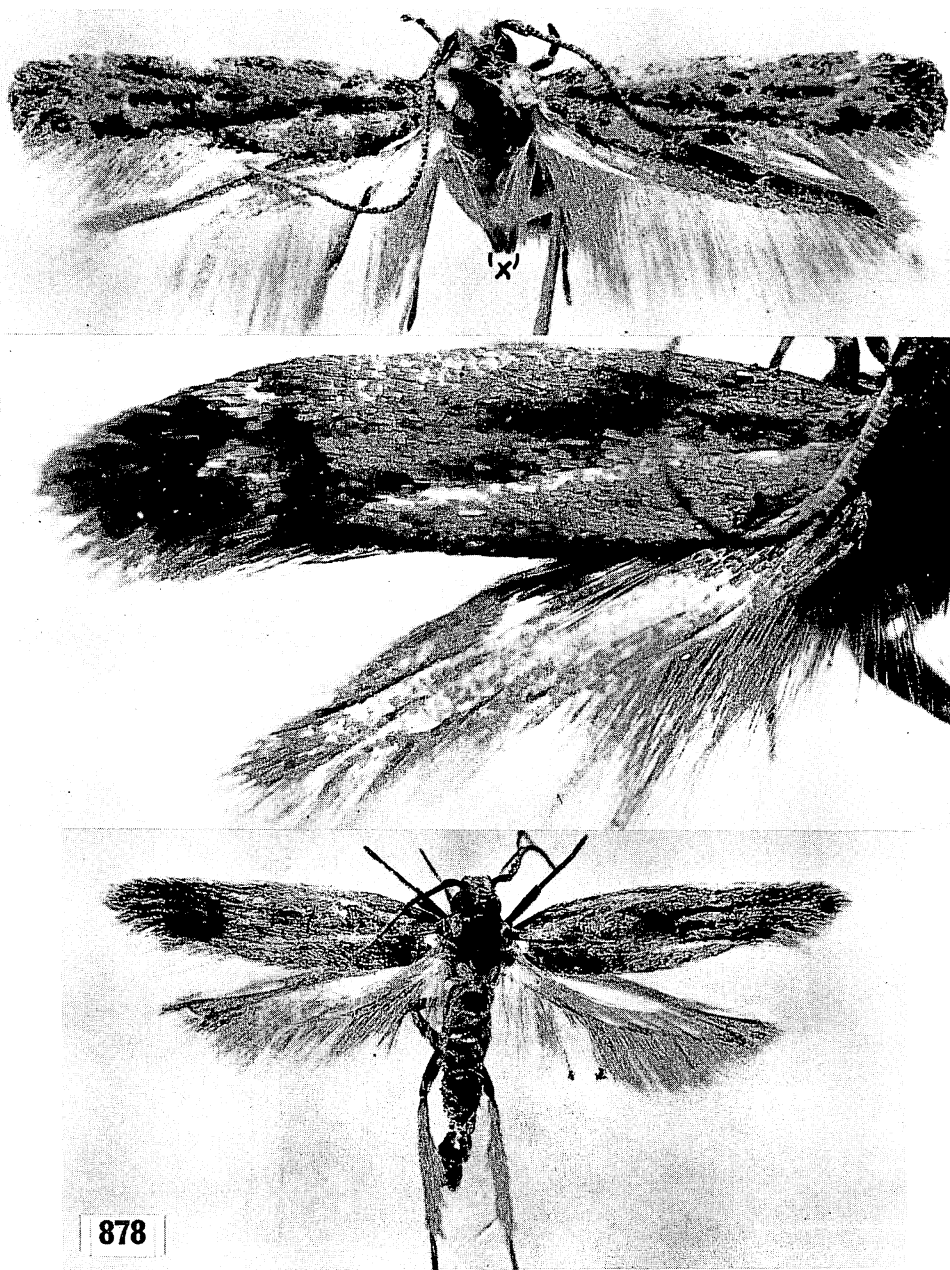


Figure 878—*Hyposmocoma*. Top, (*E.*) *brevisirigata* Walsingham, holotype male (BM slide 4494); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings mostly white with yellowish and fuscous scales. The strong hairbrushes arising from the metapleura and which cross over the base of the abdomen can be seen at "X". Middle, (*H.*) *butalidella* Walsingham, holotype male (BM slide 4119); Haleakala, forewing 5.5 mm., brownish fuscous with a white streak along the fold and a white subapical fascia. Bottom, (*E.*) *caecinervis* Meyrick, holotype male; Mt. Kaala, Oahu; forewing 7 mm., yellowish brown with the veins marked with fuscous and with a paler streak along the fold. The top and middle specimens are figured in *Fauna Hawaiiensis*.



Figure 879—*Hyposmocoma* (*Hyposmocoma*). Top, *calva* Walsingham, holotype male (abdomen lost); Kona, 4,000 feet, Hawaii; expanse 16 mm.; forewings white and fuscous. Middle, *canella* Walsingham, holotype male (BM slide 4326); Molokai, 3,000 feet; forewing 4 mm., white and fuscous. Bottom, *carbonotata* Walsingham, holotype male (BM slide 4321); Kauai, 3,000 to 4,000 feet; expanse 11 mm.; forewings white with dark fuscous maculae. These three specimens are figured in *Fauna Hawaiensis*.

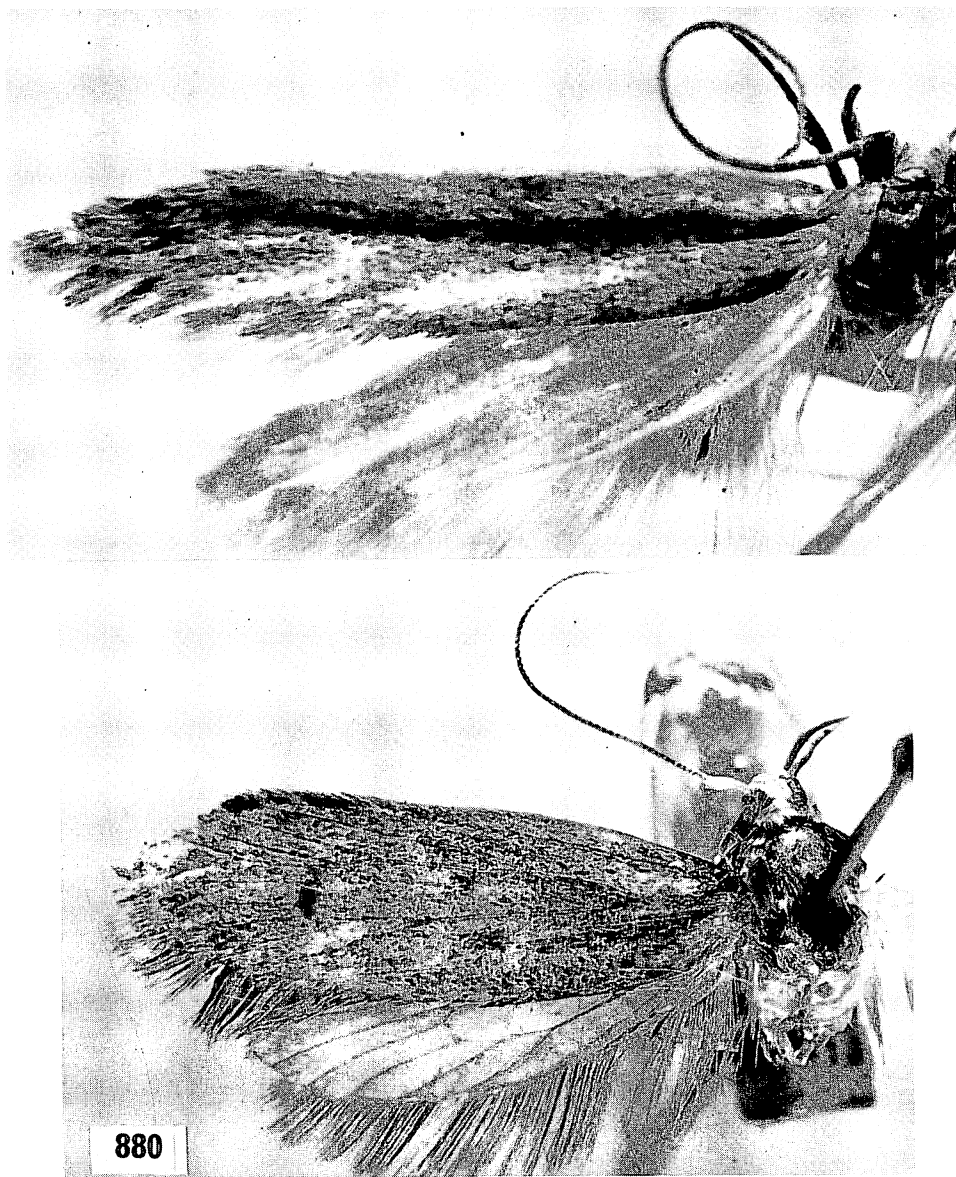


Figure 880—*Hyposmocoma*. Top, (*H.*) *carnea* Walsingham, holotype male (BM slide 4343); Kauai, 3,000 to 4,000 feet; forewing 8.5 mm., straw-colored overlaid by pink and brown shades. This specimen is figured in *Fauna Hawaiiensis*. Bottom, (*E.*) *catapyrrha* (Meyrick), holotype male (abdomen lost); Olinda, Maui, ex *Rubus* stem; forewing 11 mm., "golden-ochreous suffused ferruginous" (Meyrick).

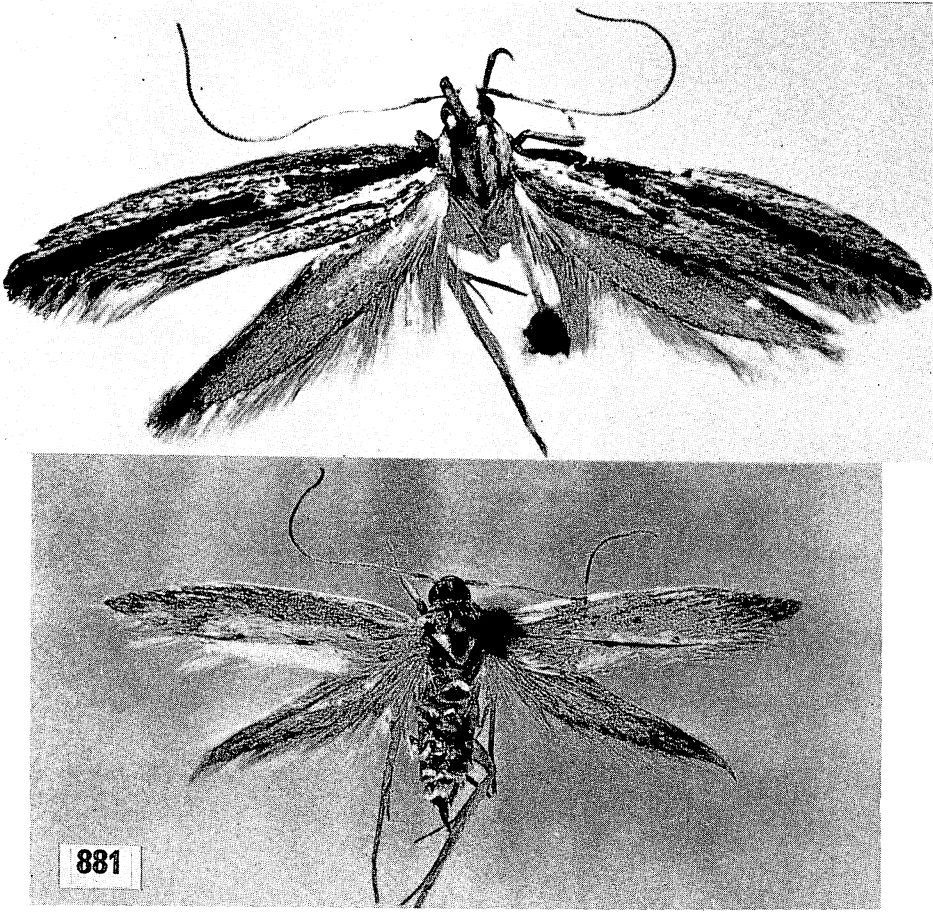


Figure 881—*Hyposmocoma* (*Euperissus*). Top, *centralia* Walsingham, holotype male (BM slide 4497); Lihue, 4,000 feet, Kauai; expanse 26 mm.; forewings white with fuscous maculae. Note the strong vannal brushes on the hindwings. This specimen was used for the *Fauna Hawaiiensis* figure. Bottom, *centronoma* Meyrick, holotype female; Kawaihapai, Oahu; forewing 6.75 mm., mostly white or iridescent white suffused with brownish or fuscous costal and with two small fuscous dots on fold (the dark tips of the wings are caused by shadows and are not color).



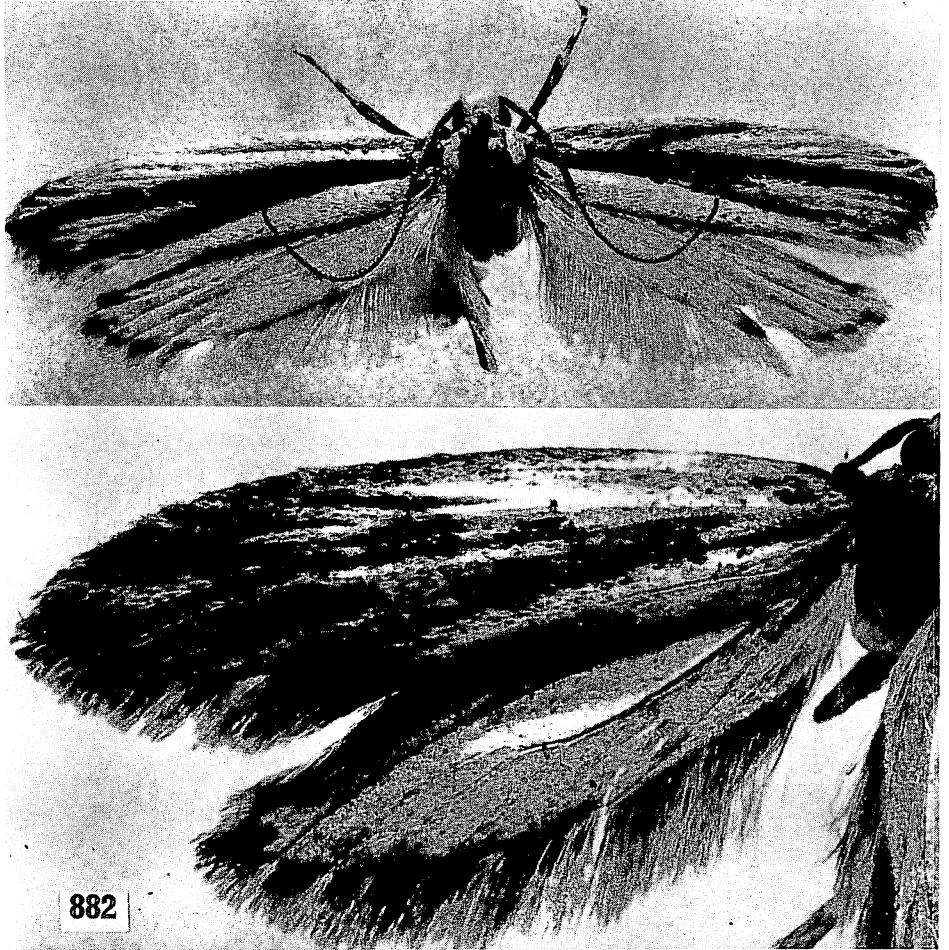


Figure 882—*Hyposmocoma* (*Euperissus*). Top, *chilonella chilonella* Walsingham, holotype male (BM slide 4499); Kauai, 3,000 to 4,000 feet; expanse 23.5 mm.; forewings straw-colored with brownish fuscous markings; there is a moderate tuft of long scales on each metapleuron. Bottom, *chilonella percondita* Walsingham, holotype male (BM slide 4501); Kilauea, Hawaii; forewing 13 mm., mostly yellowish fuscous to fuscous (the pale areas are abraded); a moderate scale tuft is on the metapleuron. These specimens are illustrated in *Fauna Hawaïensis*.

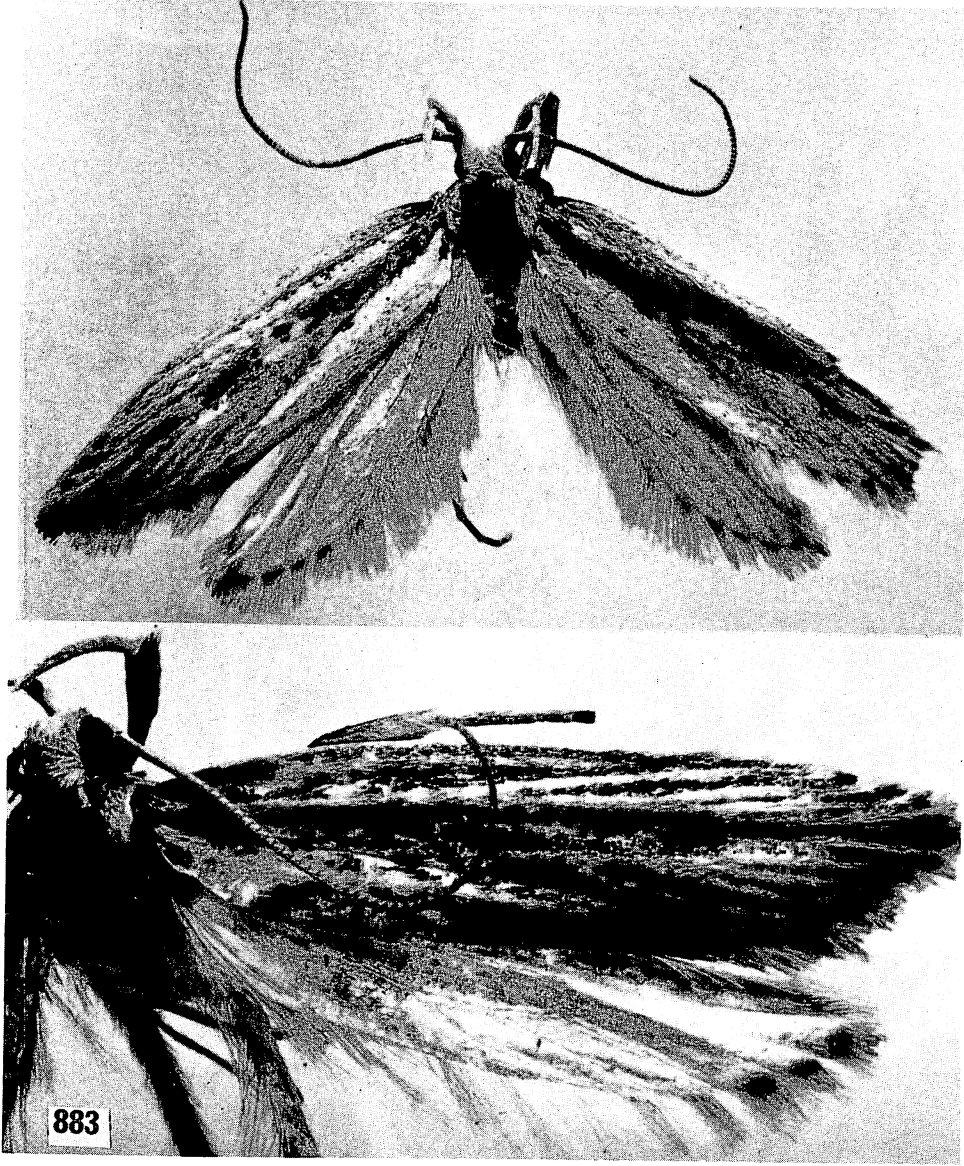


Figure 883—*Hyposmocoma* (*Euperissus*). Top, *chilonella triocellata* Walsingham, holotype male (BM slide 4498); Molokai, about 4,000 feet; forewing 11 mm., basically cream-colored with yellowish to fuscous maculae. There is a moderate tuft of long scales on each metapleuron. Note the well-developed tufts on the vannal areas of the hindwings. Bottom, *chilonella venosa* Walsingham, holotype male (BM slide 4500); Kauai, 3,000 to 4,000 feet; forewing 11 mm., background scaling pale straw-colored with mostly fuscous markings and fuscous scales along the veins. The metapleural tuft of scales appears to be moderate. These specimens were used for the *Fauna Hawaiiensis* illustrations.



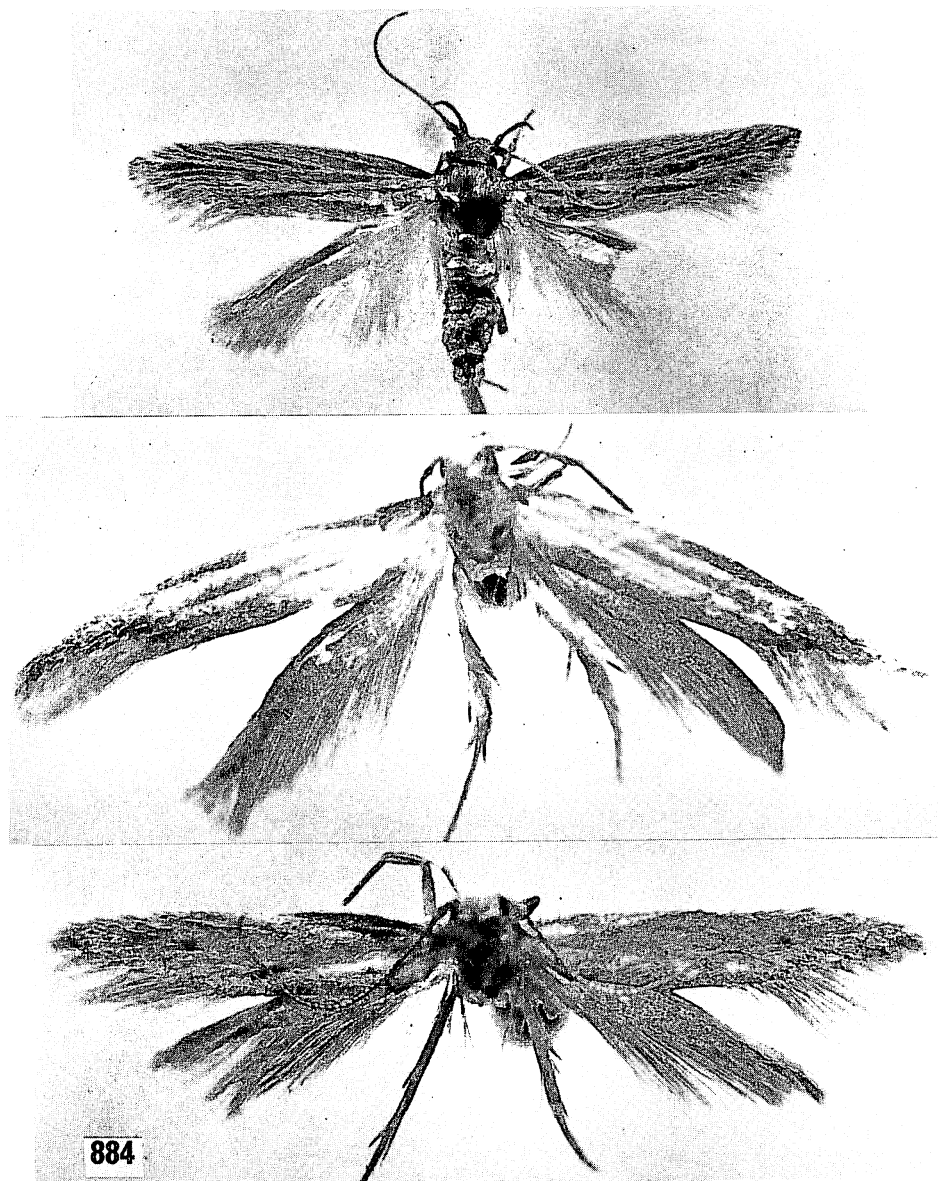
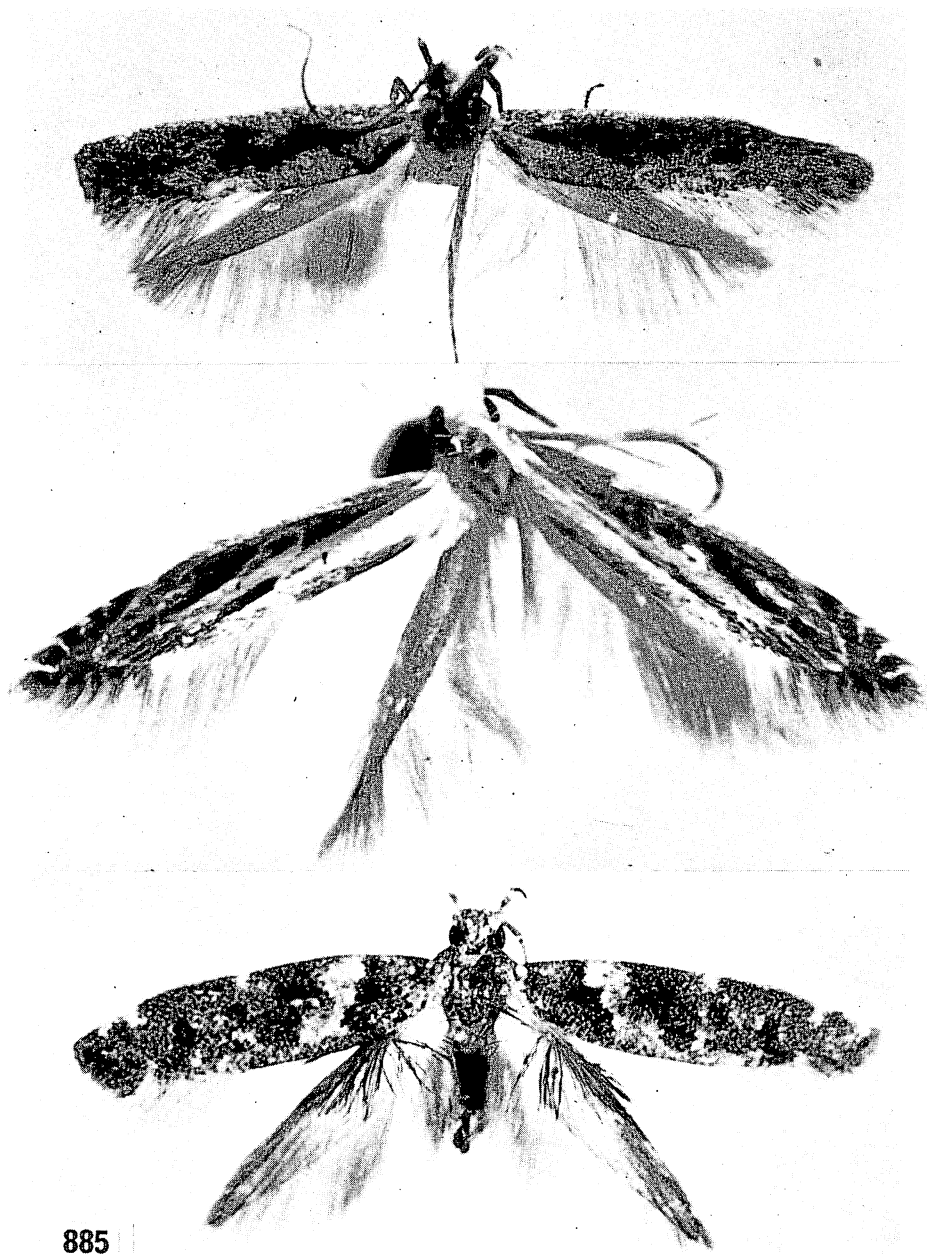


Figure 884—*Hyposmocoma*. Top, (*E.*) *chloraula* Meyrick, holotype male (slide Z-I-23-61-2); Summit Camp, Kauai, ex *Astelia*; forewing 8 mm., fuscous and whitish. Middle, (*H.*) *cincta* Walsingham, holotype female (BM slide 7060); Halemanu, Kauai, 4,000 feet; expanse 13 mm.; forewings with median zone mostly very pale and the margins brownish fuscous in distinct contrast. This is a poor photograph. Bottom, (*H.*) *adjacens* (Walsingham) (formerly considered a form of *cincta*), holotype female (BM slide 4472); Kauai, 3,000 to 4,000 feet; expanse 13 mm.; forewings with straw-colored background on which there are mostly scattered brownish fuscous maculae. The middle and bottom specimens are figured in *Fauna Hawaiiensis*.



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Figure 885—*Hyposmocoma*. Top, (*H.*) *cinereosparsa* Walsingham, holotype male (BM slide 4328); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings fuscous and white. Middle, (*E.*) *cleodorella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4435); Kona, 4,000 feet, Hawaii; forewing 5.5 mm., white and fuscous. There is an incipient brush of long scales on each metapleuron beneath the bases of the hindwings. Bottom, (*H.*) *new species 11* (Walsingham specimen 25160; BM slide 14317); Waianae Mts., about 3,000 feet, Oahu; expanse 15 mm.; forewings have scales which are mostly yellowish and greenish tipped with fuscous, and with white maculae. Note the expanded subcostal brushes on the hindwings. See the text for additional details. The top and middle specimens are figured in *Fauna Hawaiensis*.

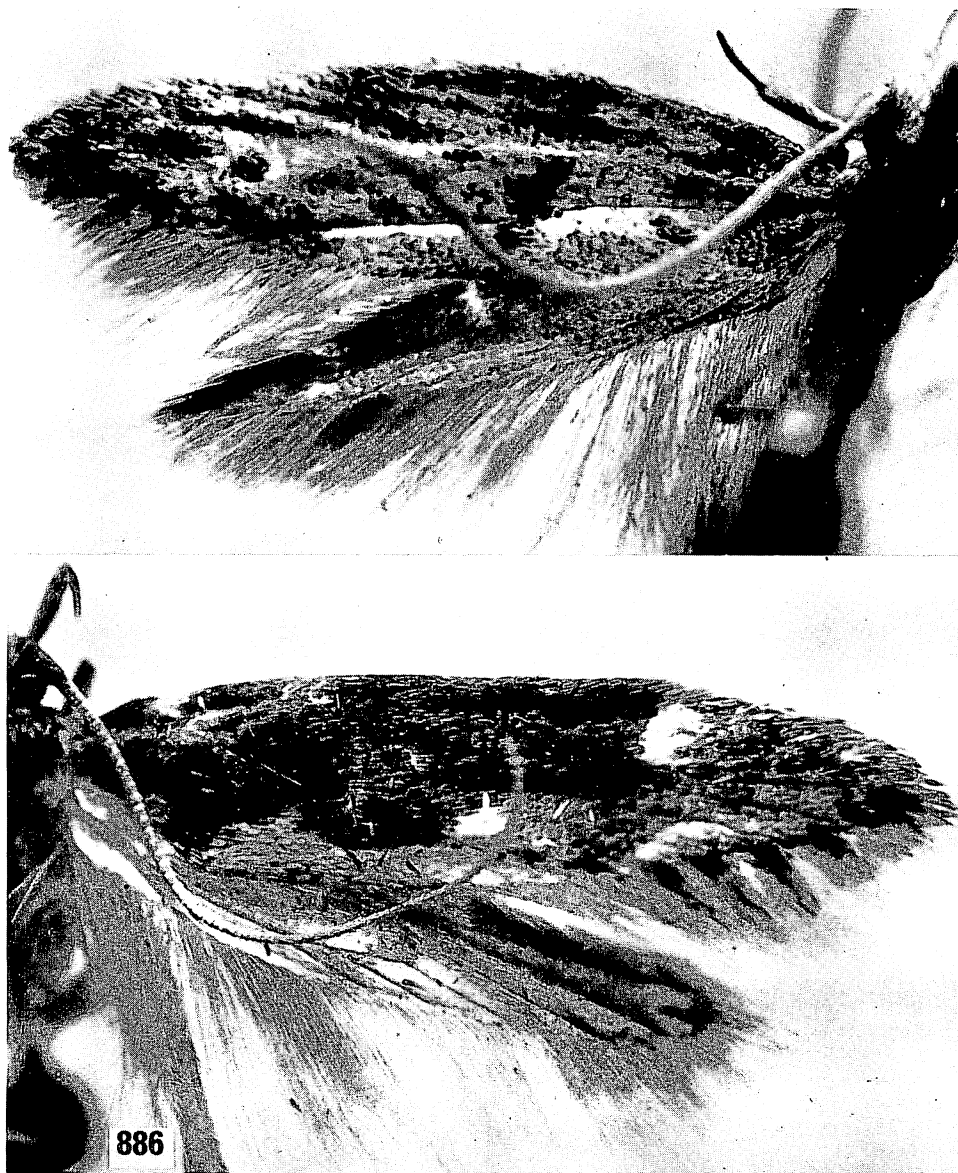


Figure 886—*Hyposmocoma*. Top, (*E.*) *columbella* (Walsingham) (“*Aphthonetus*”) allotype male (BM slide 4744); Molokai, over 3,000 feet; forewing 6.25 mm., white with some yellow and with mostly fuscous maculae. Bottom, (*H.*) *commensella* Walsingham, holotype male (BM slide 4086); Kilauea, Hawaii; expanse 18 mm.; forewing fuscous with coppery reflections and with white maculae. There is a moderate metapleural scale tuft. These specimens are figured in *Fauna Hawaiiensis*.

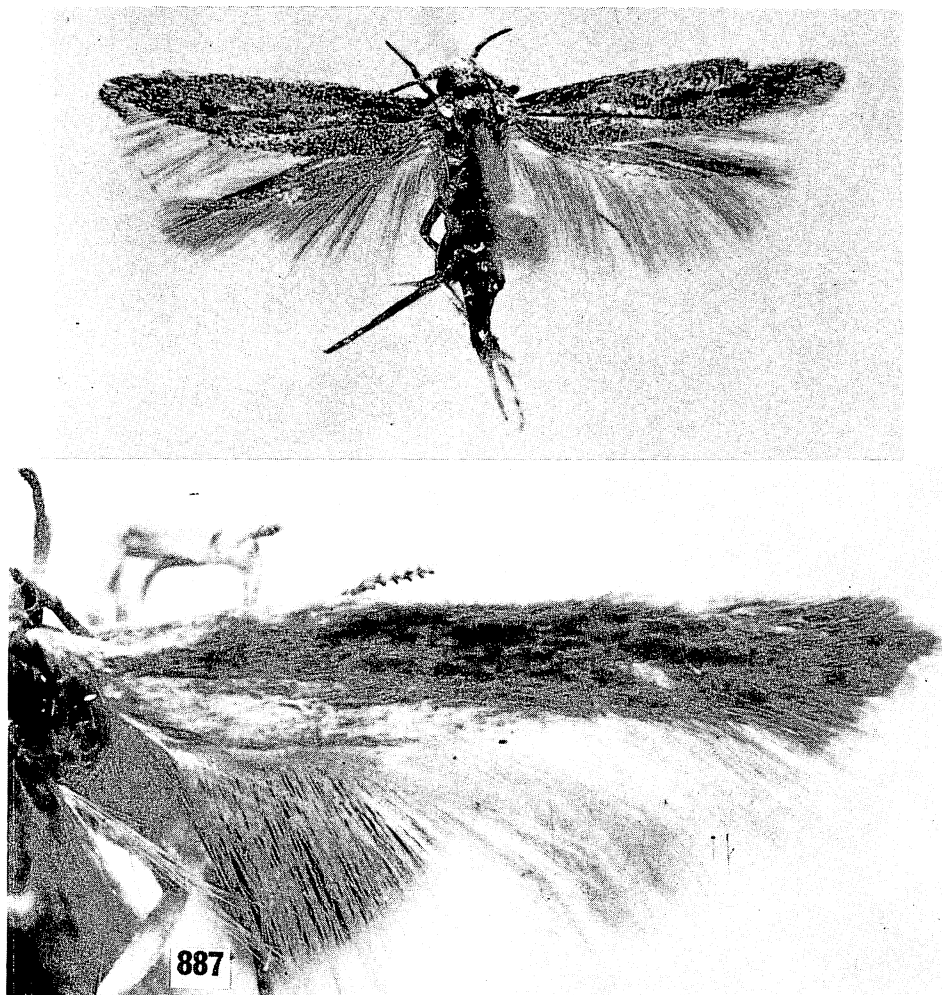


Figure 887—*Hyposmocoma*. Top, (*H.*) *communis* (Swezey) ("Petrochroa"), Honolulu; forewing 4.25 mm. Bottom, (*E.*) *complanella* (Walsingham) ("Neelysia"), holotype male (BM slide 4459); Molokai, over 3,000 feet; forewing 5 mm., mostly orange. These specimens were used for the *Fauna Hawaiiensis* figures.

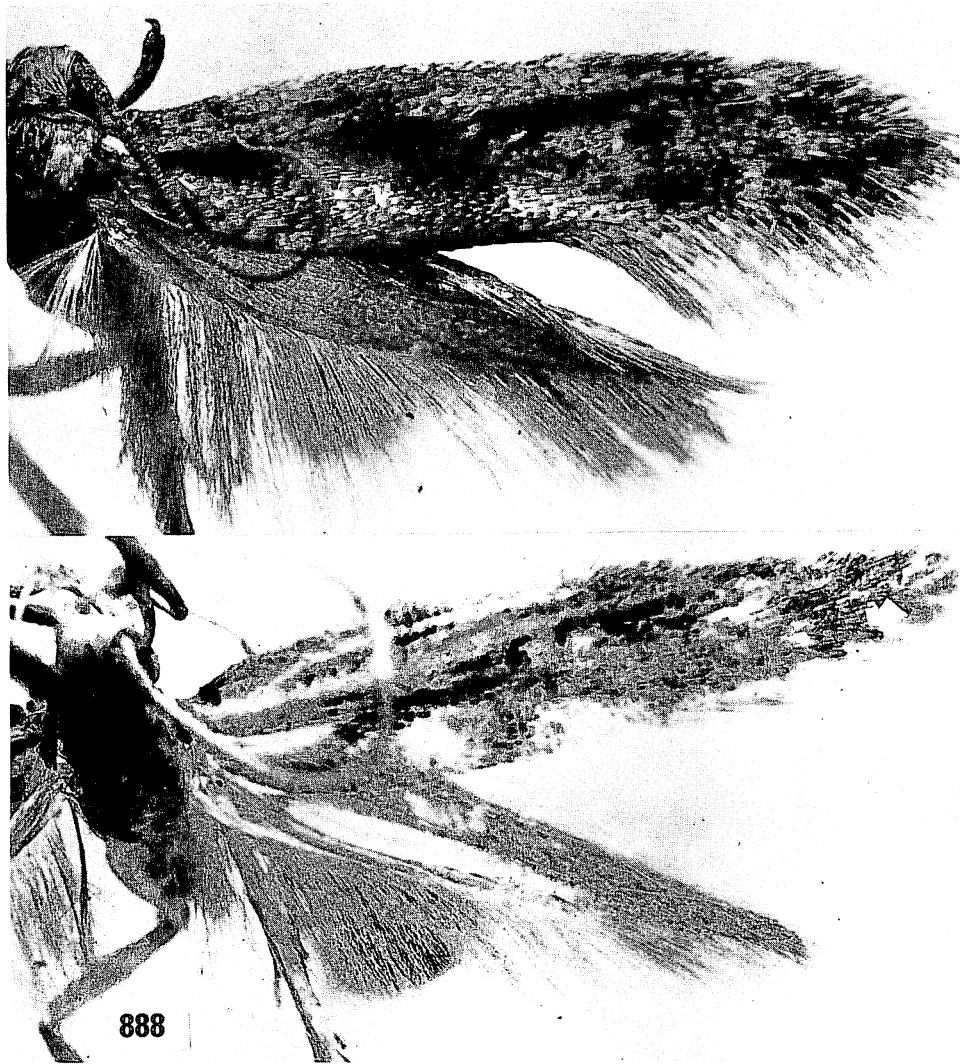


Figure 888—*Hyposmocoma*. Top, (*H.*) *conditella* Walsingham, holotype male (abdomen lost); Kauai, 3,000 to 4,000 feet; forewing 7.5 mm., mixed white and fuscous. Bottom, (*E.*) *confusa* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4746); Olinda, 4,000 feet, Maui; forewing 6 mm., basically white with some yellow and with brownish to fuscous maculae. These specimens were used for the *Fauna Hawaiiensis* illustrations.

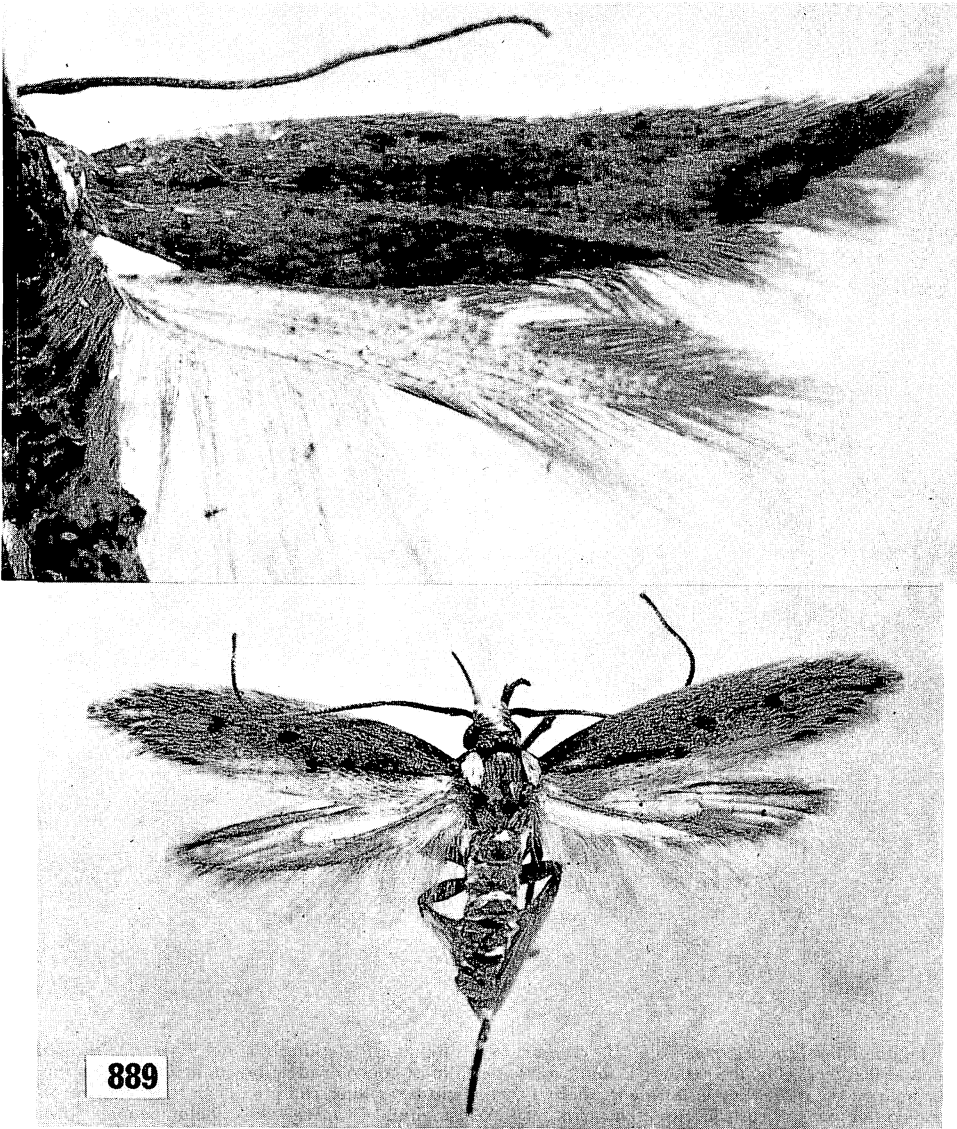


Figure 889—*Hypsmocoma*. Top, (*H.*) *continuella* Walsingham, holotype female (BM slide 7062); Haleakala, 5,000 feet, Maui; forewing 5 mm., mostly fuscous with a paler vitta along the fold, as faintly indicated in the photograph. This specimen is illustrated in *Fauna Hawaiiensis*. Bottom, (*E.*) *coprosmae* (Swezey) ("*Semnoprepia*"), holotype male; Malamalama, Mt. Konahuanui, Oahu; forewing 8.5 mm., mostly ochreous brown and with three fuscous dots as shown (the anterior parts of the wings are too dark in the photograph, and the dark dots are not revealed with enough contrast).

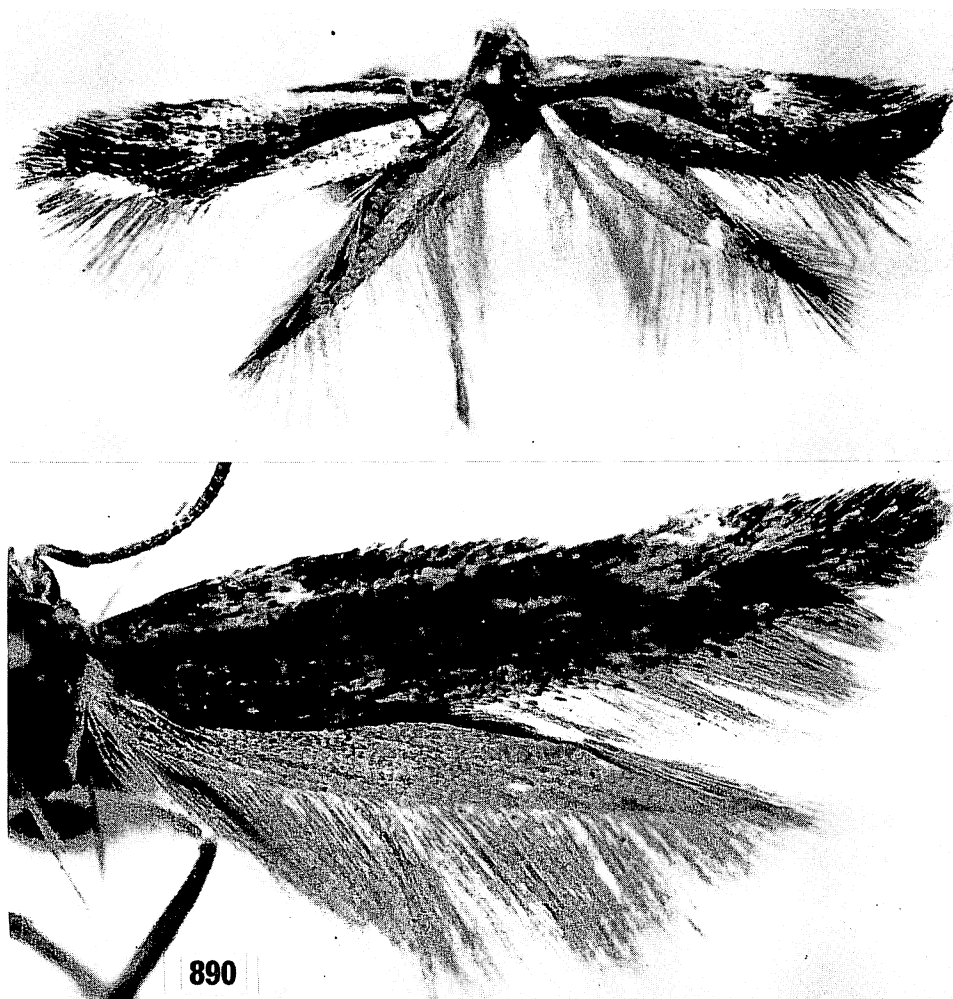


Figure 890—*Hypsoscoma*. Top, (*H.*) *coruscans* (Walsingham) ("*Agonismus*"), holotype (BM slide 5435); Kona, 4,000 feet, Hawaii; expanse 9 mm.; forewings almost concolorous submetallic greyish fuscous (the pale area on the right wing is abraded); there is a small cluster of long, sharp hairs on the metapleuron, but these do not form a brush. Bottom, (*E.*) *corticolor* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4740): Haleakala, 5,000 feet, Maui; forewing 6 mm., mostly yellowish brown with cream and fuscous scaling and maculae (the photograph is too dark). These specimens were used for the *Fauna Hawaiiensis* illustrations.





Figure 891—*Hyposmocoma* (*Hyposmocoma*). Top, *corvina* (Butler), holotype male (BM slide 4083); Haleakala, Maui; forewing 7.25 mm., black and white; note the black subcostal brush on the hindwing. Bottom, *costimaculata* Walsingham, holotype male (BM slide 4110); Molokai, above 3,000 feet; forewing 4.25 mm., golden yellow with fuscous maculae (this is a rather poor photograph). These two specimens were used for the illustrations in *Fauna Hawaiiensis*.



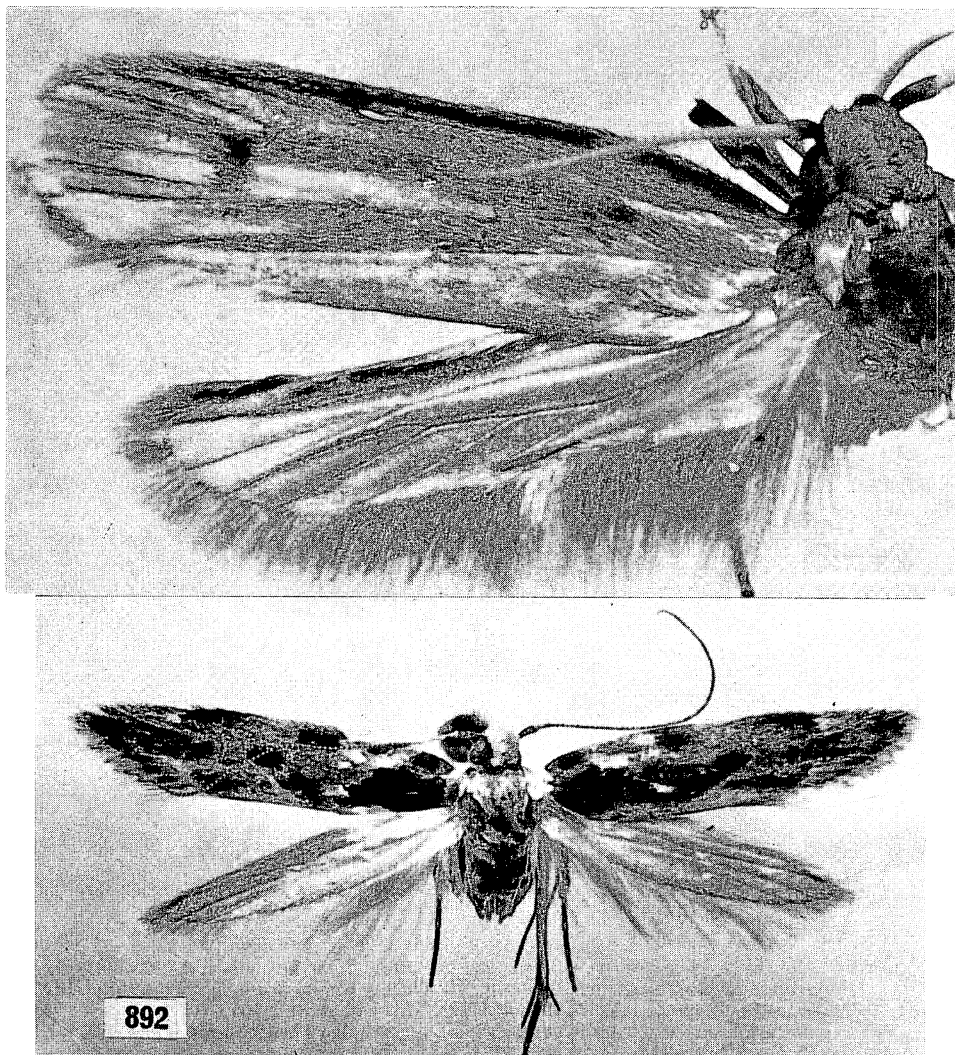


Figure 892—*Hypsmocoma*. Top, (*E.*) *cristata* (Butler), holotype male (BM slide 4390); mountains near Honolulu; forewing 10.5 mm., pale tan, or, in some light, pinkish-buff with fuscous maculae and shiny. This specimen is illustrated in *Fauna Hawaiiensis*. Bottom, (*H.*) *crossotis* Meyrick, holotype female (abdomen lost); Koolau Mts., near Honolulu; expanse 21 mm.; forewings with purplish brown background scaling with black maculae and rather dirty cream-colored areas.

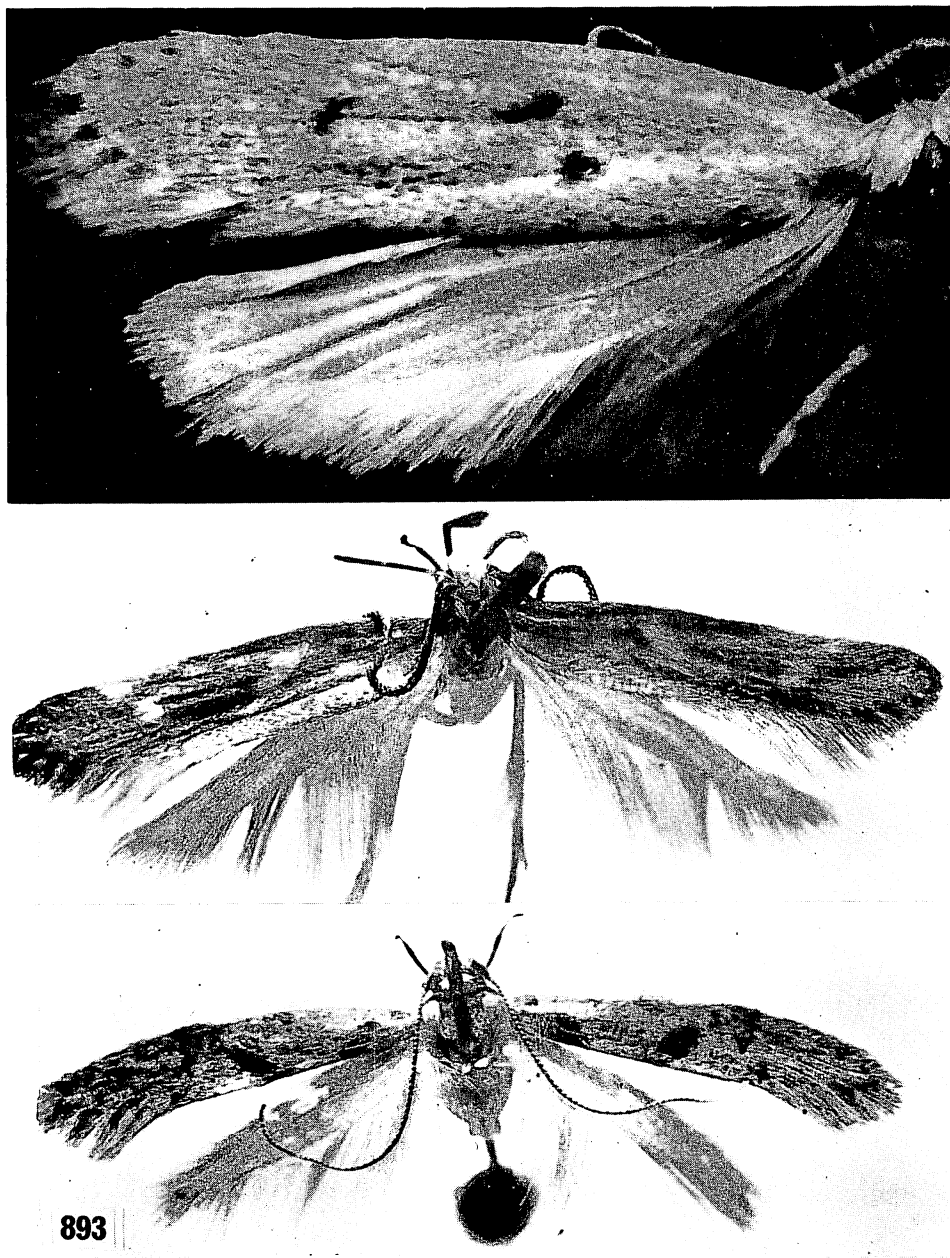


Figure 893—*Hypsoscyma*. Top, (*E.*) *cryptogamiella* (Walsingham) ("*Hyperdasylella*"), holotype male (BM slide 4428); Oloa, Hawaii; forewing 8.5 mm., buff with scattered fuscous scales and maculae. Middle, (*E.*) *cuprea* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4433); Kauai, 3,000 to 4,000 feet; expanse 11.5 mm.; forewings coppery with yellow maculae. Bottom, (*H.*) *cupreomaculata* Walsingham, holotype female (BM slide 4474); Molokai, 3,000 feet; expanse 13.5 mm.; forewings with background scaling mostly dirty white, pale fuscous scale tips, darker fuscous maculae, and some coppery reflections. These specimens are illustrated in *Fauna Hawaiiensis*.

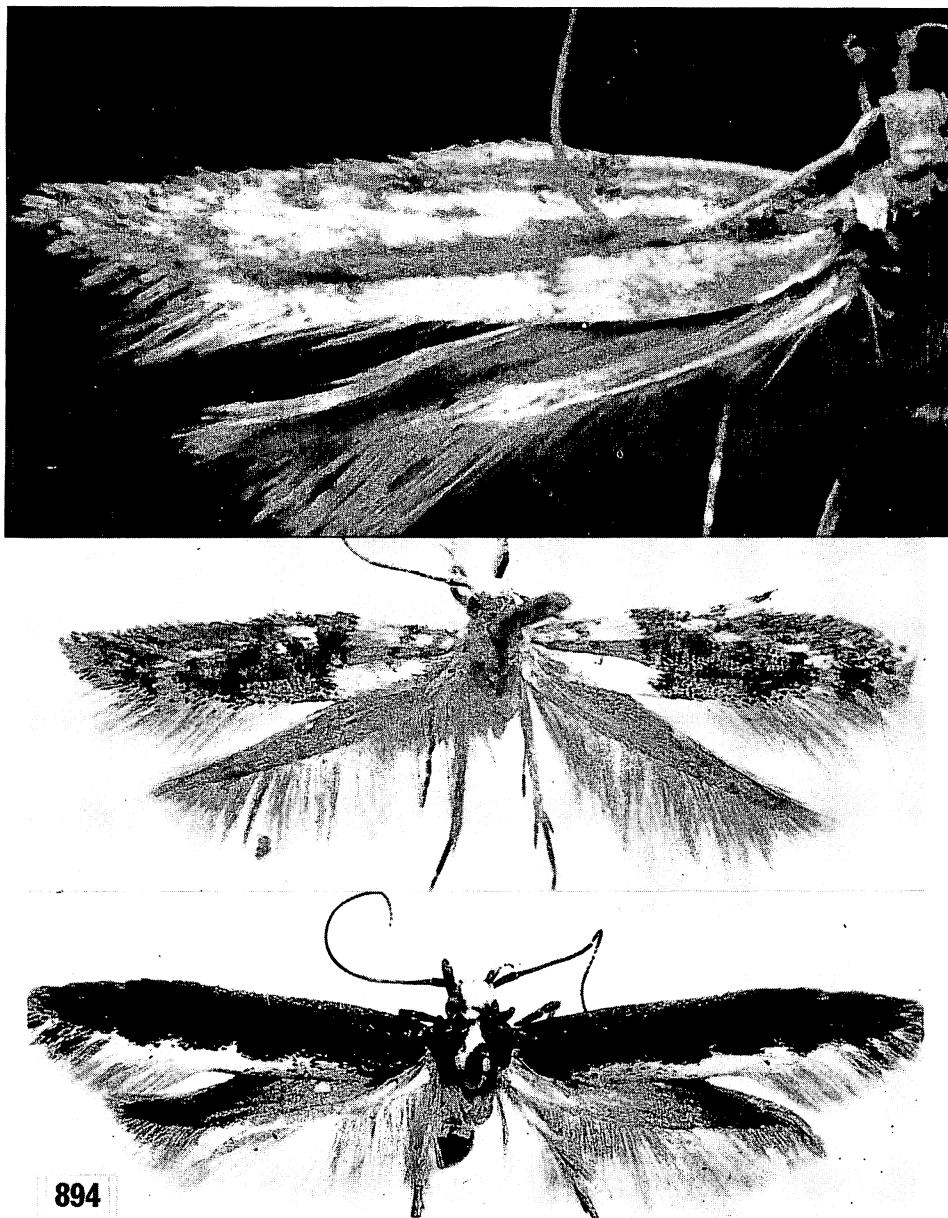


Figure 894—*Hypsoscoma*. Top, (*E.*) *diffusa* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4423); Olinda, 4,000 feet, Maui; forewing 9 mm., white with ferrugineous- and fuscous-tipped scales scattered on the wing and condensed in maculae, thus giving the wing a brown and white appearance. Middle, (*E.*) *digressa* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4745); Haleakala, 5,000 feet, Maui; expanse 12 mm.; forewings white with brownish to fuscous maculae. Bottom, (*H.*) *discella* Walsingham, allotype male (BM slide 4084); Kaholuamano, 4,000 feet, Kauai; expanse 17 mm.; forewings black and white; there is a moderate metapleural tuft. The top and middle specimens were used for the *Fauna Hawaiiensis* illustrations.

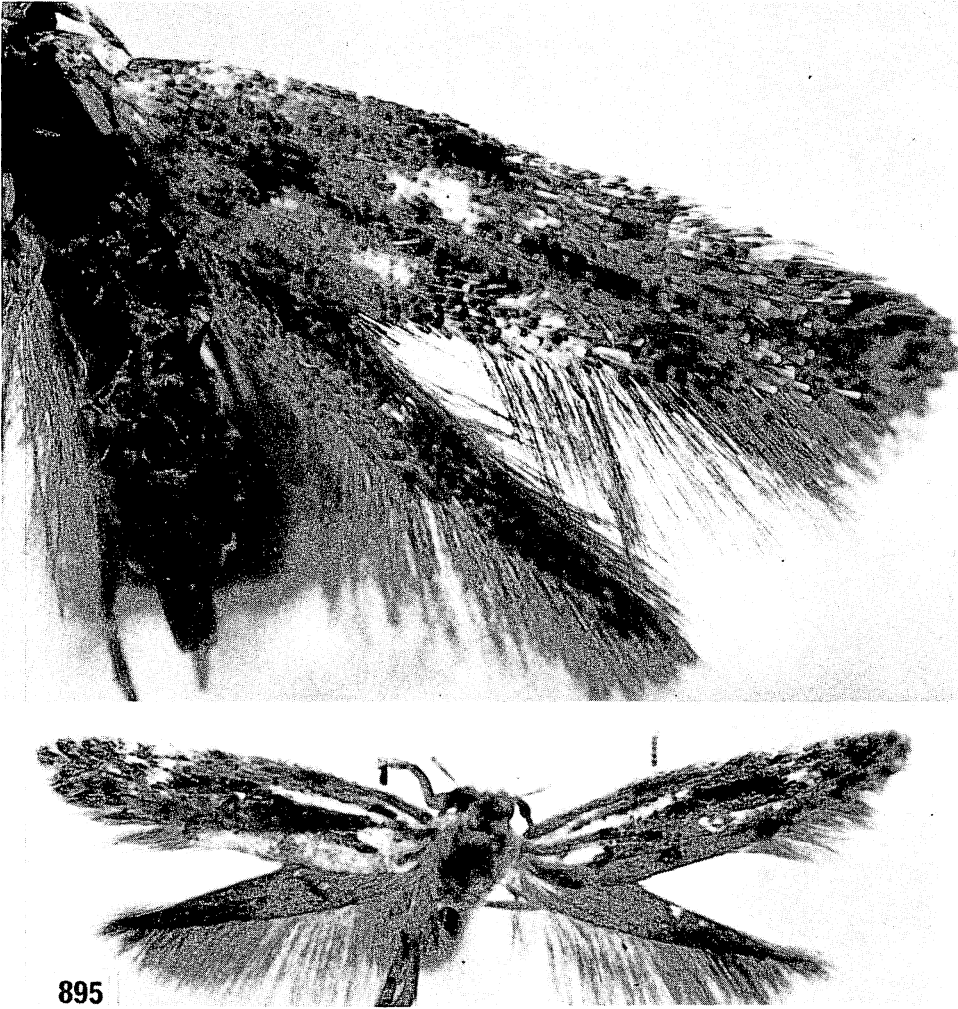


Figure 895—*Hyposmocoma* (*Euperissus*). Top, *discolor* Walsingham, holotype female (BM slide 7172); Kilauea, Hawaii; forewing 5.25 mm., yellowish, white, and fuscous (several of the pale-appearing areas are abrasions). Bottom, *divergens* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 5237); Molokai, above 3,000 feet; expanse 11 mm.; forewings ferrugineous with yellow and fuscous vittae and maculae and with some white in the preapical areas. These specimens were used for the *Fauna Hawaiiensis* illustrations.

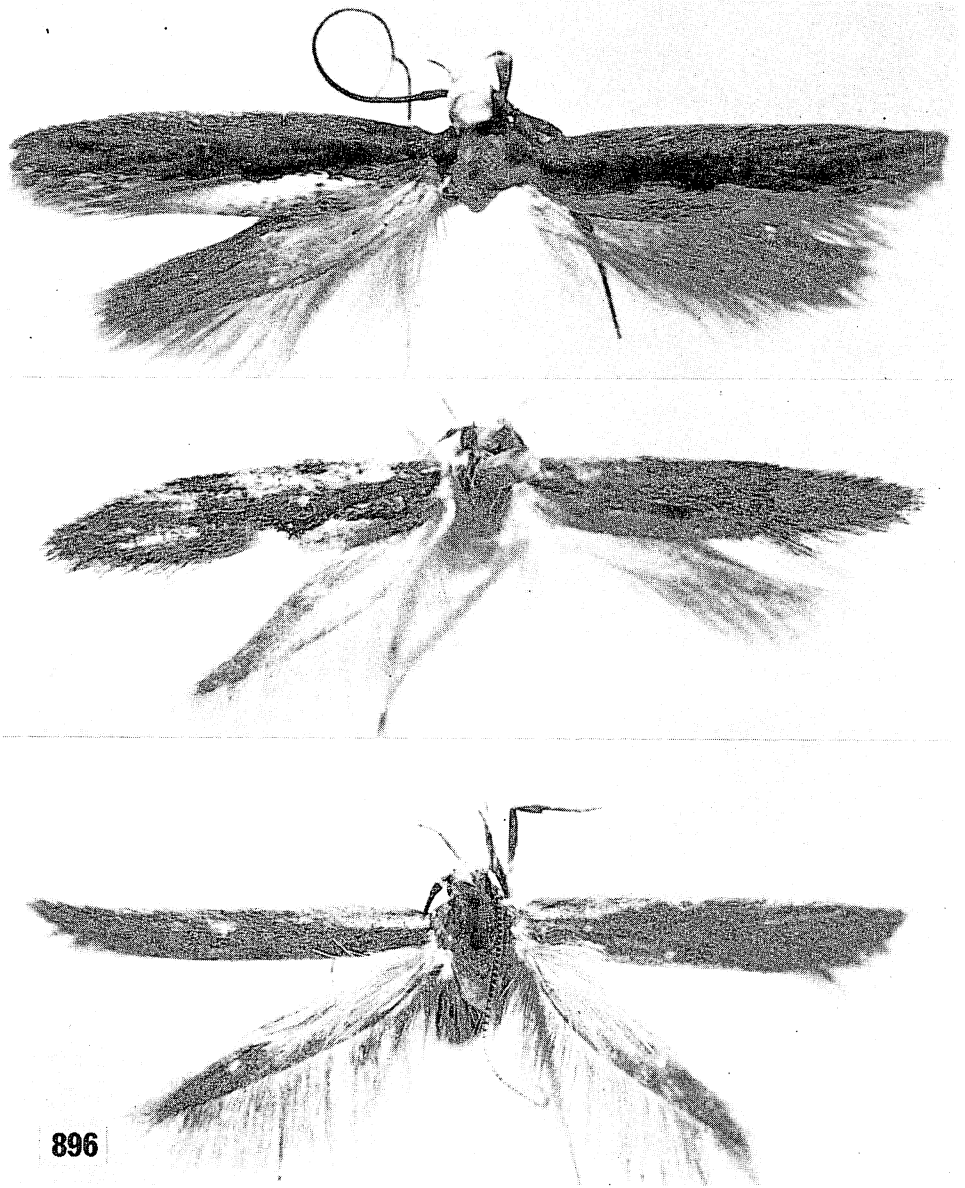


Figure 896—*Hyposmocoma* (*Hyposmocoma*). Top, *divisa* Walsingham, holotype male (abdomen lost); Kauai, 3,000 to 4,000 feet; expanse 15 mm.; forewings black and white. Middle, *domicolens* (Butler), holotype female (wrongly labeled as a male) (BM slide 4096); Makawao, about 2,000 feet, Maui; expanse 13.5 mm.; forewings straw-colored and fuscous. Bottom, *suffusa* (Walsingham) (formerly considered to be a form of *domicolens*), holotype male (BM slide 4095); Kilauea, Hawaii; expanse 18 mm.; forewings with the scales mostly greyish white and tipped with yellowish or brownish which gives a brownish cast; note the expanded pale yellow subcostal brushes on the hindwings. These specimens are illustrated in *Fauna Hawaïensis*.

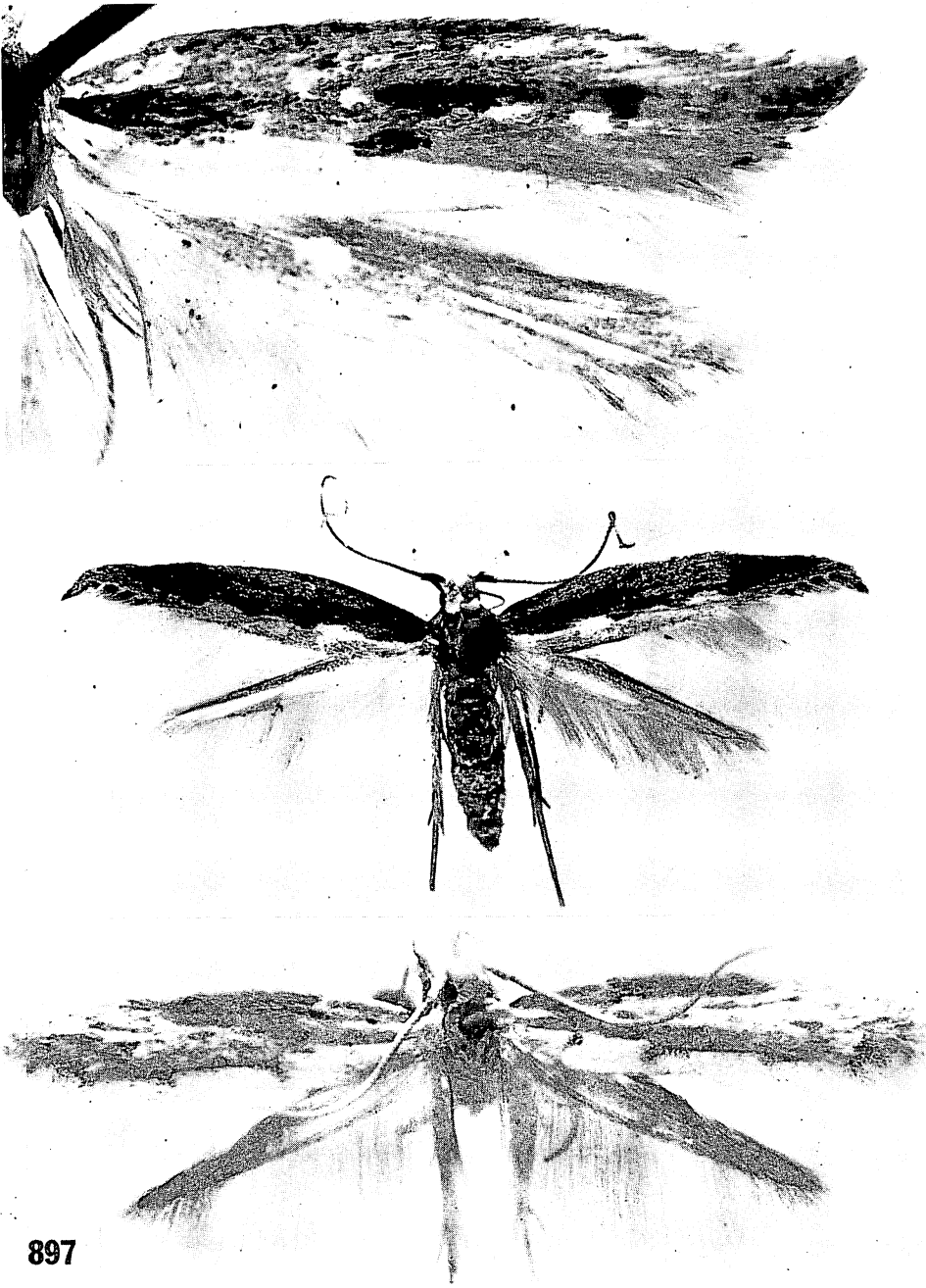


Figure 897—*Hyposmocoma* (*Euperissus*). Top, *dorsella* Walsingham, holotype male (BM slide 4331); Waianae Mts., 3,000 feet, Oahu; forewing 7 mm., cream-colored and brownish fuscous with fuscous maculae. Middle, *ekaha* (Swezey) ("*Euhyposmocoma*"), holotype; Halawa Valley, Oahu; forewing 8 mm., brown with posterior whitish ochreous zone sprinkled with brownish scales. Bottom, *elegans* (Walsingham) ("*Aphtho-netus*"), holotype male (BM slide 4756); Olinda, 4,000 feet, Maui; expanse 18 mm.; forewings with the background scaling white and pale green with fuscous-tipped scales which form maculae. A long tuft of hair arises from the axil of each hindwing. The top and the bottom specimens are illustrated in *Fauna Hawaiensis*.



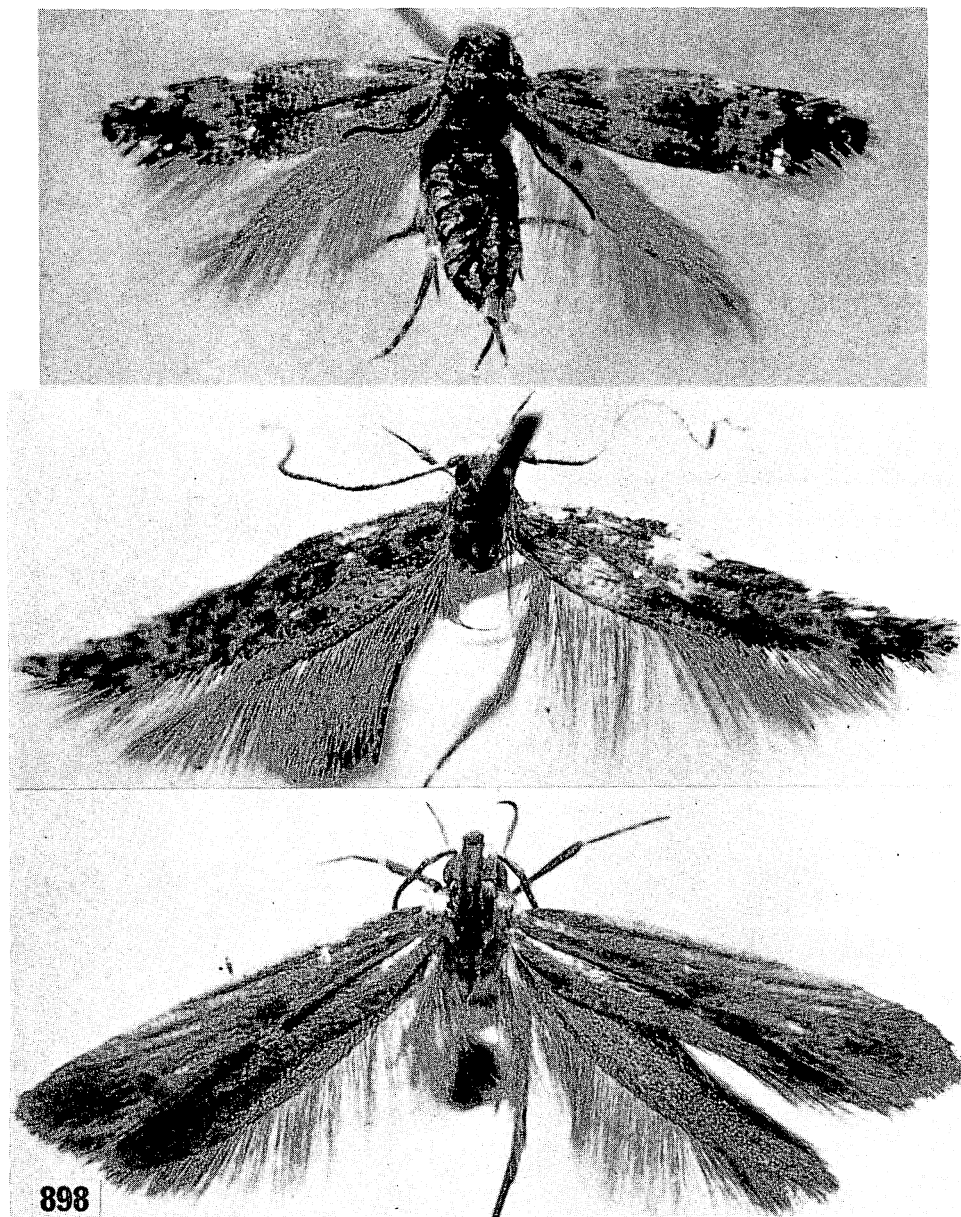
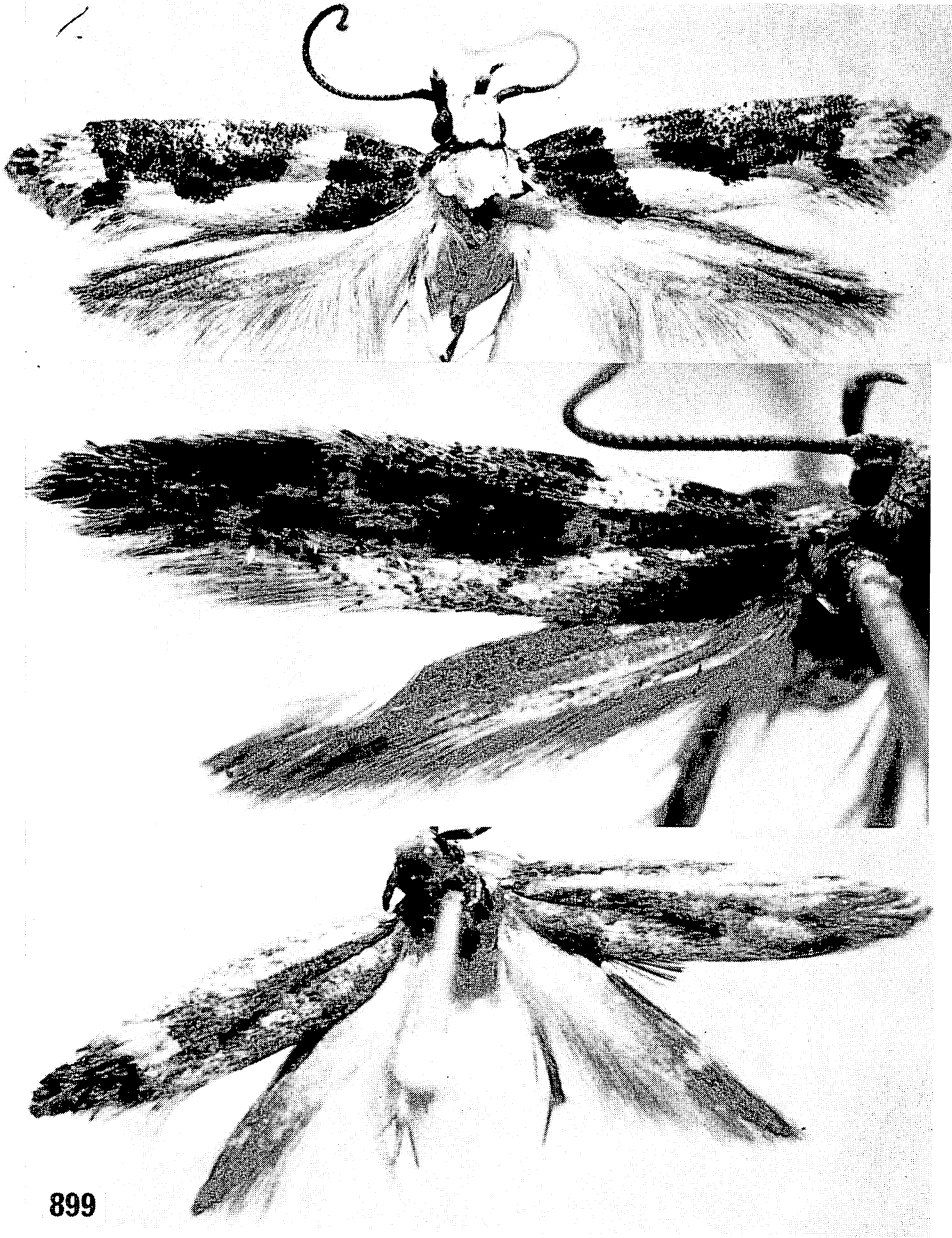


Figure 898—*Hyposmocoma*. Top, (*H.*) *elegantula* (Swezey) ("Petrochroa") lectotype (here designated); Koko Head, Oahu; forewing 2.5 mm., brown and fuscous with a variable whitish fascia near basal fourth, a yellow or whitish macula near distal three-fourths, and scattered submetallic scales distad as revealed by the white spots in the photograph. Middle, (*E.*) *eleuthera* (Walsingham) ("*Aphthonetus*"), holotype female (BM slide 4716); Kilauea, Hawaii; expanse 10 mm.; forewings with mixed white, yellowish, and fuscous scales (the large, pale costal area on the right forewing is an abrasion). Bottom, (*E.*) *emendata* Walsingham, holotype male (BM slide 4138); Haleakala, 5,000 feet, Maui; expanse 14.5 mm.; forewing brownish fuscous with a cream-colored vitta at the basal half of the fold and from there a scattering of cream-colored scales reaching to a cream-colored spot on termen. The middle and bottom specimens are figured in *Fauna Hawaiiensis*.



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Figure 899—*Hyposmocoma*. Top, (*H.*) *empedota* Meyrick, lectotype male (BM slide 9556 Clarke); Koolau Mts., near Honolulu; expanse 13 mm.; a boldly marked black and white species. Middle, (*E.*) *empetra* (Meyrick) ("*Aphthonetus*"), lectotype male (BM slide 9579 Clarke); Koolau Mts., Oahu; forewing 5 mm., brownish with a broad pale fascia near basal fourth (a shadow the length of the forewing confuses the pattern in the photograph, and the area costad of what appears as a pale area along the posterior part of the wing should appear concolorous). Bottom, (*H.*) *endryas* Meyrick, holotype male (abdomen lost); Koolau Mts., near Honolulu; forewing 4.75 mm., brownish fuscous with paler and darker areas. Note the dark subcostal brushes protruding from the hindwings.



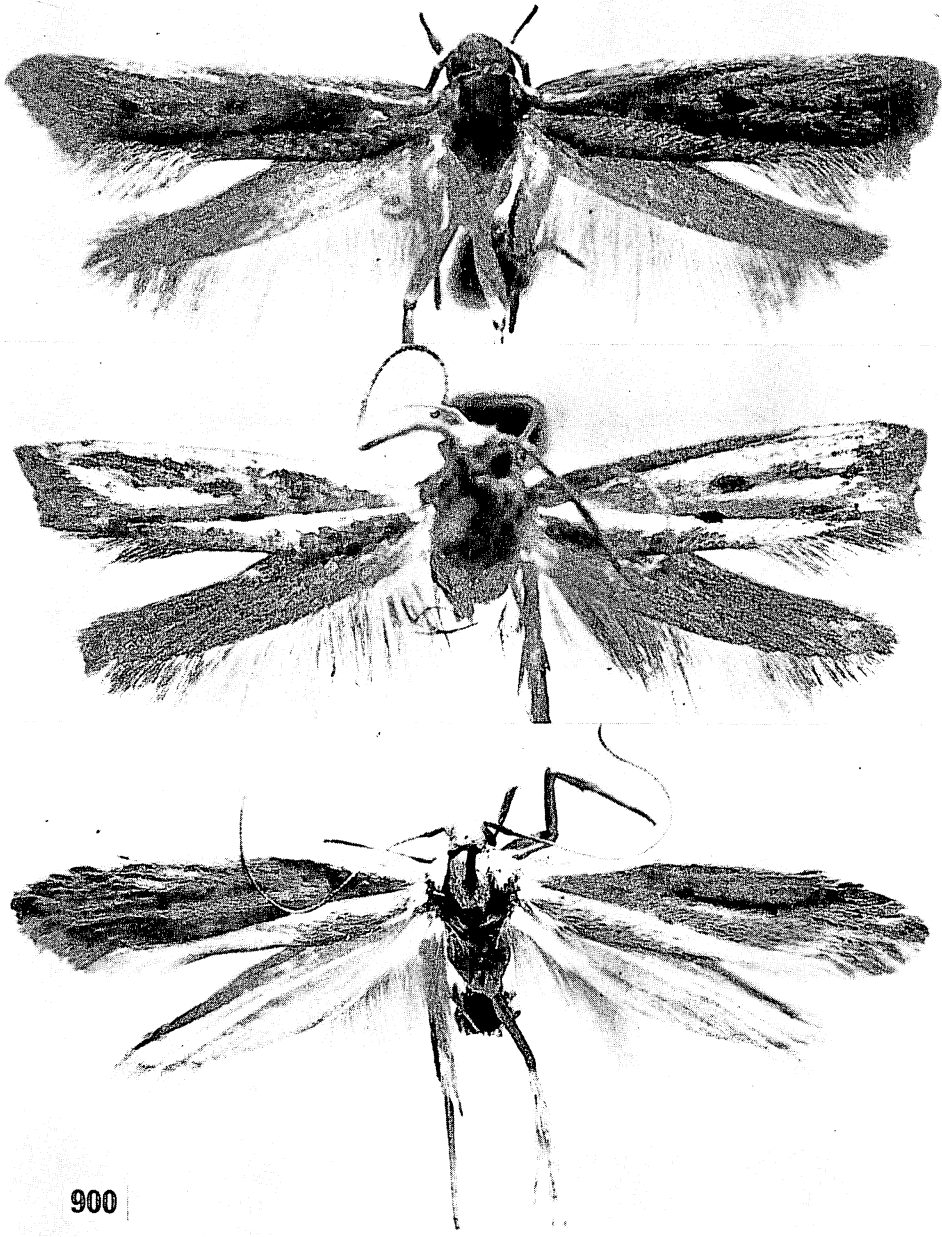


Figure 900—*Hyposmocoma* (*Euperissus*). Top, *enixa* Walsingham, holotype male (BM slide 4134); Kaholuanamano, 4,000 feet, Kauai; expanse 13 mm.; forewings brownish fuscous with darker maculae. Middle, *ensifer* Walsingham, holotype male (BM slide 4139); Kilauea, Hawaii; expanse 12.5 mm. as mounted; forewings mostly fuscous with cream and yellow pale areas. There is a small metapleural cluster of long scales. Bottom, *epicharis* Walsingham, holotype female (abdomen lost); Molokai, above 3,000 feet; expanse 28.5 mm. This is one of the largest and finest of the species whose forewings are almost entirely canary yellow (the shadows on the photograph give a misleading impression). The vannal tufts on the hindwings are well developed. These specimens are figured in *Fauna Hawaiiensis*.

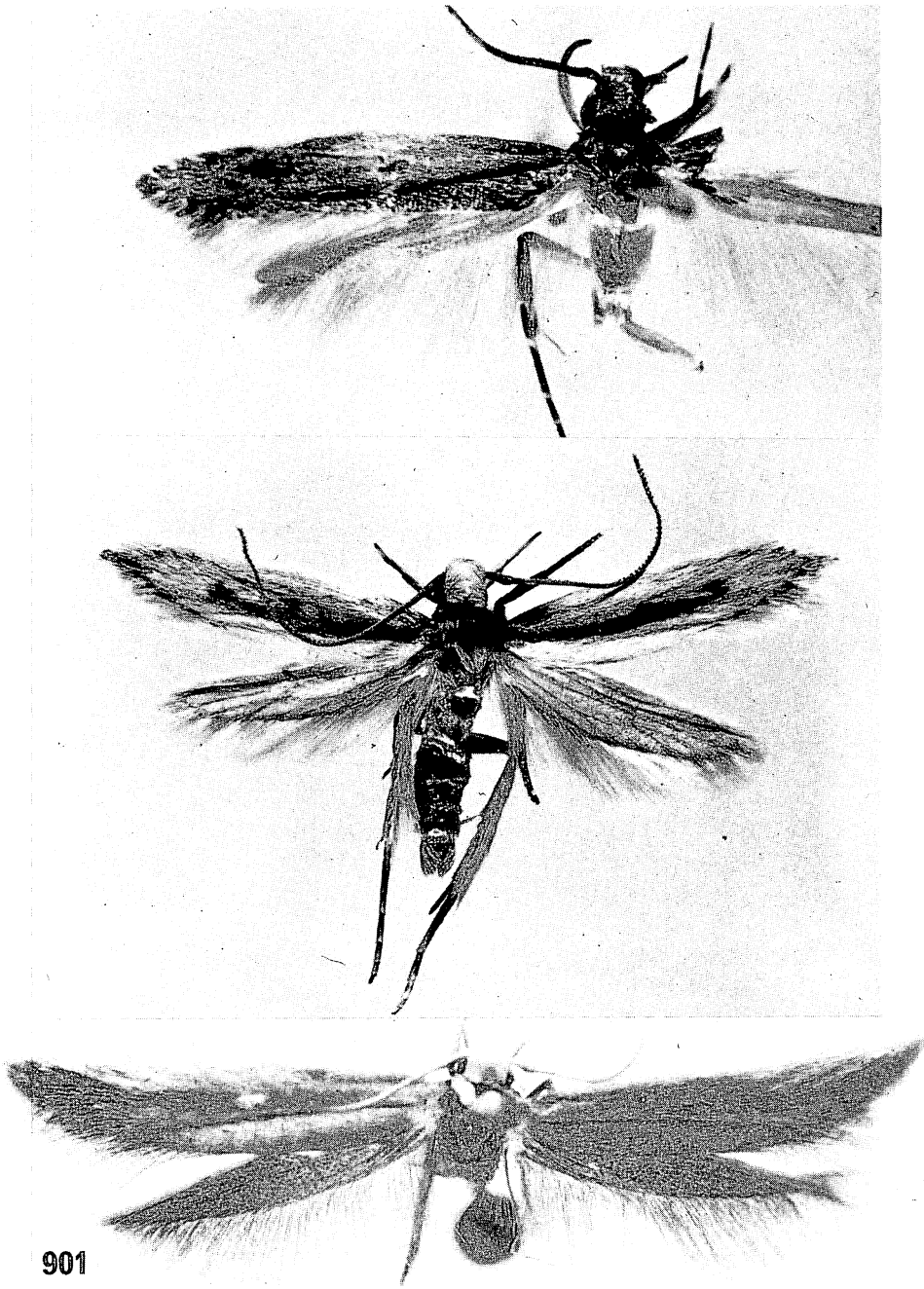
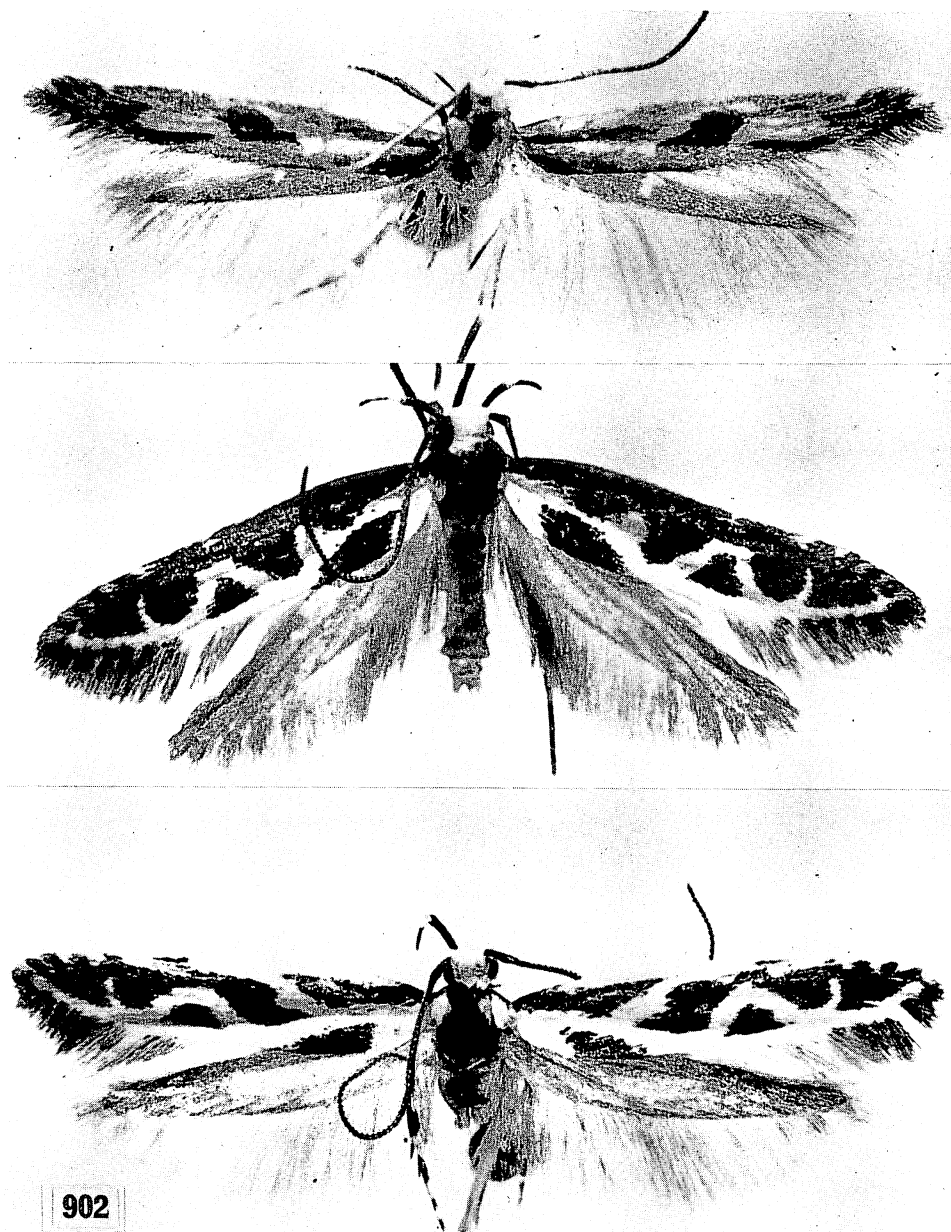


Figure 901—*Hypsmocoma*. Top, (*E.*) *erebogramma* (Meyrick) ("*Neelysia*"), holotype male (damaged, abdomen lost); Kahuku, Oahu, ex *Hesperomannia*; forewing 5 mm., in some lights bronzy brown-fuscous costad and brownish fuscous flecked posteriorly with white squamae and with fuscous maculae (the dark area across the wing at about distal quarter is mostly shadow and not dark color). Middle, (*E.*) *erismatias* Meyrick, holotype male (slide Z-I-22-61-4); Nuuanu, Honolulu; ex *Euphorbia*; forewing 7.25 mm., ochraceous white with prominent brown to fuscous maculae. Bottom, (*H.*) *evanescens* Walsingham, holotype male (BM slide 4113); Haleakala, 5,000 feet, Maui; expanse 14.5 mm.; forewings brassy grey suffused with fuscous (the photograph does not reveal the delicate shading of the colors). This specimen is figured in *Fauna Hawaiiensis*.



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Figure 902—*Hyposmocoma* (*Euperissus*). Top, *exaltata* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4444); Haleakala, 4,000 feet, Maui; expanse 12.5 mm.; forewing yellow to orange with white and fuscous maculae, the submedial oblique fascia is fuscous orange, bordered with fuscous. There is a pair of strong, yellow metapleural brushes which cross over the abdomen, and the abdomen has large, modified dorsal squamae. Middle, *exornata* Walsingham, holotype male (BM slide 5556); Kona, 4,000 feet, Hawaii; expanse 17 mm.; forewings cream and black. Each metapleuron has a weak tuft of long hairs and scales. Bottom, *flavicosta* (Walsingham) (formerly considered a form of *exornata*), holotype male (BM slide 4079); Kilauea, Hawaii; expanse 19.5 mm.; forewings white and cream with bold black maculae. Each metapleuron has a weak tuft of fine hairs and long slender squamae. These three specimens are figured in *Fauna Hawaiiensis*.

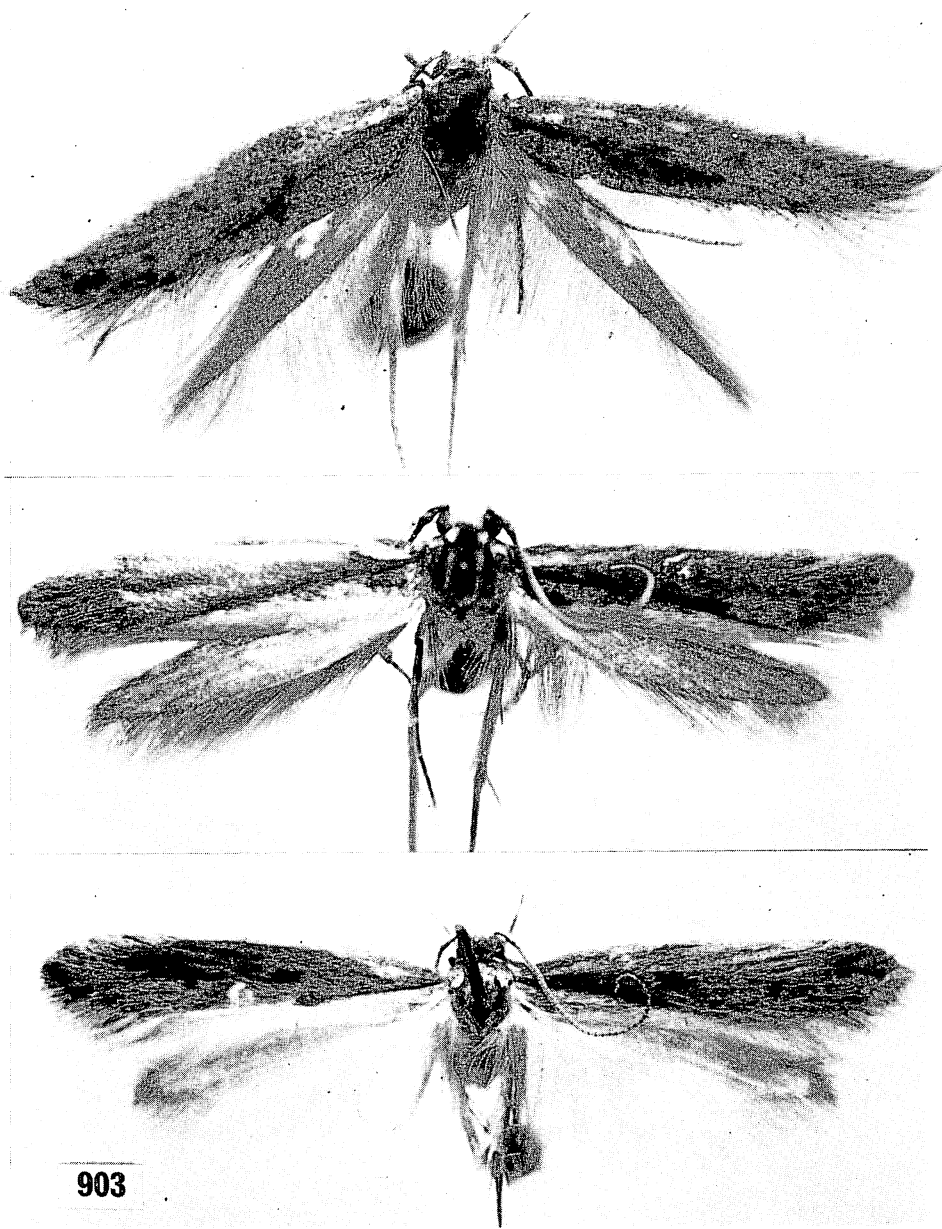


Figure 903—*Hypsoscyma*. Top, (*E.*) *exsul* (Walsingham) ("*Aphthonetus*"), holotype female (BM slide 4414); Kilauea, Hawaii; expanse 12 mm.; forewings with whitish background densely set with brownish and fuscous-tipped scales. Middle, (*H.*) *fallacella* Walsingham, holotype male (BM slide 4332); expanse 15 mm.; the pale (cream) posterior margin of the forewing is not revealed with enough contrast to the remainder of the wing which is mostly brown (the apparently pale subcostal zone on the left forewing is from light reflection and is not a pale area). Bottom, (*E.*) *falsimella* Walsingham, holotype male (BM slide 4333); expanse 18 mm.; forewings with pale area behind fold cream-colored with remainder of wing mostly brownish and with darker maculae (the pale spot near posterior margin of left forewing is an abrasion). Each of these specimens is figured in *Fauna Hawaiensis*.

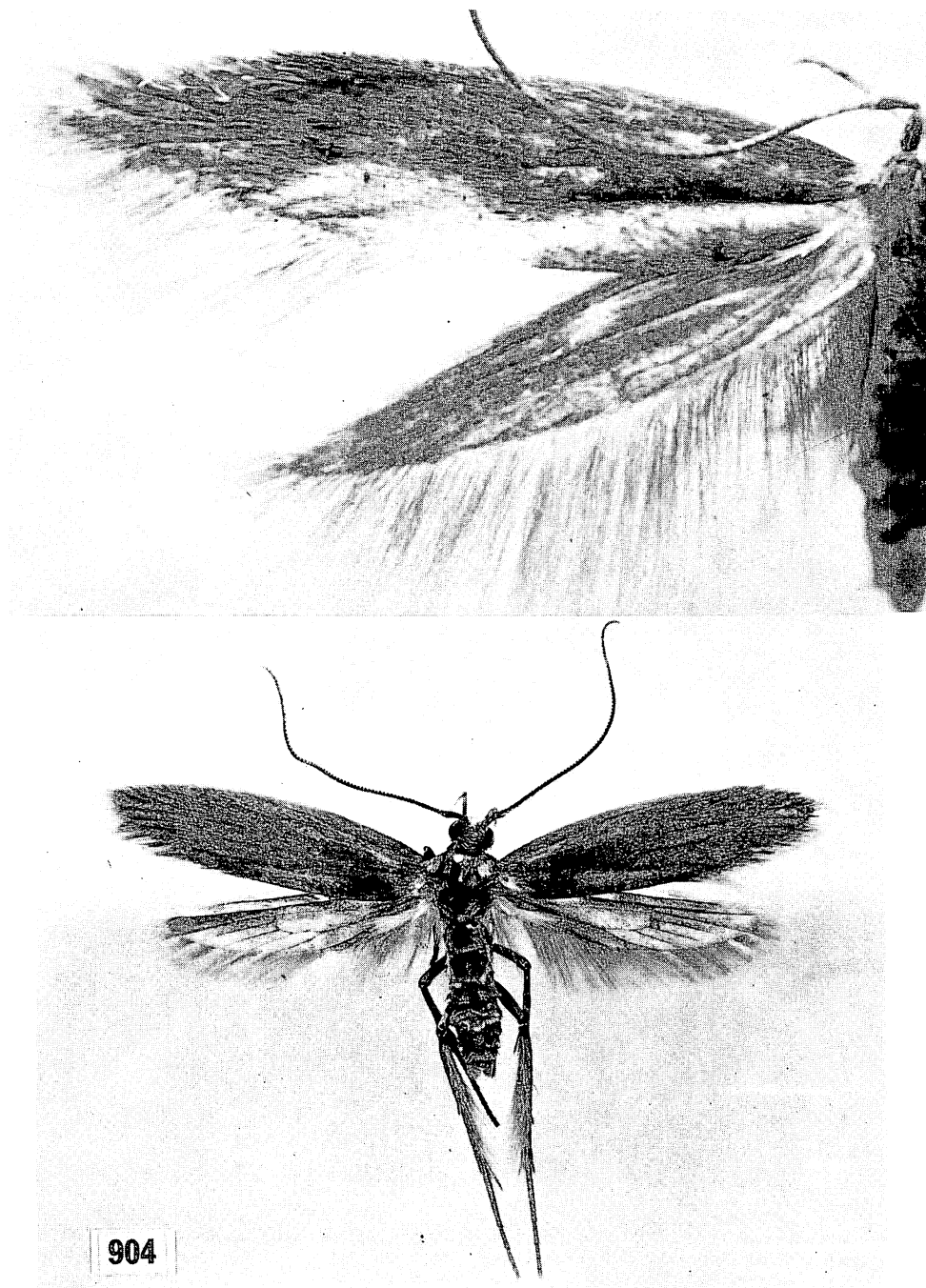


Figure 904—*Hypsmocoma*. Top, (*H.*) *ferricolor* Walsingham, holotype female (BM slide 7066); Hualalai, Kona, 5,000 feet, Hawaii; forewing 6.75 mm., ferruginous brownish with darker or more ferruginous areas. This specimen is figured in *Fauna Hawaiiensis*. Bottom, (*E.*) *ferruginea* (Swezey) ("*Semnoprepia*"), holotype male; Mt. Olympus, Oahu; ex *Cheirodendron*; forewing 12 mm., immaculate, concolorous ferruginous.

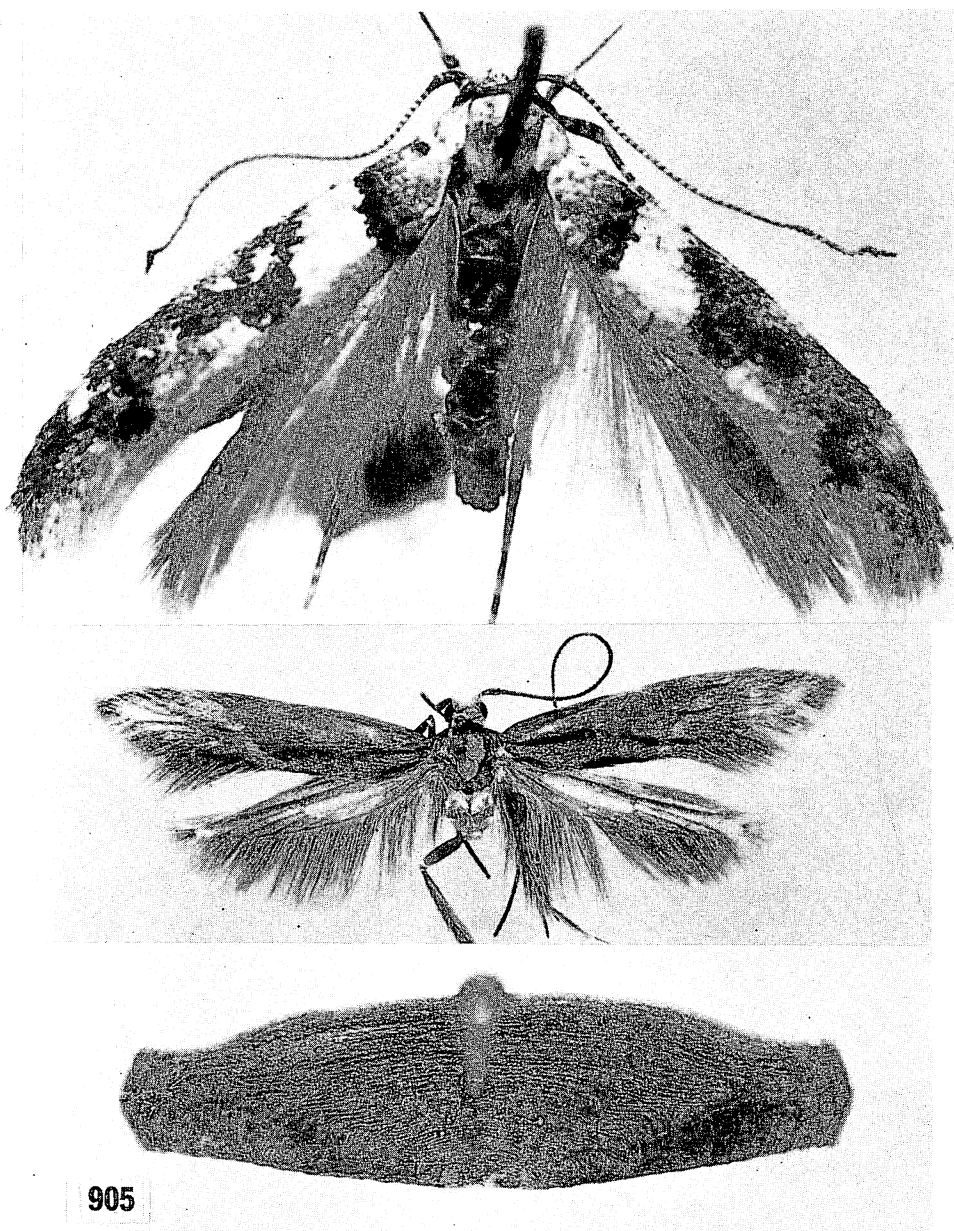


Figure 905—*Hyposmocoma* (*Hyposmocoma*). Top, *fervida* Walsingham, holotype female (slide not made); Molokai, above 3,000 feet; forewing 5.75 mm., white and fuscous. This specimen is illustrated in color in *Fauna Hawaiiensis*. Middle, *flicivora* Meyrick, holotype (abdomen lost); Konahuanui, Oahu; ex *Cibotium*; forewing 7.5 mm., mostly ferrugineous and fuscous, paler and tinged with ochraceous distad, and with an outwardly oblique paler fascia from near middle of posterior margin extending about halfway across forewing. Bottom, a larval case of the same species; length 12 mm.



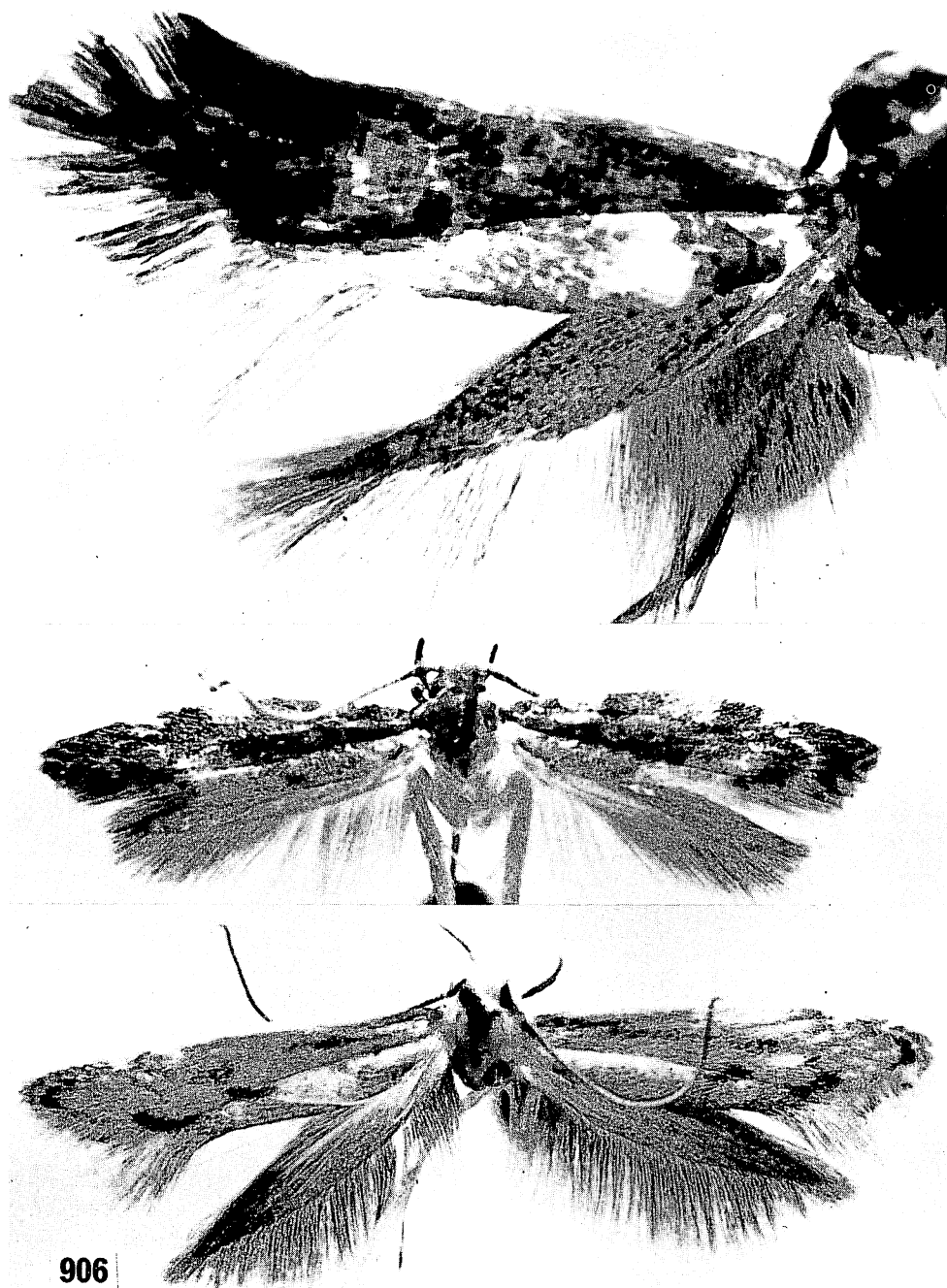
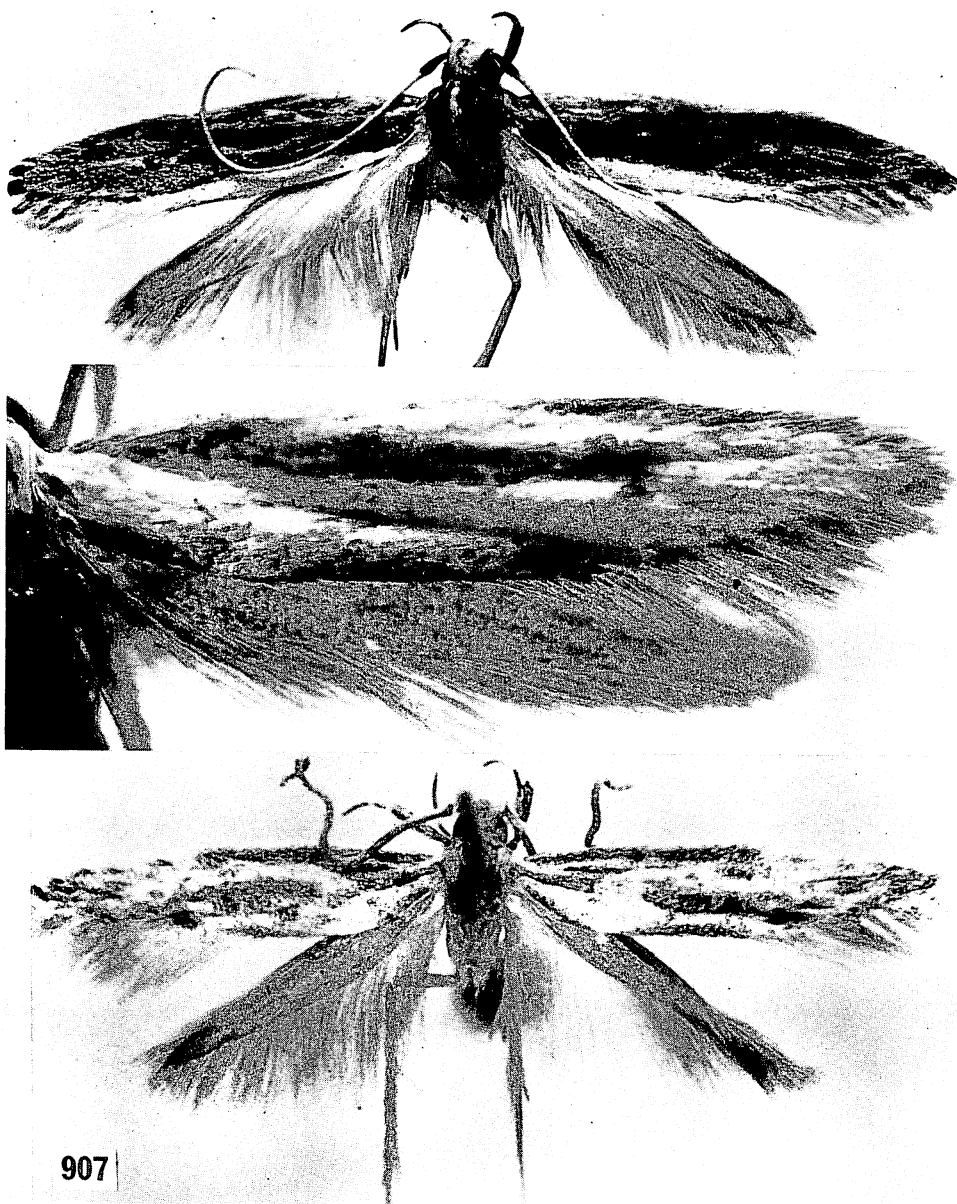


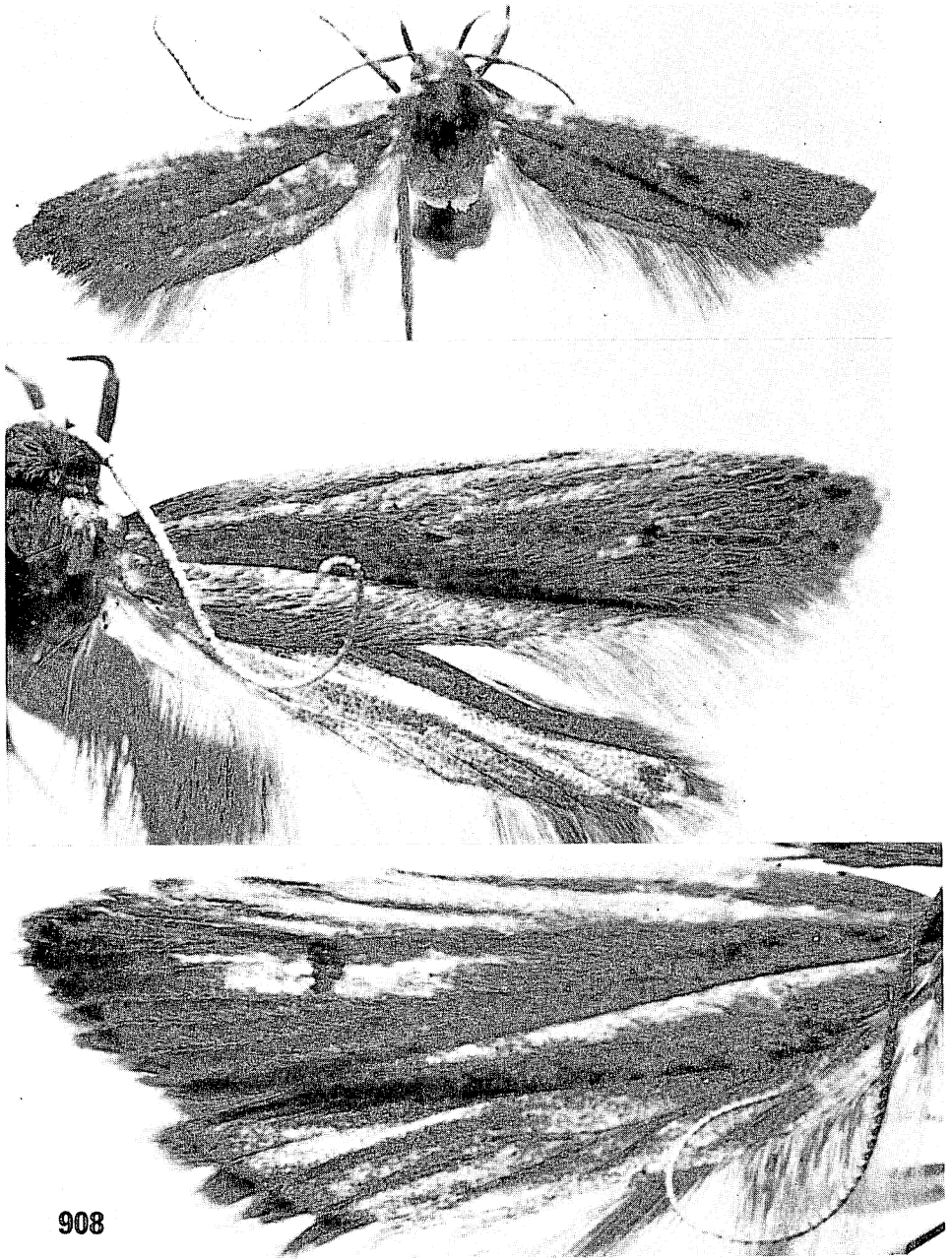
Figure 906—*Hypsoscoma*. Top, (*H. flavipalpis* (Walsingham) ("*Agonismus*"), holotype female (BM slide 4309); Haleakala, 4,000 feet, Hawaii; forewing 4.25 mm., fuscous with coppery and submetallic reflections and some paler areas (the subbasal pale area and the large pale macula behind the fold near the basal quarter are too pale in the photograph). Middle, (*E. fluctuosa* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4741); Kauai, 3,000 to 4,000 feet; expanse 14 mm.; forewings ferrugineous with white or cream and fuscous scaling and maculae. Bottom, (*H. fractinubella* Walsingham, holotype male (BM slide 4146); Olinda, 4,000 feet, Maui; expanse 14 mm.; forewings cream and straw-colored with fuscous markings. A yellow subcostal brush is visible on the left hindwing. These specimens are illustrated in *Fauna Hawaiiensis*.



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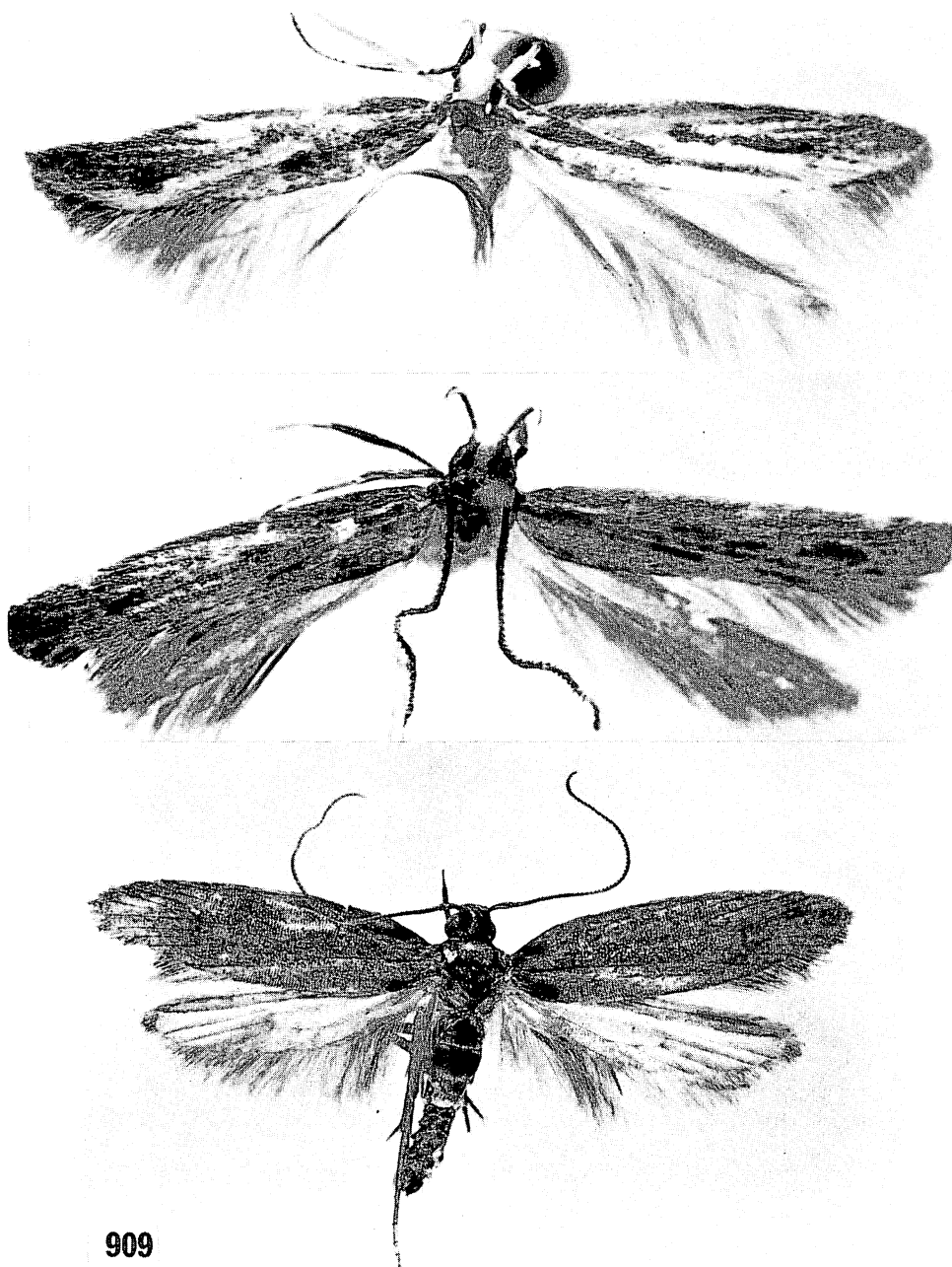
Figure 907—*Hypsoscoma*. Top, *H. fractistriata* Walsingham, allotype male (BM slide 4496); Waianae Mts., Oahu; expanse 17.5 mm.; forewings straw-colored with brownish fuscous markings. (Note the dark base of the antenna and the strong, pale subcostal brushes on the hindwings.) There is a modest metapleural cluster of long scales. Middle, (*E.*) *fractivittella* Walsingham, holotype female (BM slide 7063); Kauai, 3,000 to 4,000 feet; forewing 6 mm. long, cream with fuscous maculae. Bottom, (*E.*) *fugitiva* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4738); Kaholuamano, 4,000 feet, Kauai; expanse 13 mm.; forewings white with yellow and fuscous maculae. The middle and bottom specimens were used for the *Fauna Hawaïensis* illustrations.





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Figure 908—*Hyposmocoma* (*Euperissus*). Top, *fulvida* Walsingham, holotype male (BM slide 4337); Molokai, about 4,000 feet; expanse 14 mm.; forewings brown with fuscous maculae. Middle, *fulvocervina* Walsingham, holotype male (BM slide 4342); Kaholuamano, 4,000 feet, Kauai; forewing 9 mm., mostly ferruginous with three nearly black discal spots, partly outlined in pale coloring, and apex with fuscous maculae. Bottom, *fulvogrisea* (Walsingham) ("*Semnoprepia*"), holotype male (BM slide 4429); Kauai, 3,000 to 4,000 feet; forewing 10.5 mm., pale brown with fuscous maculae. These specimens are illustrated in *Fauna Hawaiiensis*.



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Figure 909—*Hyposmocoma* (*Euperissus*). Top, *fuscidentata* Walsingham, holotype female (BM slide 4462); Kilauea, Hawaii; expanse 12.5 mm.; forewings white and fuscous. Middle, *fuscofusa* (Walsingham) ("Neelysia"), holotype male (BM slide 4439); Kauai, 3,000 to 4,000 feet; forewing 5.25 mm., yellow fuscous and brownish fuscous marked with dark fuscous vittae at middle of wing. Bottom, *fuscopurpurata* Zimmerman, holotype female (slide not made); Mt. Olympus, Oahu; forewing 9.75 mm., almost entirely purplish fuscous. The top and middle specimens are figured in *Fauna Hawaiiensis*.

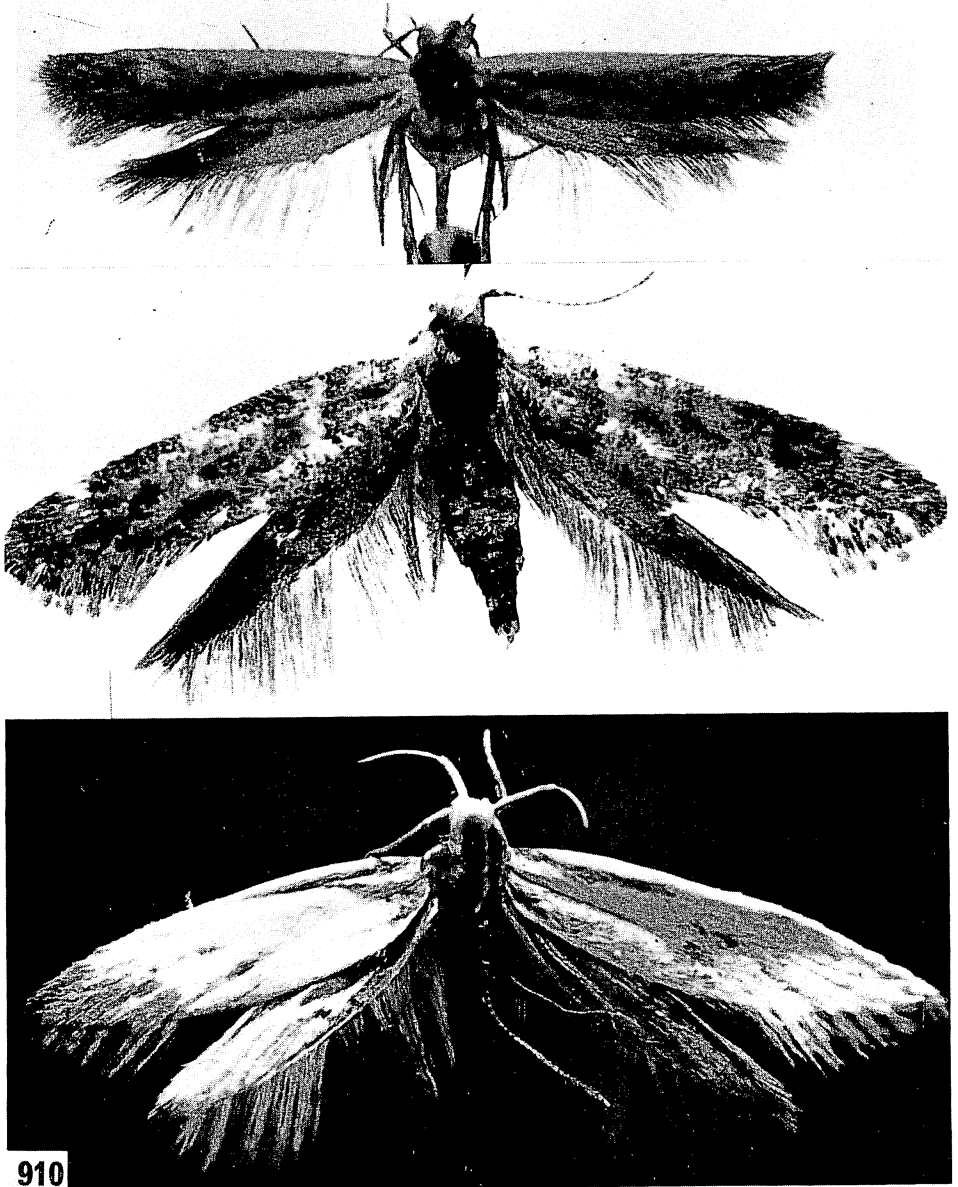


Figure 910—*Hyposmocoma* (*Hyposmocoma*). Top, *fuscopurpurea* Walsingham, holotype male (BM slide 4127); Haleakala, 5,000 feet, Maui; expanse 12 mm.; forewings solidly dark purplish fuscous. Middle, *fuscotogata* Walsingham, holotype female (BM slide 7173); Molokai, over 3,000 feet; expanse 13 mm.; forewings yellow-orange, white, and fuscous. Bottom, *geminella* Walsingham, holotype male (BM slide 4147); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings white to cream-colored with fuscous markings (which have been nearly obliterated in my photograph, especially on left side). The top and middle specimens were illustrated in *Fauna Hawaiiensis*.

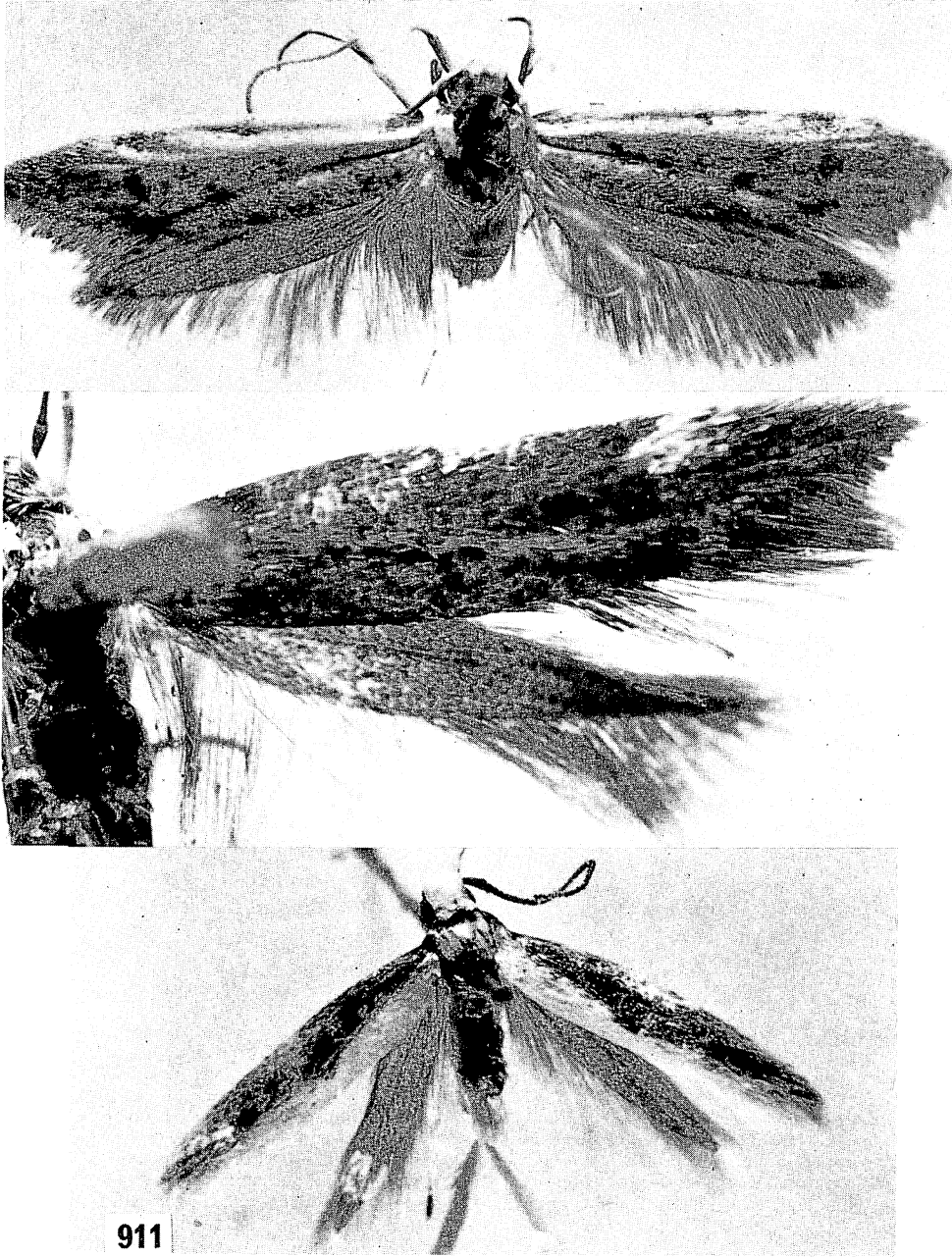
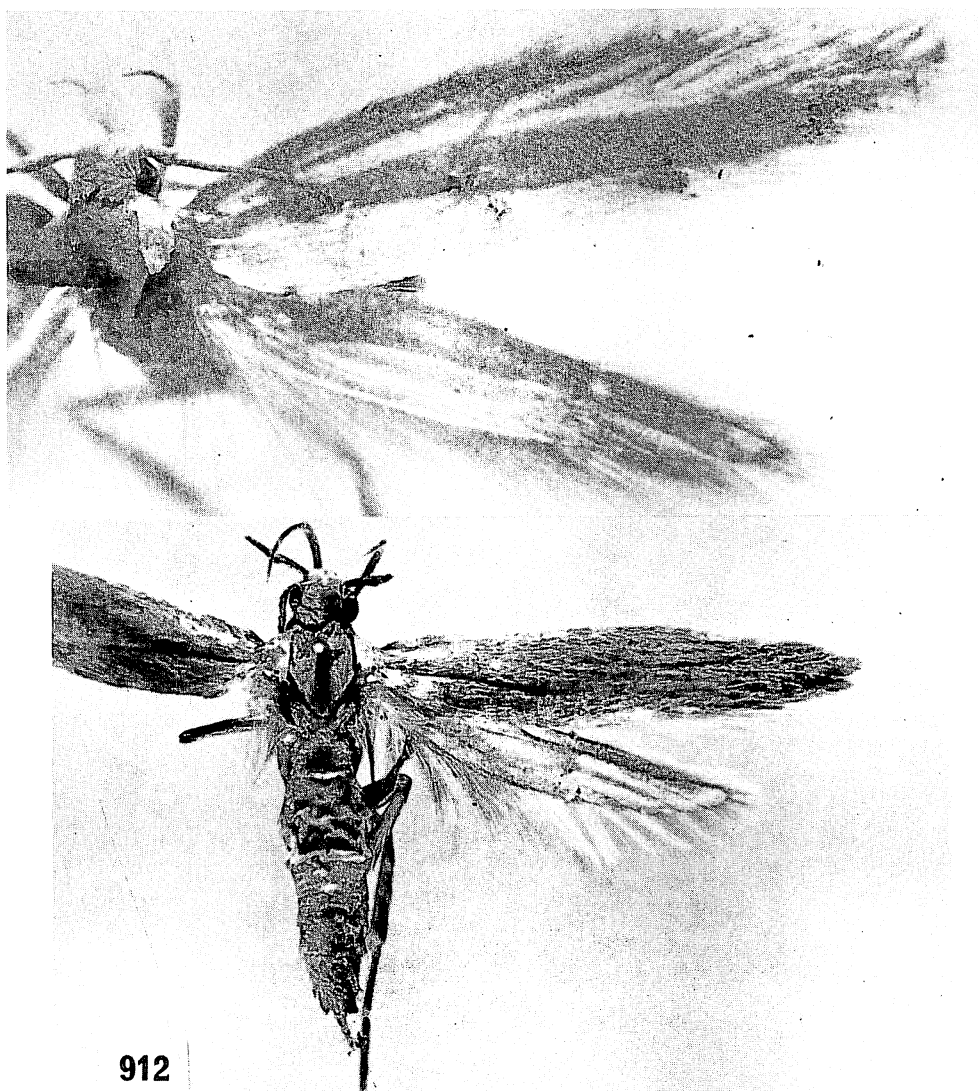


Figure 911—*Hypsmocoma* (*Hypsmocoma*). Top, *genitalis* Walsingham, holotype male (BM slide 4145); Olinda, 4,000 feet, Maui; expanse 17 mm.; forewings mostly straw-colored with fuscous markings. Middle, *haleakalae* (Butler), holotype female (BM slide 7067); Haleakala, about 4,000 feet, Maui; forewing 6 mm., fuscous brown with orange vittae (mostly obscure in this photograph) and orange maculae. Bottom, *hemicasis* Meyrick, paratype male; Pacific Heights, Oahu; forewing 4.5 mm., fuscous and pale yellow or cream-colored. The top and middle specimens were used for the *Fauna Hawaiensis* illustrations.



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Figure 912—*Hyposmocoma* (*Euperissus*). Top, *hirsuta* (Walsingham) ("Aphthonetus"), holotype female (BM slide 4413); Kauai, 3,000 to 4,000 feet; forewing 9 mm., pale straw- or cream-colored with clusters of fuscous-tipped squamae (especially those in the raised clusters). This specimen is illustrated in color in *Fauna Hawaïiensis*. Bottom, *homopyrrha* (Meyrick) ("Phthoraula"), holotype female (slide Z-IX-5-61-A); Nuuanu, Honolulu; ex dead *Metrosideros*; forewing 7.5 mm., extensively ochreous, paler costad, without maculae.

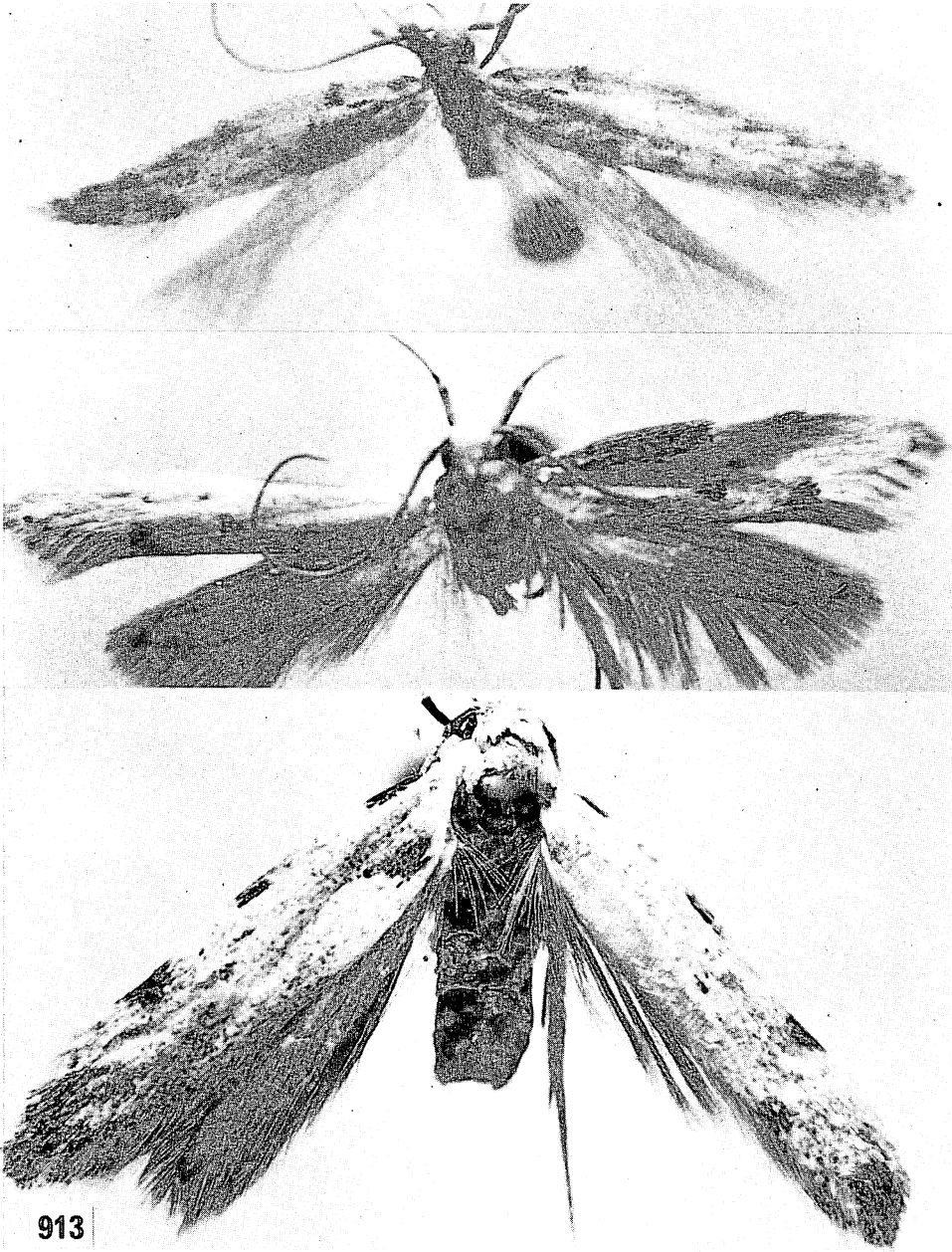


Figure 913—*Hyposmocoma*. Top, (*E.*) *humerella* (Walsingham) (“*Aphthonetus*”), allotype male (BM slide 4754); Haleakala, 5,000 feet, Maui; expanse 14 mm.; forewings white with fuscous-tipped squamae scattered among and in the maculae. A tuft of long, fine hair issues from each hindwing axil. Middle, (*H.*) *humerovittella* Walsingham, holotype male (BM slide 4101); Waianae Mts., 3,000 feet; forewing expanse 15 mm., whitish ochreous with brown to fuscous maculae. This specimen is figured in *Fauna Hawaïensis*. Bottom, (*H.*) *hygroscopta* Meyrick, paratype female; Halemanu, Kauai; forewing 6 mm., white sprinkled with brown and with fuscous to black maculae.



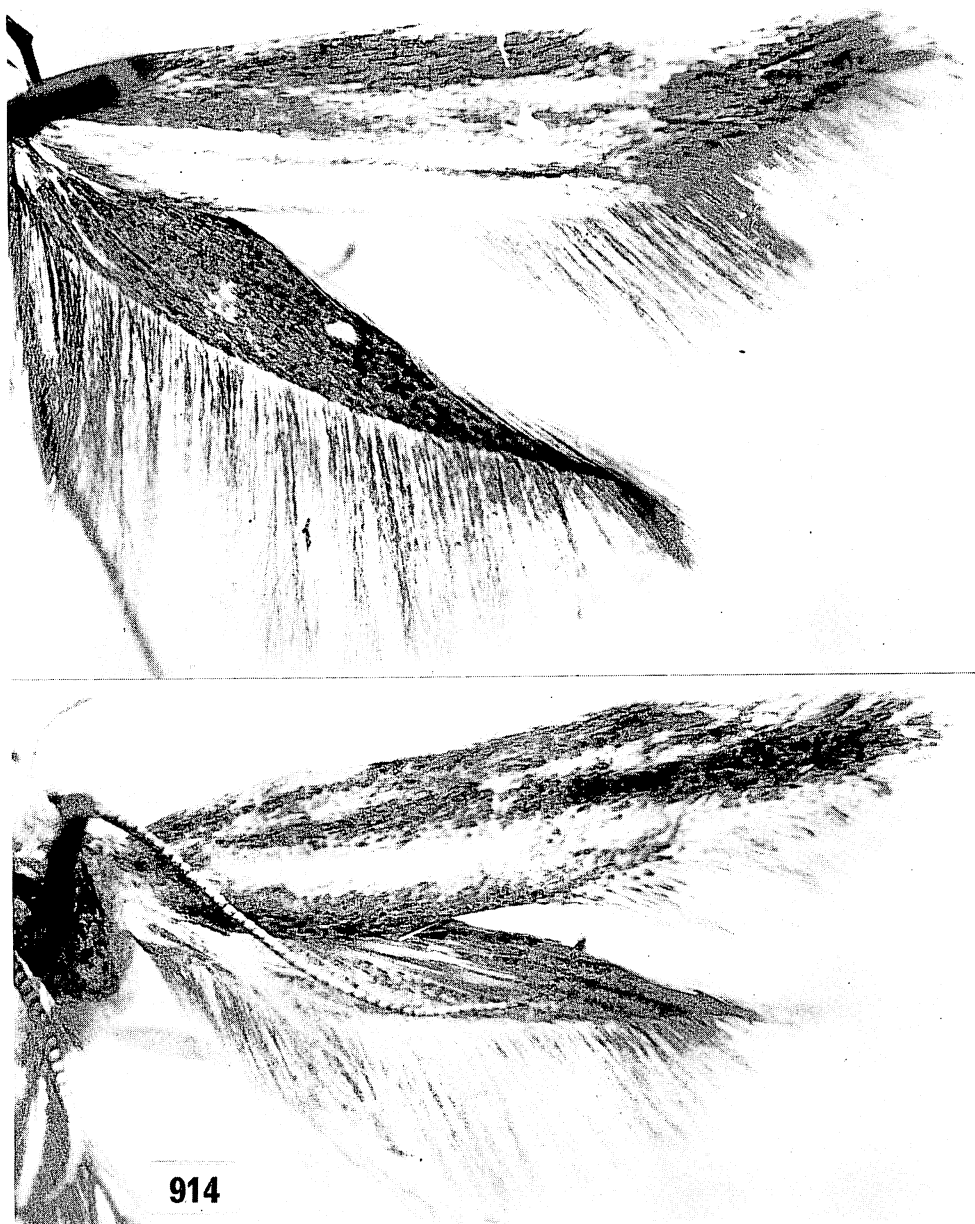


Figure 914—*Hyposmocoma* (*Hyposmocoma*). Top, *illuminata* Walsingham, holotype male (BM slide 4108); Haleakala, 5,000 feet, Maui; forewing 6.5 mm., mostly silvery white with a dark costal vitta (the color pattern is poorly rendered in the photograph, and the white spots are faults in the negative). Bottom, *impunctata* Walsingham, holotype male (BM slide 4114); Kilauea, Hawaii; forewing 7.5 mm., pale brown with dark vittae. Note the yellow hairbrushes on the hindwing. These specimens are illustrated in *Fauna Hawaiiensis*.

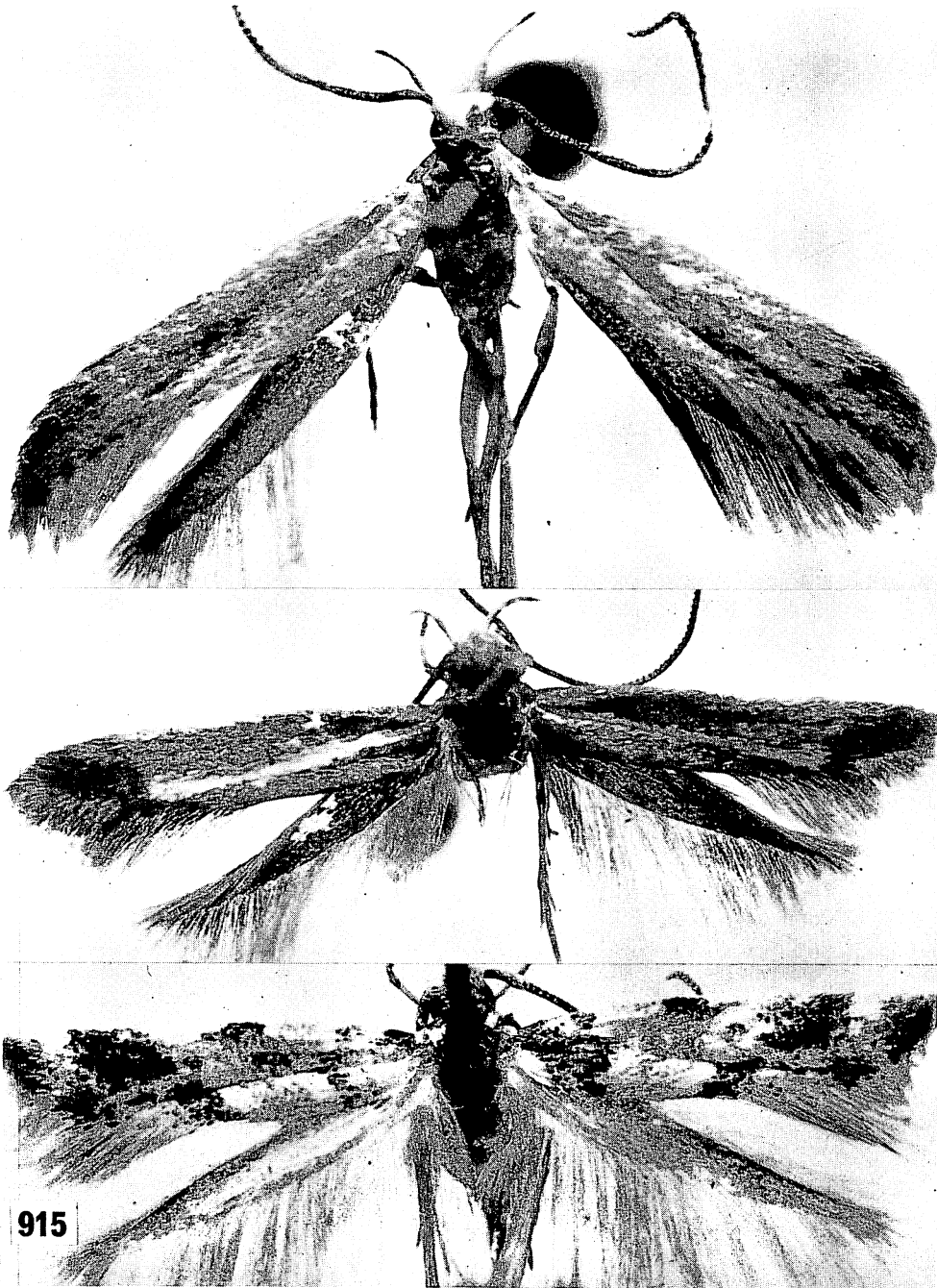


Figure 915—*Hyposcymoma*. Top, (*E*) *incongrua* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4512); Haleakala, 5,000 feet, Maui; forewing 5 mm., concolorous orange. Middle, (*H.*) *indicella* Walsingham, holotype male (BM slide 4117); Haleakala, 5,000 feet, Maui; expanse 10 mm.; the photograph does not reveal adequately the sharp contrast between the blackish background scaling and the pure white vitta along the fold. Bottom, (*E.*) *inflexa* Walsingham, holotype male (BM slide 4493); Haleakala, 5,000 feet, Maui; expanse 9.5 mm.; forewings white, yellow, and fuscous. These three specimens are figured in *Fauna Hawaiensis*.



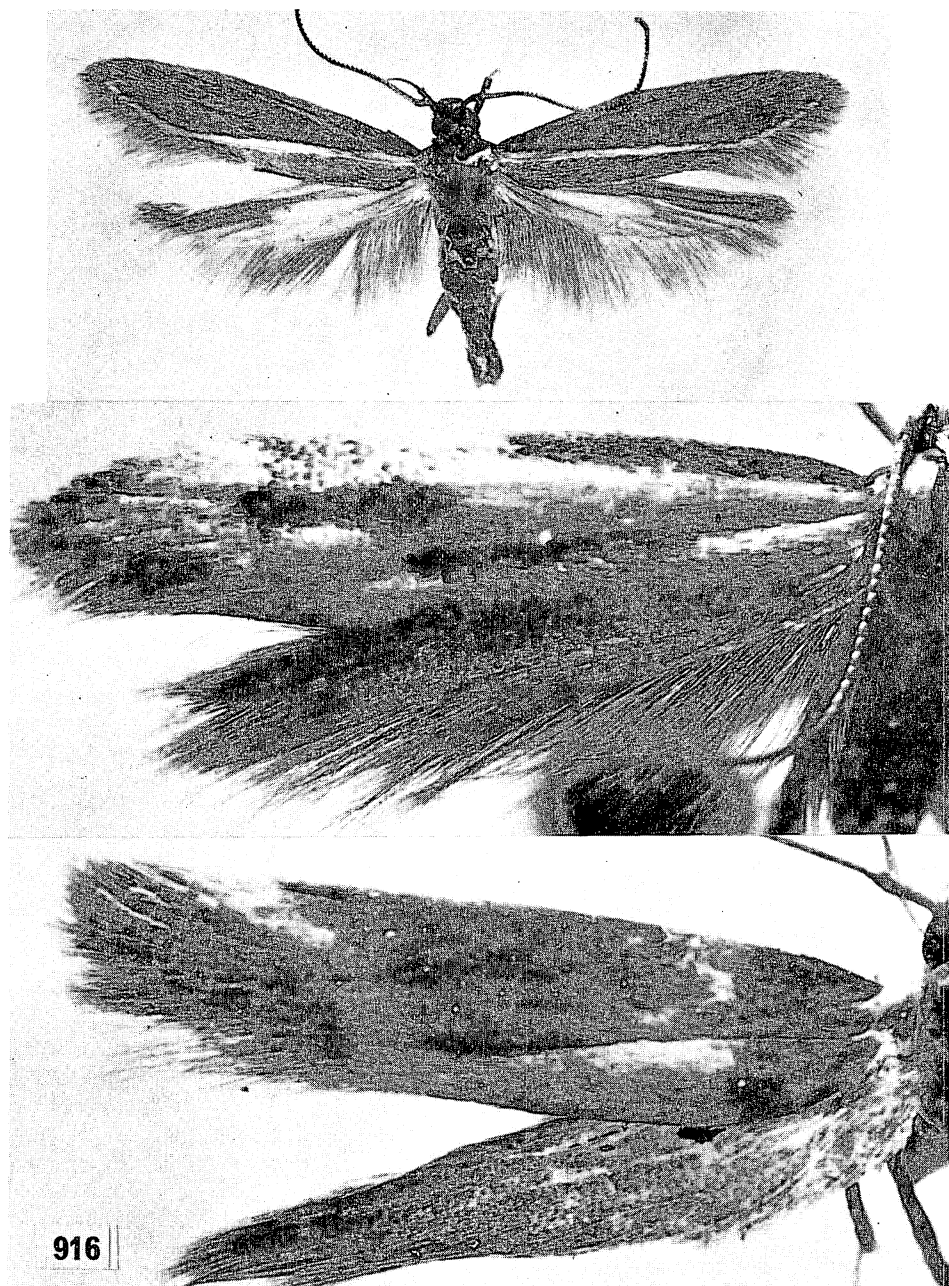


Figure 916—*Hyposmocoma*. Top, (*E.*) *insinuatix* Meyrick, holotype male (slide Z-I-22-61-2); Kainalu, 2,000 to 3,000 feet, Molokai; ex *Smilax*; forewing 8.25 mm., purplish fuscous with a sharply contrasting white vitta as figured. Middle, (*H.*) *intermixta* Walsingham, holotype female (BM slide 7064); Molokai, about 4,000 feet; forewing 6.5 mm., straw-colored with fuscous markings. Bottom, (*H.*) *inversella* Walsingham, holotype female (no slide was made because the abdomen found glued to the mounting pith may not belong to this species); Waianae Mts., Oahu, 2,000 feet, Oahu. Forewing 5 mm., the dark area is purplish, and the pale areas are orange. The middle and bottom specimens are figured in *Fauna Hawaïensis*.



Figure 917—*Hyposmocoma*. Top, (*H.*) *iodes* Walsingham, holotype male (BM slide 4477); Molokai, 3,000 feet, forewing 6 mm., mixed greyish white, brownish and fuscous. Middle, (*H.*) *irregularis* Walsingham, holotype male (BM slide 4484); Kauai, 3,000 to 4,000 feet; expanse 14 mm.; forewings white and fuscous. Bottom, (*E.*) *jugifera* Meyrick, holotype male (slide Z-I-20-61-3); Mt. Tantalus, Oahu; ex dead *Acacia koa* wood; forewing 7.5 mm., pale brownish flecked with black and with black maculae. The top and middle specimens are illustrated in *Fauna Hawaiiensis*.

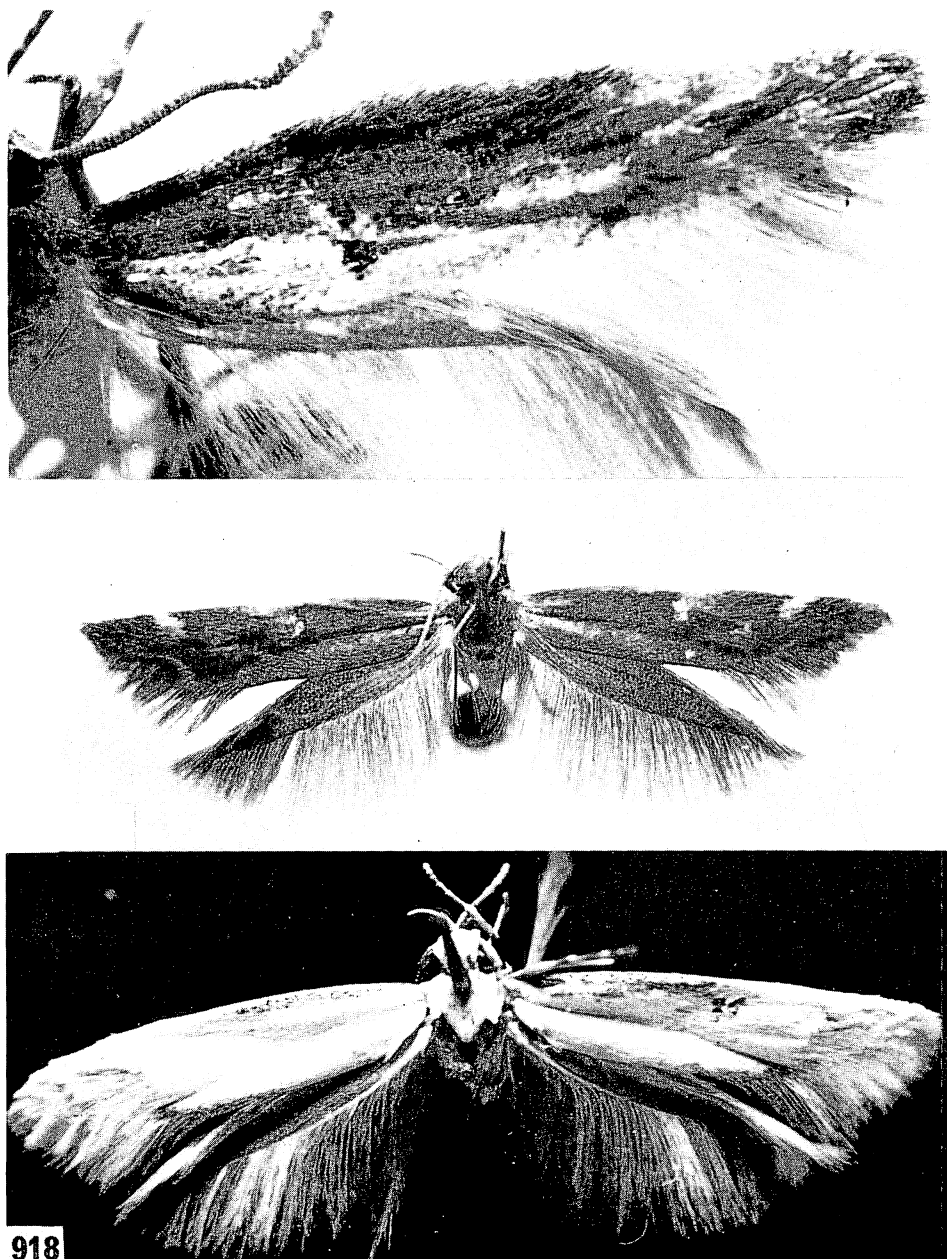


Figure 918—*Hyposmocoma*. Top, (*E.*) *kauaiensis* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4739); Halemanu, 4,000 feet, Kauai; forewing 5.5 mm., white with yellowish to fuscous scaling and maculae. Middle, (*H.*) *lacertella* Walsingham, allotype (BM slide 4129); Haleakala, 5,000 feet, Maui; expanse 15 mm.; forewings brownish with whitish maculae. There is an incipient hairbrush on each metapleuron. Bottom, (*H.*) *lactea* Walsingham, holotype male (BM slide 4318); Halemanu, 4,000 feet, Kauai; expanse 14 mm.; forewings straw-colored with a strong fuscous costal vitta on the basal half and some fuscous on the posterior margin basad of the fringe; the dark maculae do not show well on this photograph. The top and bottom specimens are figured in *Fauna Hawaiiensis*.

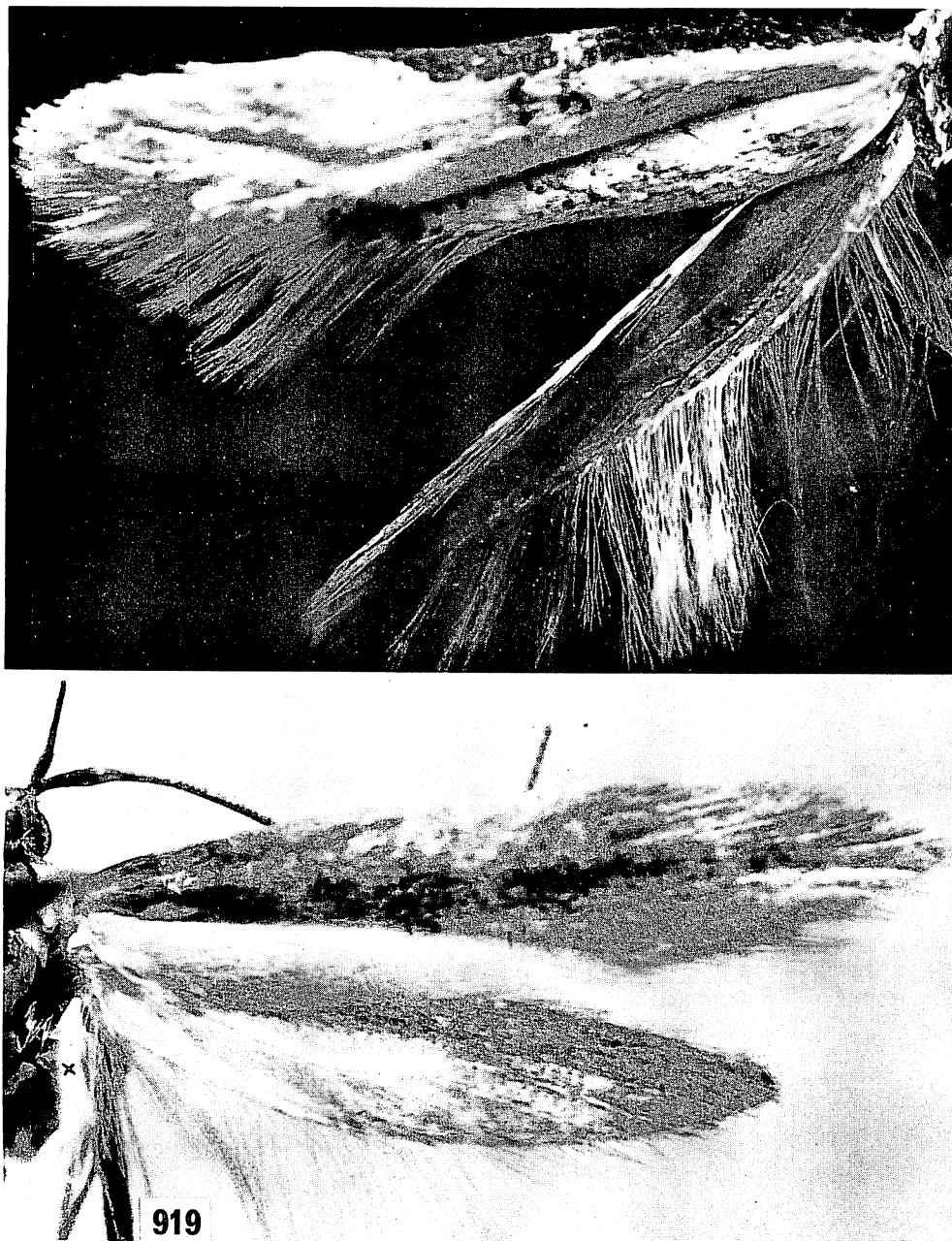


Figure 919—*Hypsmocoma*. Top, (*H. lacticretella* Walsingham, holotype female (BM slide 7065); Olinda, 4,000 feet, Maui; forewing 5.5 mm., cream-colored with fuscous maculae. This specimen is figured in *Fauna Hawaiiensis*. Bottom, (*E. latiflua* Meyrick, holotype male (BM slide 9558 Clarke); Koolau Mts., above Honolulu; forewing 6.25 mm., yellow, brown, and fuscous (the contrast between the yellow posterior part of the forewing and the anterior brown or fuscous part is more obvious in nature than is revealed in this photograph). Note the strong yellow brush (marked by "X" and mostly out of focus) from the posterior axil of the hindwing.

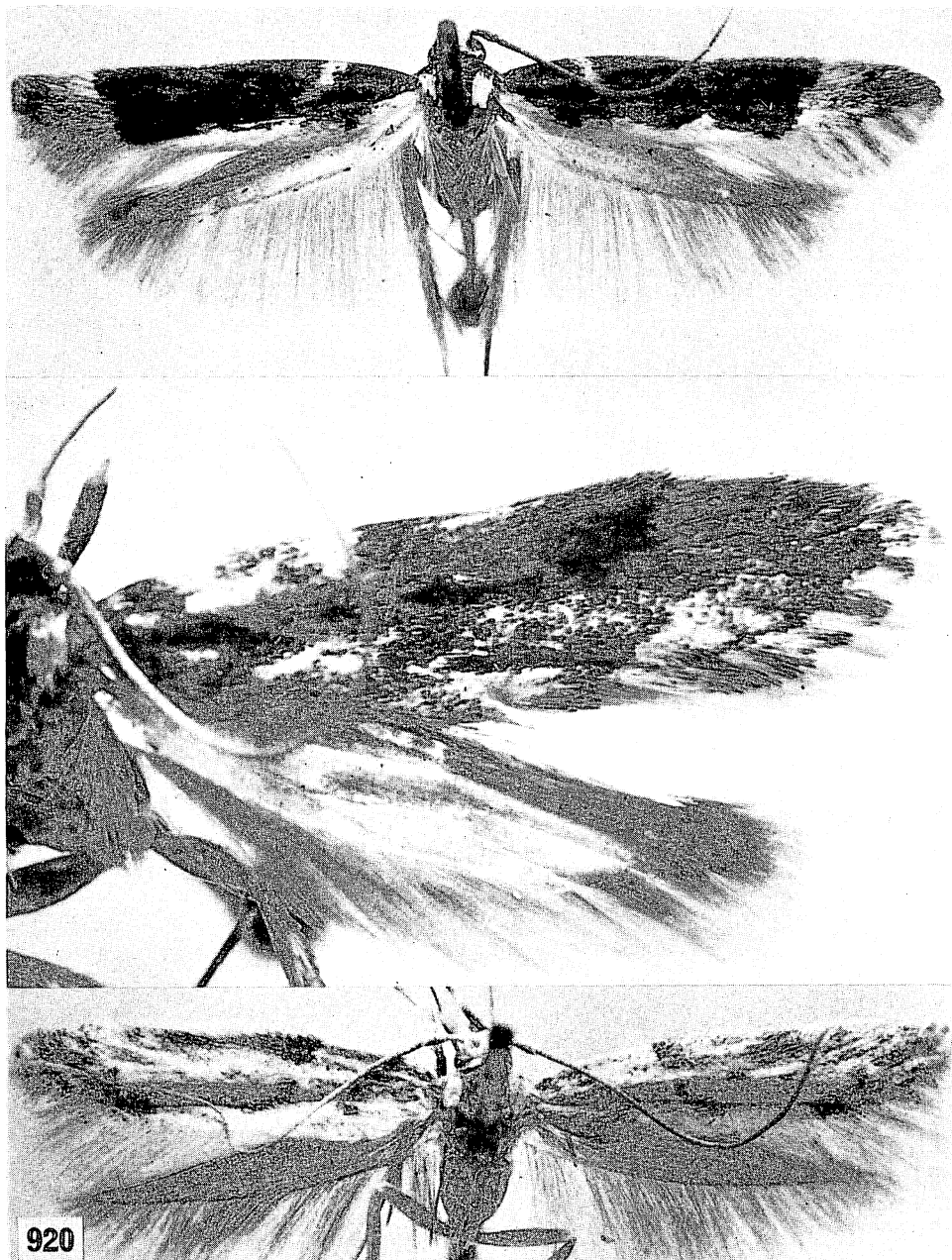


Figure 920—*Hypsmocoma*. Top, (*H. lebetella* Walsingham, holotype male (BM slide 4094); Olinda, 4,000 feet Maui; expanse 18 mm.; forewings white with areas of yellow and dark fuscous; there is a moderate metapleural tuft. Middle, (*H. leporella* Walsingham, holotype male (BM slide 4087); Kauai, 3,000 to 4,000 feet; forewing 10.5 mm., dirty white and fuscous with coppery reflections. Bottom, (*E. lichenalis* (Walsingham) ("*Aphthonetus*"), holotype female (abdomen lost); Lanai, 2,000 feet; expanse 14 mm.; forewings with yellow, brownish, and fuscous maculae. All of these specimens are illustrated in *Fauna Hawaiiensis*.





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Figure 921—*Hyposmocoma* (*Hyposmocoma*). Top, *lignicolor* (Walsingham), holotype male (BM slide 4392); Haleakala, 5,000 feet, Maui; forewing 6.5 mm., cream-colored with pale and dark fuscous maculae; the metapleurae lack hairbrushes. Bottom, *lignivora* (Butler) ("*Diplosara*"), holotype male (BM wing slide 9609 Clarke; abdomen lost); Oahu; forewing 10 mm., white, pale, and dark fuscous with large, conspicuous tufts of raised squamae. There is an incipient metapleural brush, and there is an unusual (for its group) vannal brush. Both of these specimens are figured in *Fauna Hawaiiensis*.

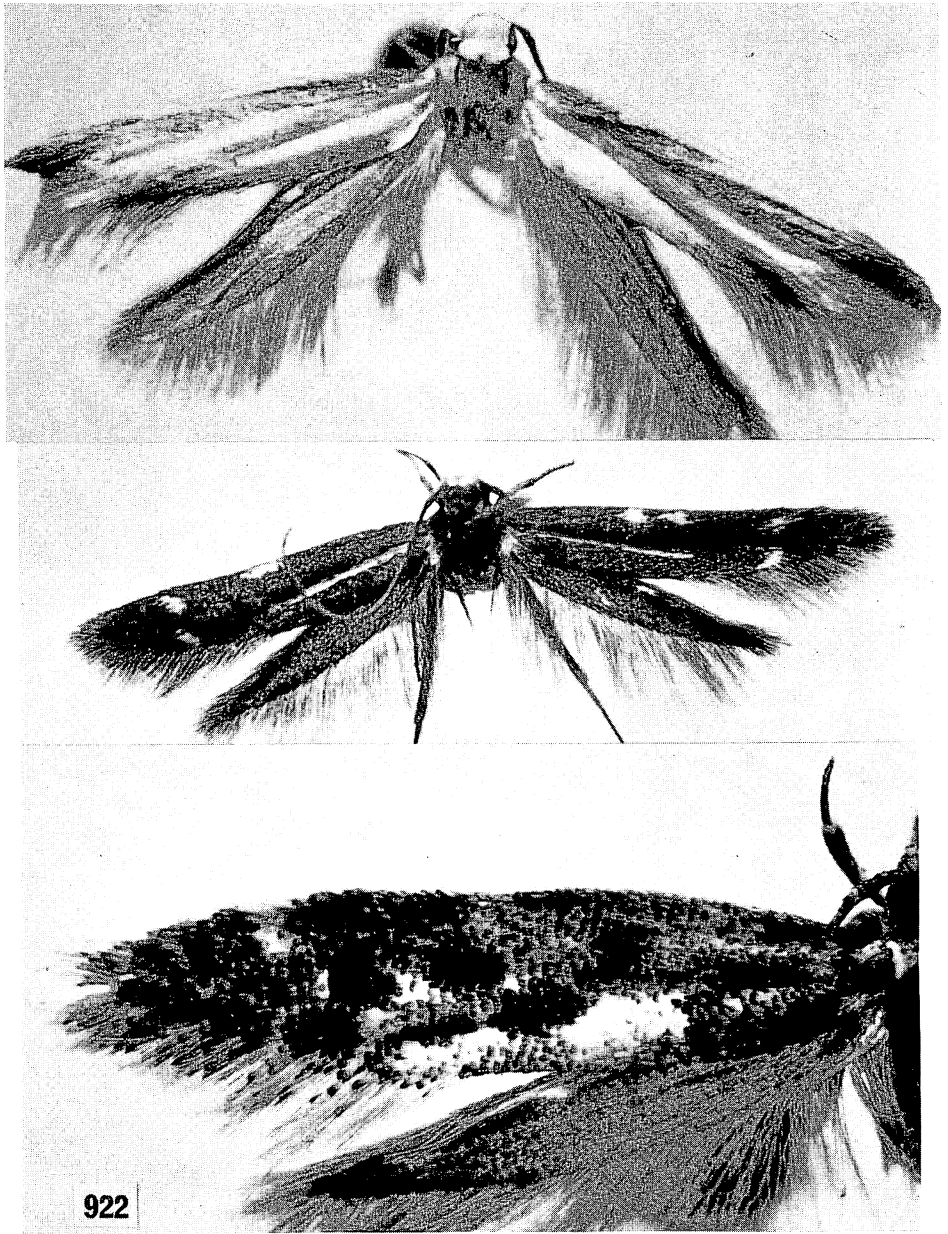


Figure 922—*Hyposmocoma*. Top, (*E.*) *limata* Walsingham, holotype male (BM slide 4105); Kilauea, Hawaii; forewing 7 mm., brown and white (the photograph has too much light on the front and the brown costal zone appears to be pale, but it should contrast with the white medial and posterior zones). Middle, (*H.*) *lineata* Walsingham, holotype male (BM slide 4122); Haleakala, 5,000 feet, Maui; expanse 12 mm.; forewings fuscous with white maculae (the most basad of the two submedial white spots on the right forewing is a hole). This species looks almost exactly like *ludificata* (figure 924), but it lacks the subcostal brush on the hindwings. Bottom, (*H.*) *liturata* Walsingham, holotype male (BM slide 4478); Kona, 4,000 feet, Hawaii; forewing 6 mm., white and fuscous. The sides of the thorax have very large, broad squamae. These specimens are illustrated in *Fauna Hawaiiensis*.

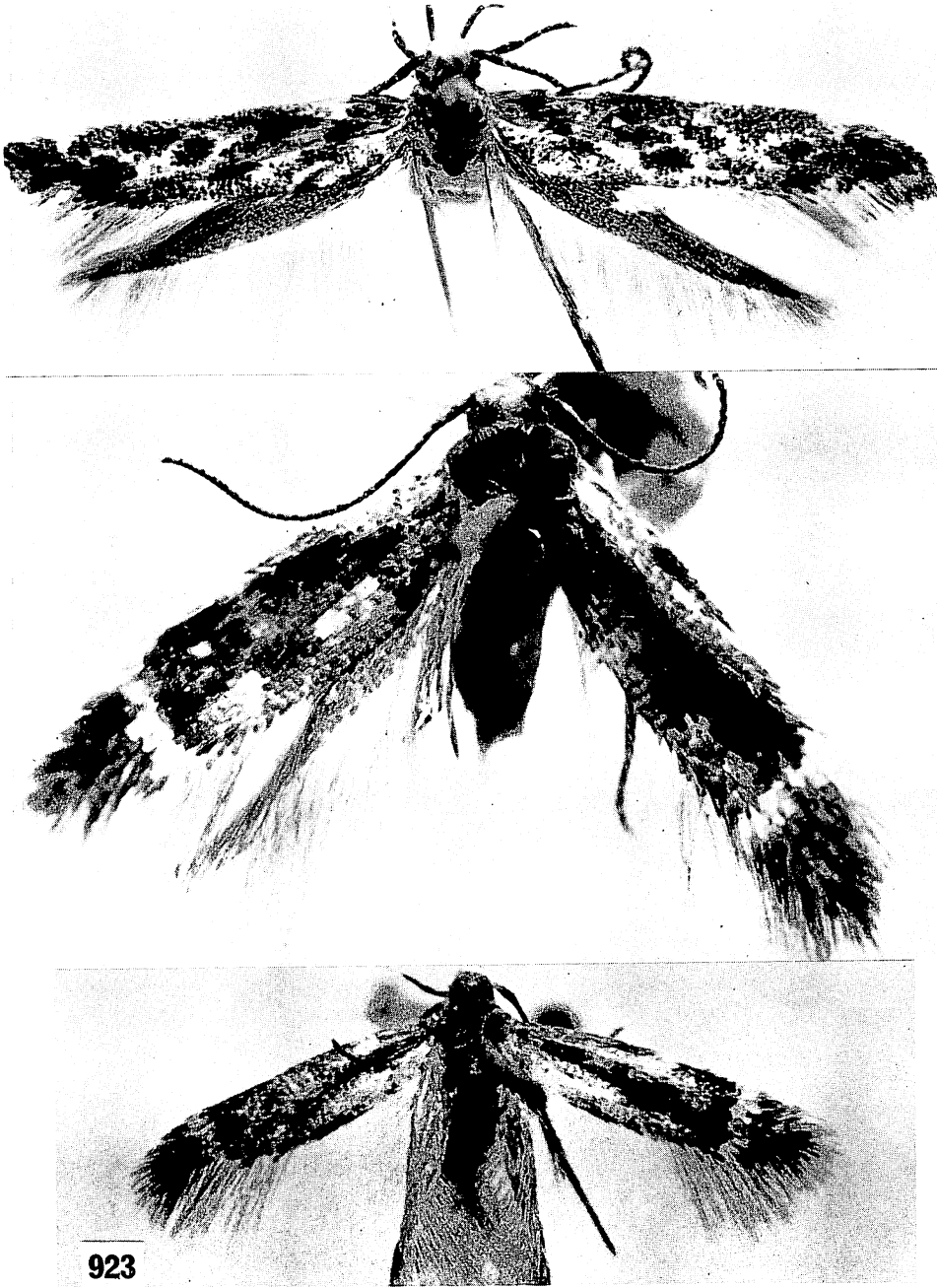


Figure 923—*Hyposcocoma* (*Hyposcocoma*). Top, *lixiviella* Walsingham, allotype male (BM slide 4480); Kauai, 3,000 to 4,000 feet; expanse 10 mm.; forewings creamy white and fuscous. Middle, *longisquamella* (Walsingham) ("*Elachista*"), holotype female (BM slide 7176); Kona, 4,000 feet, Hawaii; forewing 3 mm., fuscous and white. This specimen is figured in *Fauna Hawaiiensis*. Bottom, a paratype of the synonym "*Petrochroa*" *nigrella* Swezey; Kilauea, Hawaii; forewing 2.75 mm.





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Figure 924—*Hypsoscoma*. Top, (*E.*) *longitudinalis* Walsingham, allotype male (abdomen lost); Kona, 4,000 feet, Hawaii; expanse 17 mm.; forewings streaked with white, yellowish, and fuscous; there is a moderate cluster of long squamae on each metapleuron. Middle, (*H.*) *lucifer* Walsingham, holotype female (BM slide 7061); Molokai, above 4,000 feet; forewing 7 mm., brown with a yellow vitta along fold and yellow maculae along costa. Bottom, (*H.*) *ludificata* Walsingham, holotype male (BM slide 4121); Haleakala, 5,000 feet, Maui; expanse 16 mm.; forewings fuscous and white (on the right forewing, the pale costal area and the inward extension of the submedial white maculae are abrasions). This species is closely similar to *lineata* (figure 922), but *ludificata* has a strong yellow subcostal brush on the hindwing. The middle and bottom specimens are illustrated in *Fauna Hawaiensis*.



Figure 925—*Hypsocoma*. Top, (*E.*) *lugens* Walsingham, holotype male (BM slide 4135); Haleakala, 5,000 feet, Maui; forewing 12 mm., scales mostly brown with greyish white bases. Middle, (*E.*) *lunifer* Walsingham, holotype female (slide not made); Haleakala, 5,000 feet, Maui; expanse 14 mm.; forewings dark fuscous with white maculae. Bottom, (*H.*) *torquata* Walsingham female (BM slide 4092); Kauai, 3,000 to 4,000 feet; expanse 9 mm. (with tips of wings bent down, as mounted); forewings dark fuscous with white maculae which include yellow squamae. This specimen was labeled "male", but it is a female. All of these specimens were illustrated in *Fauna Hawaiiensis*.

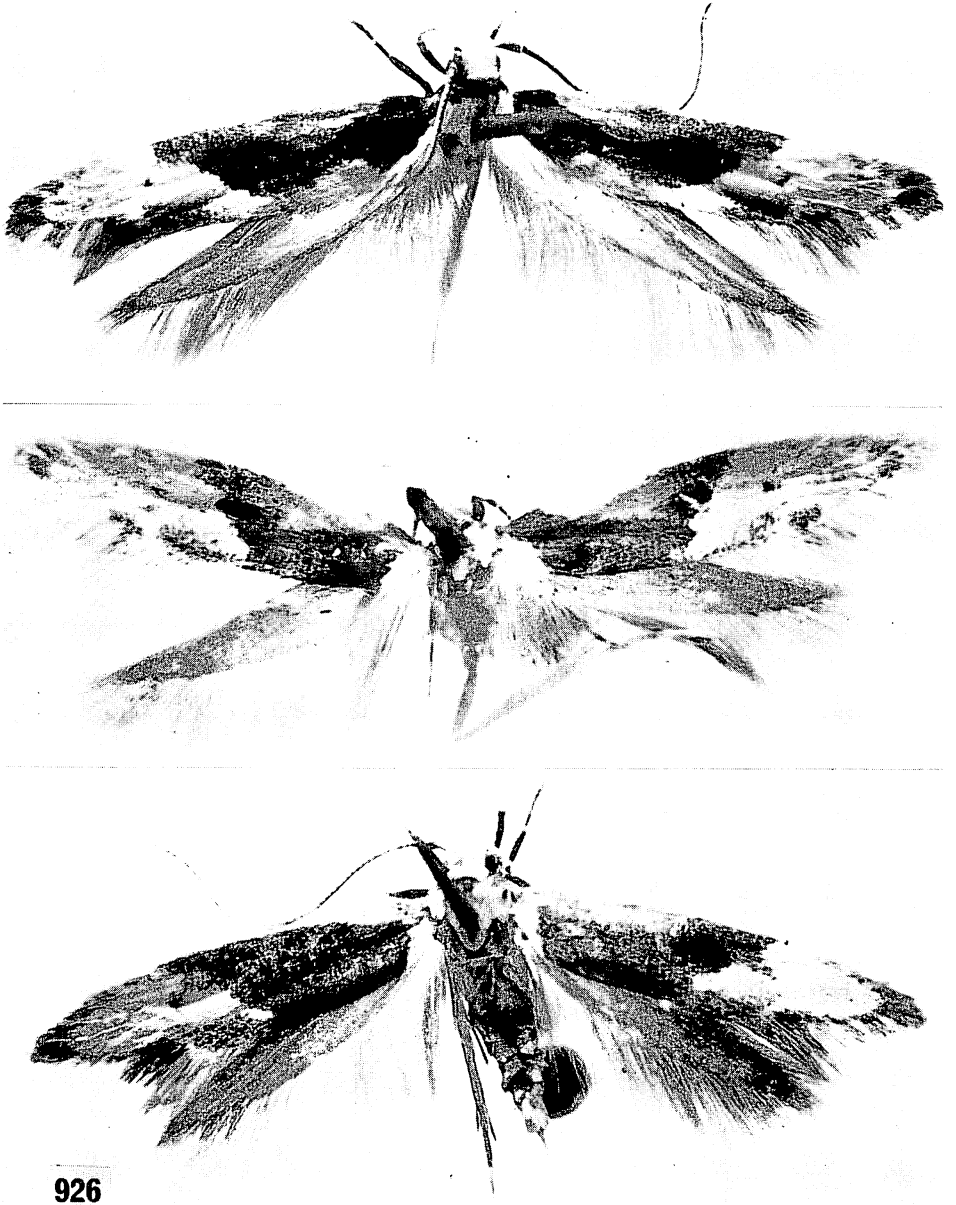


Figure 926—*Hyposmocoma* (*Hyposmocoma*). Top, *lupella* Walsingham, holotype male (BM slide 4097); Kaholuamano, 4,000 feet, Kauai; expanse 15 mm.; forewings dark and pale fuscous and white. There is a small tuft on each metapleuron. Middle, *candidella* (Walsingham) (formerly considered a form of *lupella*); holotype male (BM slide 4360); Kona, 4,000 feet, Hawaii; expanse 13 mm.; forewings white and fuscous with reflections of copper. Bottom, *suffusella* (Walsingham), holotype female (slide not made); Molokai, above 3,000 feet; expanse 14 mm.; white and brownish fuscous with reflections of copper. These three specimens are illustrated in *Fauna Hawaiiensis*.

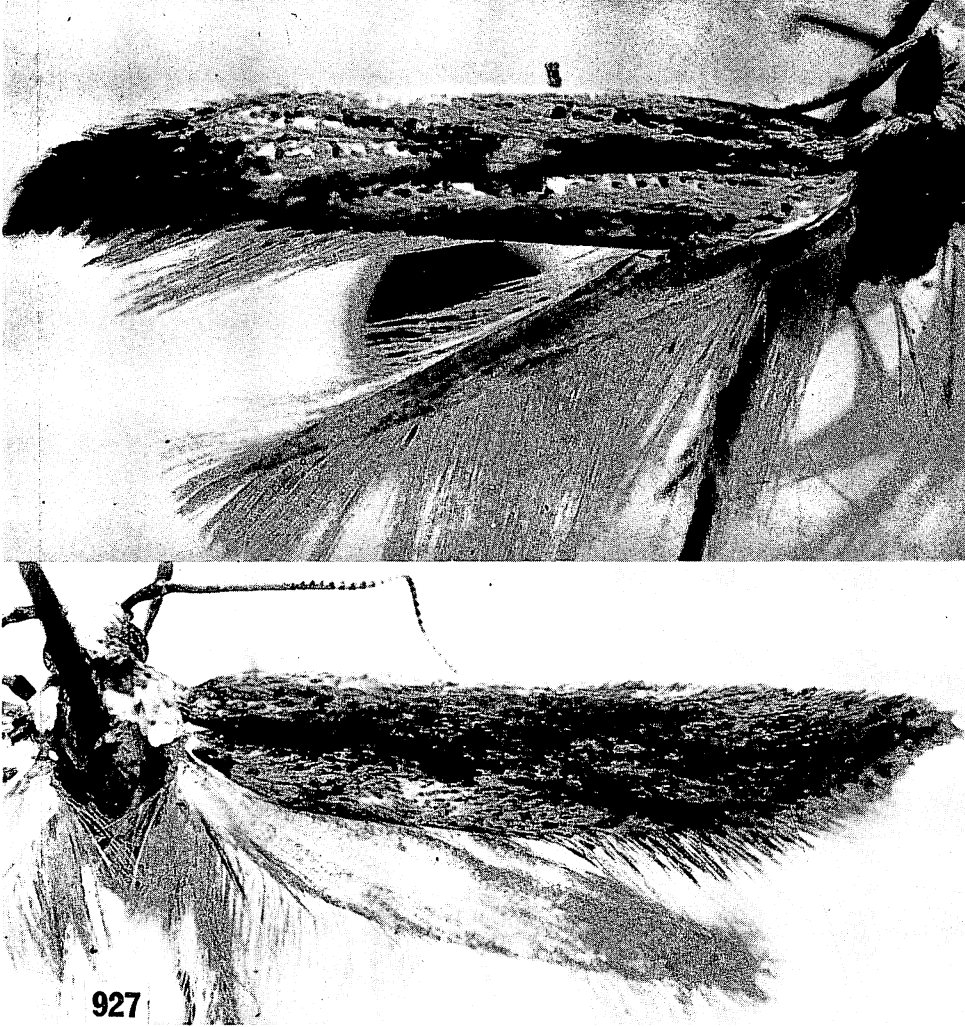


Figure 927—*Hypsmocoma* (*Euperissus*). Top, *mactella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4450); Kauai, 3,000 to 4,000 feet; forewing 5 mm. long, brownish orange with blackish and whitish scales tending to form vittae. The male has strong metapleural brushes that cross over the abdomen where their apices are enclosed by a mass of huge squamae. Bottom, *maestella* Walsingham, holotype male (BM slide 4341); Kaholuamano, 4,000 feet, Kauai; forewing 10 mm., brown with white and fuscous maculae. These two specimens are illustrated in *Fauna Hawaiiensis*.

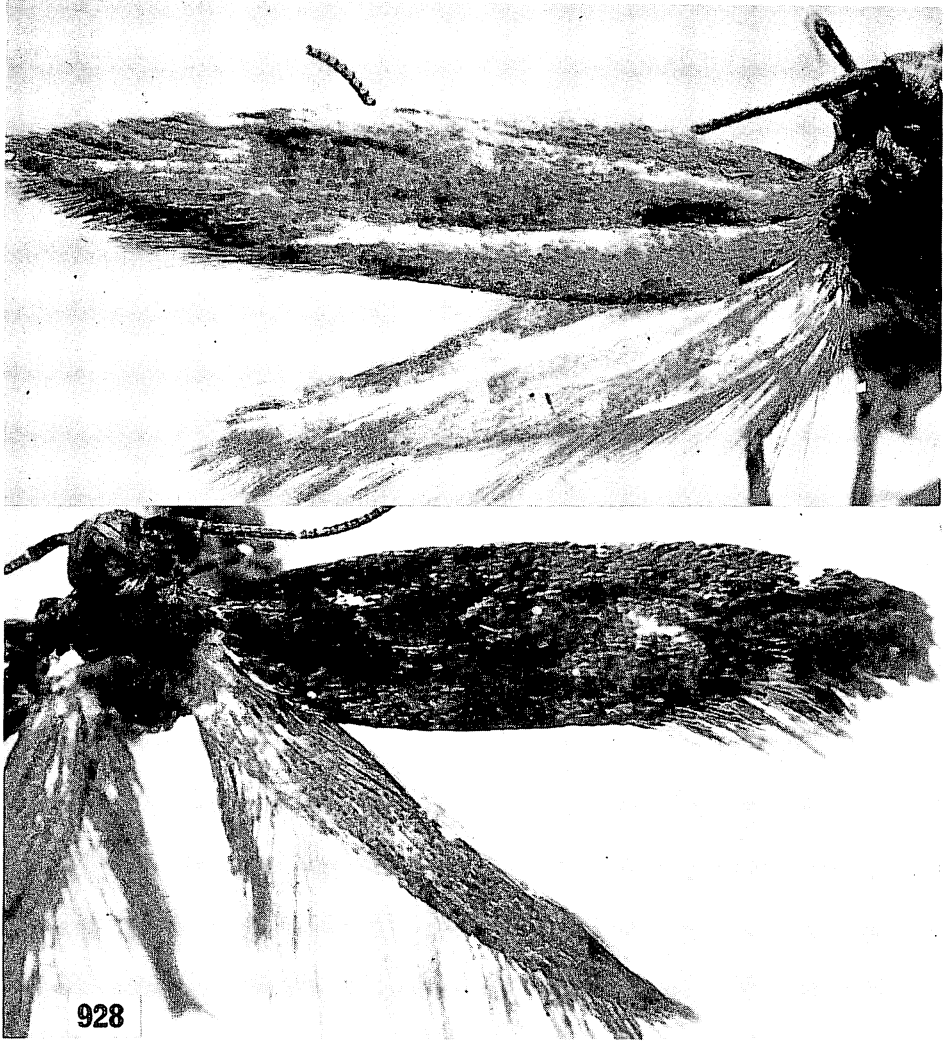
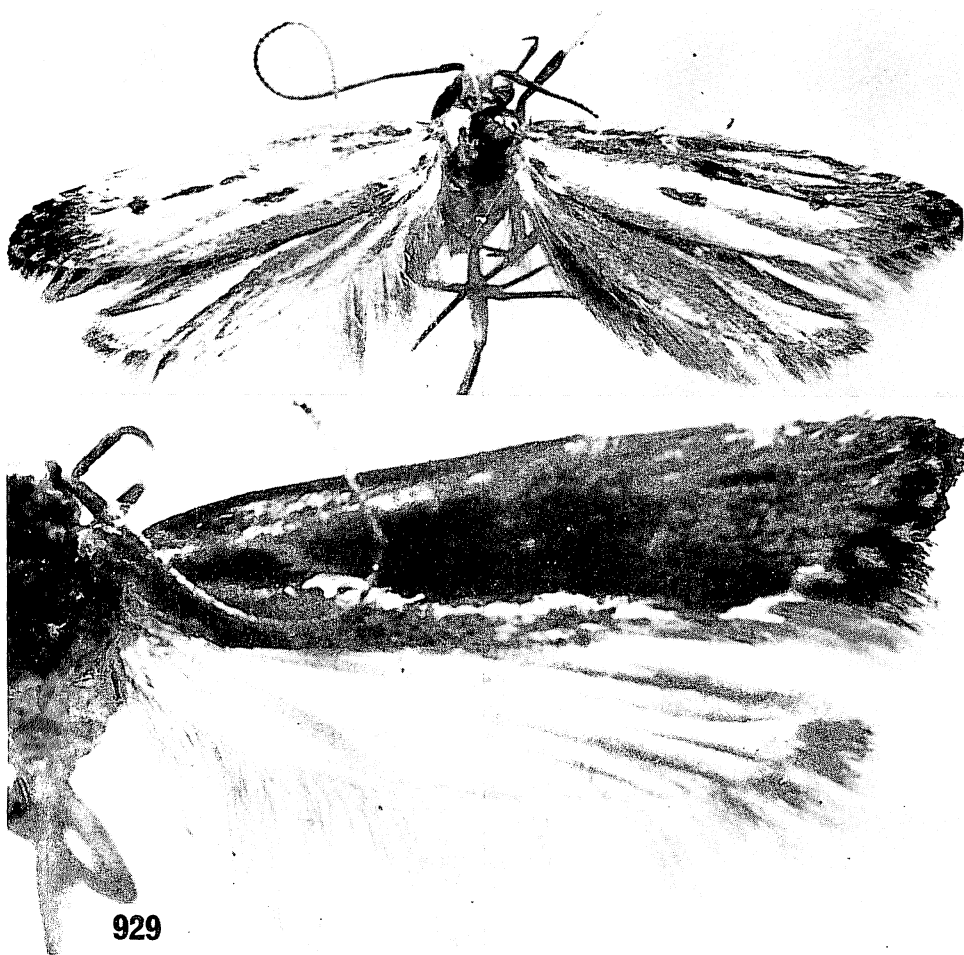


Figure 928—*Hyposmocoma*. Top, (*E.*) *malacopa* Meyrick, lectotype male (BM slide 9568 Clarke); Koolau Mts., Oahu; forewing 6.5 mm., brownish orange. Bottom, (*H.*) *malornata* Walsingham, holotype male (BM slide 4358); Olinda, 4,000 feet, Maui; forewing 6.5 mm., dark fuscous with a few white to cream-colored scales and two cream-colored, preapical, marginal maculae as shown. Note the subcostal brush on the hindwing. There is a small metapleural tuft. This specimen is figured in color in *Fauna Hawaiiensis*.



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Figure 929—*Hypsmocoma*. Top, (*E.*) *margella* (Walsingham) ("*Semnoprepia*"), holotype male (BM slide 4430); Kilauea, Hawaii; expanse 18.5 mm.; forewings rather dirty whitish with fuscous maculae. Bottom, (*H.*) *marginotata* Walsingham, holotype male (BM slide 4132); Kauai, 3,000 to 4,000 feet; forewing 7 mm., fuscous with white maculae. Both of these specimens are illustrated in *Fauna Hawaiiensis*.

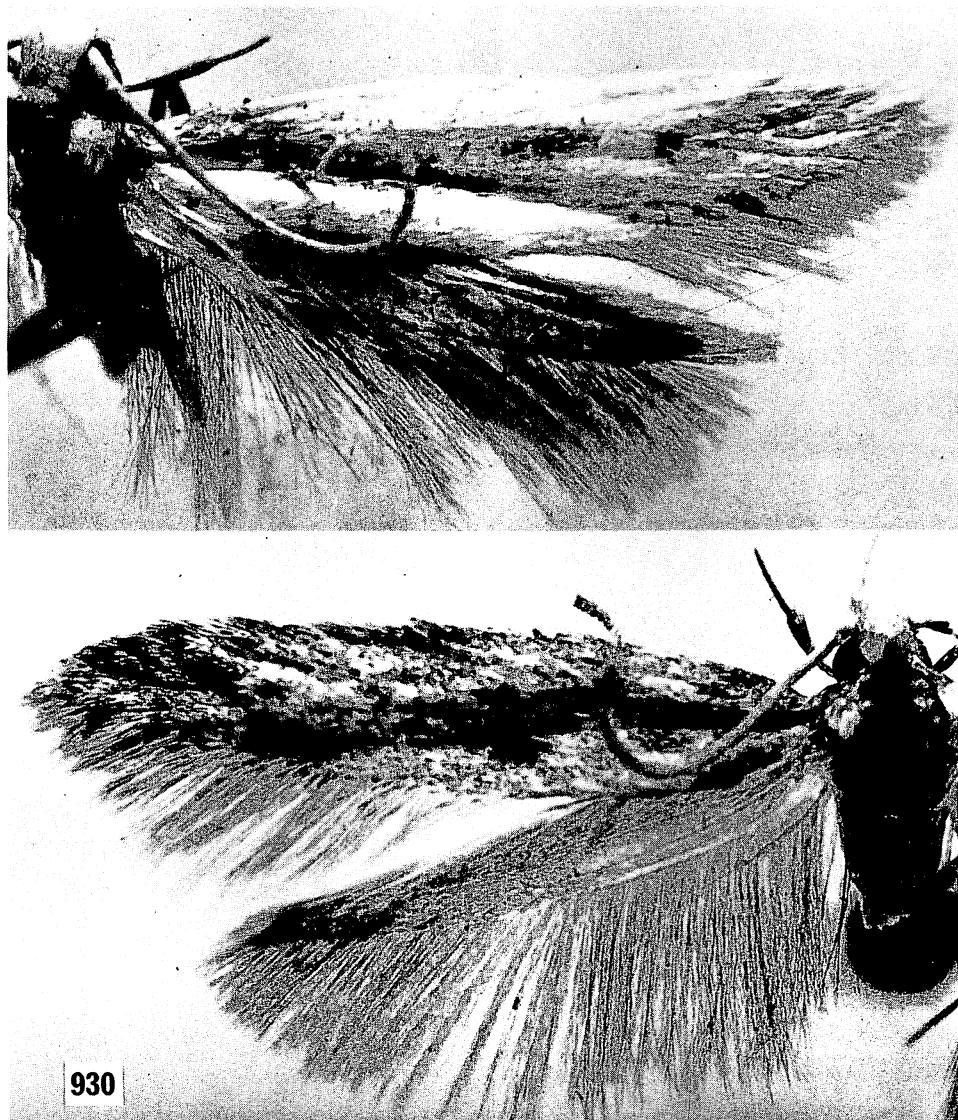


Figure 930—*Hypsmocoma*. Top, (*H.*) *mediella* Walsingham, allotype male (BM slide 4098); Waianae Mts., Oahu; forewing 5 mm., white to cream-colored with brown to fuscous maculae. Bottom, (*E.*) *mediocris* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4737); Haleakala, 5,000 feet, Maui; forewing 8 mm., mixed white, yellowish, brownish, and fuscous. The dark macula behind the fold and beyond the end curve of the antenna is a cluster of raised squamae. This specimen is figured in *Fauna Hawaiiensis*.



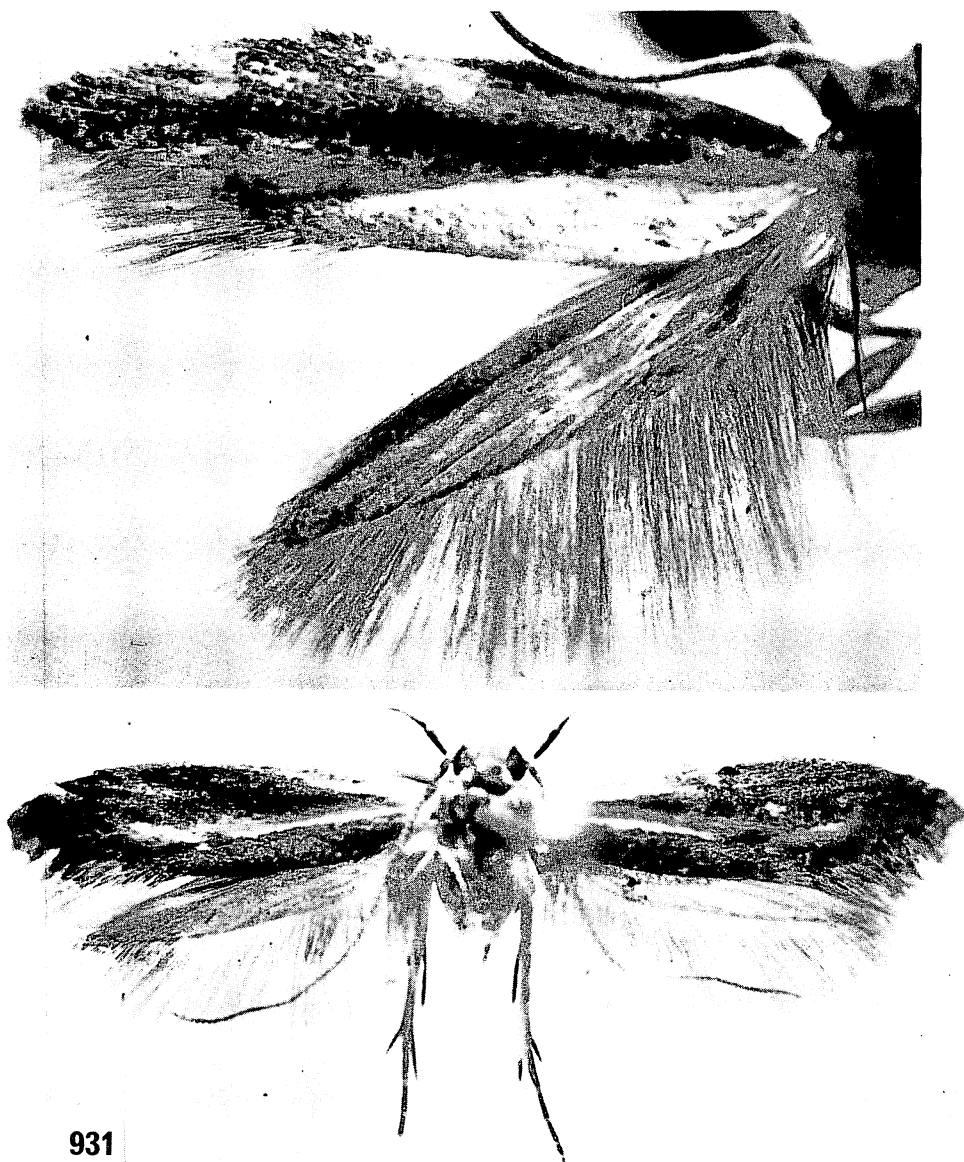


Figure 931—*Hypsmocoma* (*Hypsmocoma*). Top, *mediospurcata* Walsingham, holotype (BM slide 4102); Kilauea, Hawaii; forewing 6 mm., white to cream-colored with brownish maculae. This specimen is illustrated in color in *Fauna Hawaiiensis*. Bottom, *mesorectis* Meyrick, holotype male (BM slide 9569 Clarke); Koolau Mts., Oahu; expanse 11.5 mm.; forewings brown with a very conspicuous pale vitta (the apparently pale basal costal areas in this photograph are light reflections and are not the pale scaling which is confined to the submedial vittae).





Figure 932—*Hyposmocoma* (*Hyposmocoma*). Top, *metallica* Walsingham, holotype male (BM slide 4116); Kona, about 5,000 feet, Hawaii; forewing 6.5 mm., very dark with a metallic sheen. The photograph cannot accurately reproduce the rather brassy, shiny squamae. The reflections from them produce an inaccurate appearance. Bottom, *metrosiderella* Walsingham, holotype male (BM slide 4354); Halemanu and Kaholuamano, 4,000 feet, Kauai; forewing 6 mm., creamy white and fuscous. See figure 802 for a figure of the larval case from which this moth was reared. Note the strong subcostal brush. These specimens are illustrated in *Fauna Hawaiensis*.

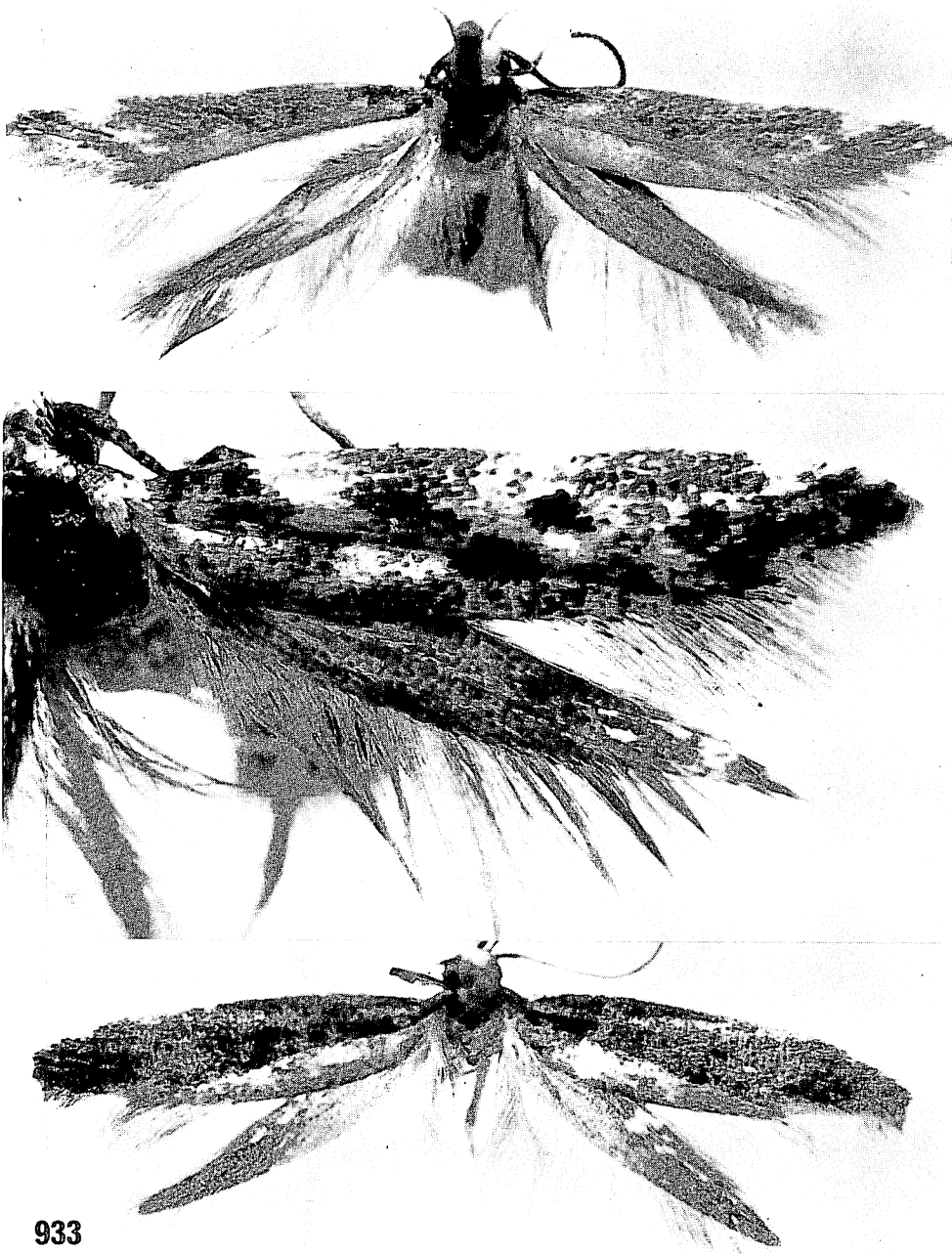


Figure 933—*Hypsmocoma* (*Hypsmocoma*). Top, *mimema* Walsingham, holotype male (BM slide 4349); Haleakala, 5,000 feet, Maui; expanse 11 mm., forewings yellow and fuscous. Middle, *mimica* Walsingham, holotype male (BM slide 4479); Molokai, over 3,000 feet; forewing 4.75 mm., white and fuscous. Bottom, *modesta* Walsingham, holotype male (BM slide 4330); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings yellowish and brownish fuscous. These specimens are all illustrated in *Fauna Hawaïensis*.

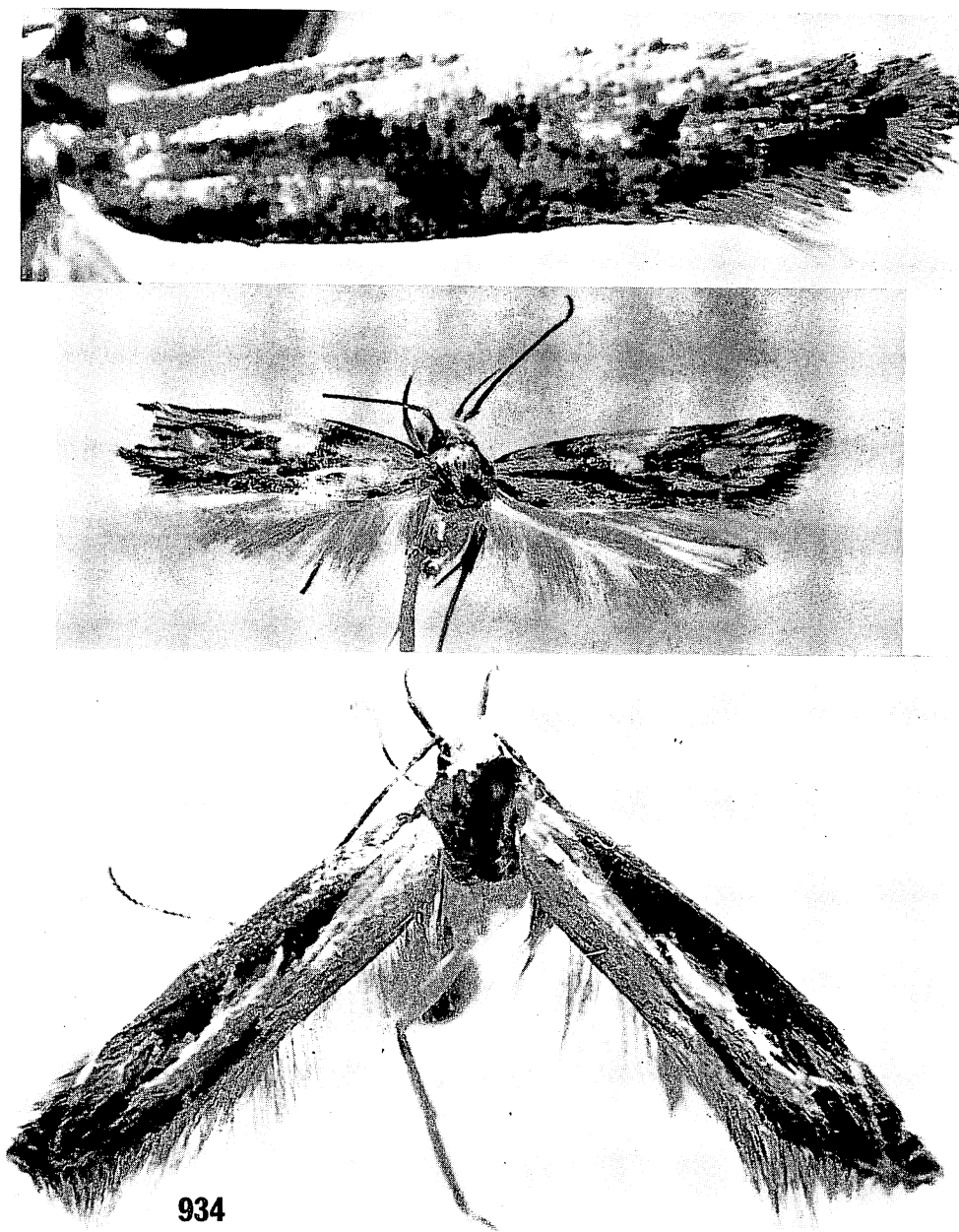


Figure 934—*Hyposmocoma*. Top, (*H.*) *montivolans* (Butler), holotype male (BM slide 4476); mountains near Honolulu; forewing 4.75 mm., mixed greyish, white, and pale and dark fuscous; there is a small metapleural tuft. Middle, (*E.*) *mormopica* (Meyrick) ("*Neelysia*"), holotype female (abdomen lost); Punaluu, Oahu; forewing 6 mm., basically a beautiful yellow with brownish fuscous maculae and two prominent white maculae on the disc. Bottom, (*E.*) *municeps* (Walsingham) ("*Neelysia*"), holotype female (BM slide 4316); Olinda, 4,000 feet, Maui; forewing 7 mm., yellowish and white with fuscous maculae. The specimens at top and bottom are figured in *Fauna Hawaiensis*.

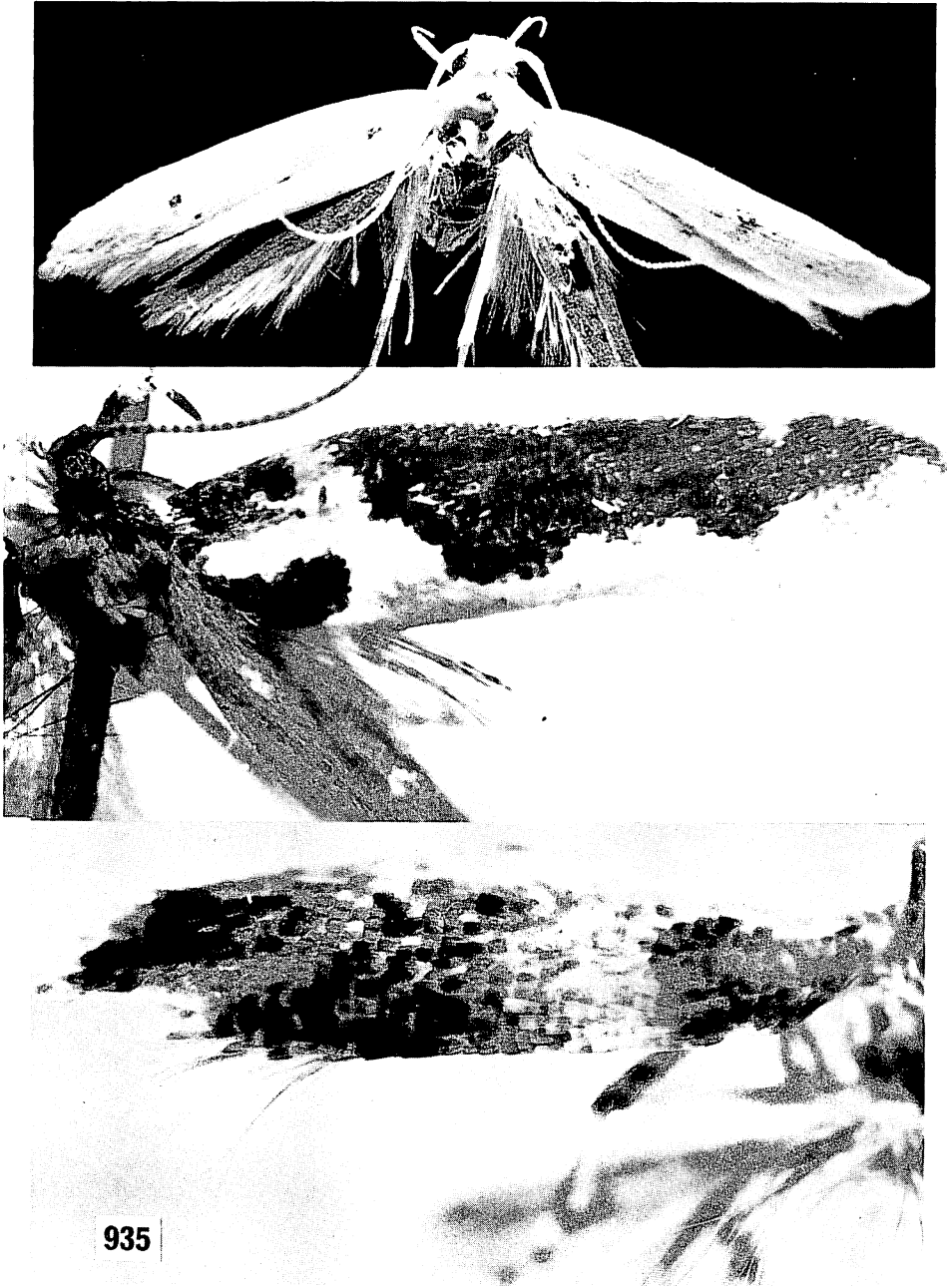


Figure 935—*Hyposmocoma*. Top, (*E.*) *mystodoxa* Meyrick, lectotype male (BM slide 9557 Clarke); Koolau Mts., near Honolulu; forewing 6.5 mm., shining white with a few small black maculae. Middle, (*H.*) *nebulifera* Walsingham, holotype male (BM slide 4091); Koolau Mts., 2,000 feet, near Honolulu; forewing 5 mm., white mixed with some yellow scales and with black. There is a moderate metapleural tuft. This specimen is figured in *Fauna Hawaiiensis*. Bottom, (*H.*) *neckerensis* (Swezey) ("Petrochroa"); Gardner Island; forewing 2.5 mm., brownish fuscous and white (this specimen is abraded and faded and has a split in the subcostal area).

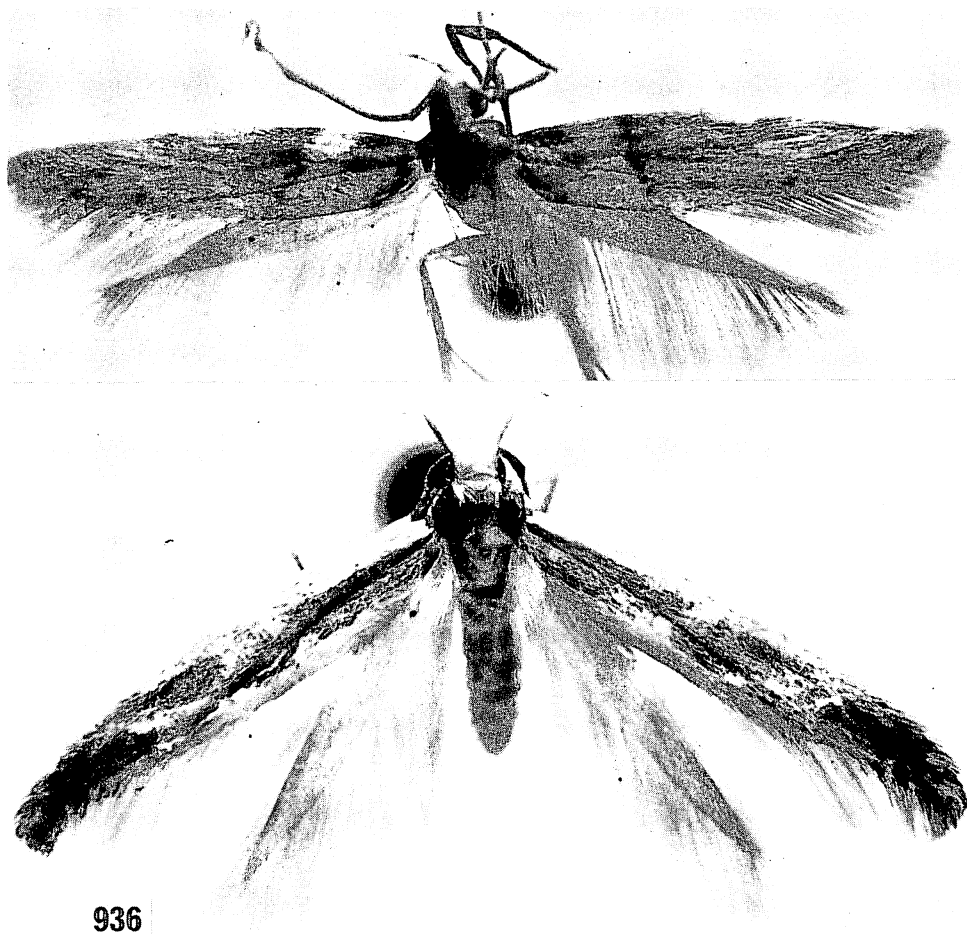


Figure 936—*Hyposmocoma* (*Euperissus*). Top, *nemo* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4752); Haleakala, 5,000 feet, Maui; expanse 12 mm.; forewing has whitish background scaling with ferrugineous to fuscous areas and maculae. Bottom, *nemoricola* (Walsingham) ("*Neelysia*"), holotype female (BM slide 8069); forest above Pelekunu, Molokai; forewing 5.75 mm., brownish orange to fuscous with the posterior marginal zone mostly white, cream, and yellow. The male has long thoracic brushes which cross over the back of the abdomen. These two specimens are illustrated in *Fauna Hawaiiensis*.



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Figure 937—*Hyposmocoma* (*Hyposmocoma*). Top, *nephelodes* Walsingham, allotype female (BM slide 4487); Waianae Mts., 3,000 feet, Oahu; forewing 7 mm. long, straw-colored and fuscous. Middle, *niger* Walsingham, holotype male (BM slide 4128); Molokai, about 4,000 feet; expanse 8 mm.; forewings very dark fuscous without a pattern (the pale areas on the right wing are abrasions). There is an incipient tuft on each metapleuron. Bottom, *nigralbida* Walsingham, holotype male (BM slide 4081); Kauai, 3,000 to 4,000 feet; expanse 17.5 mm.; forewings boldly black and white. The middle and bottom specimens are figured in *Fauna Hawaiiensis*.

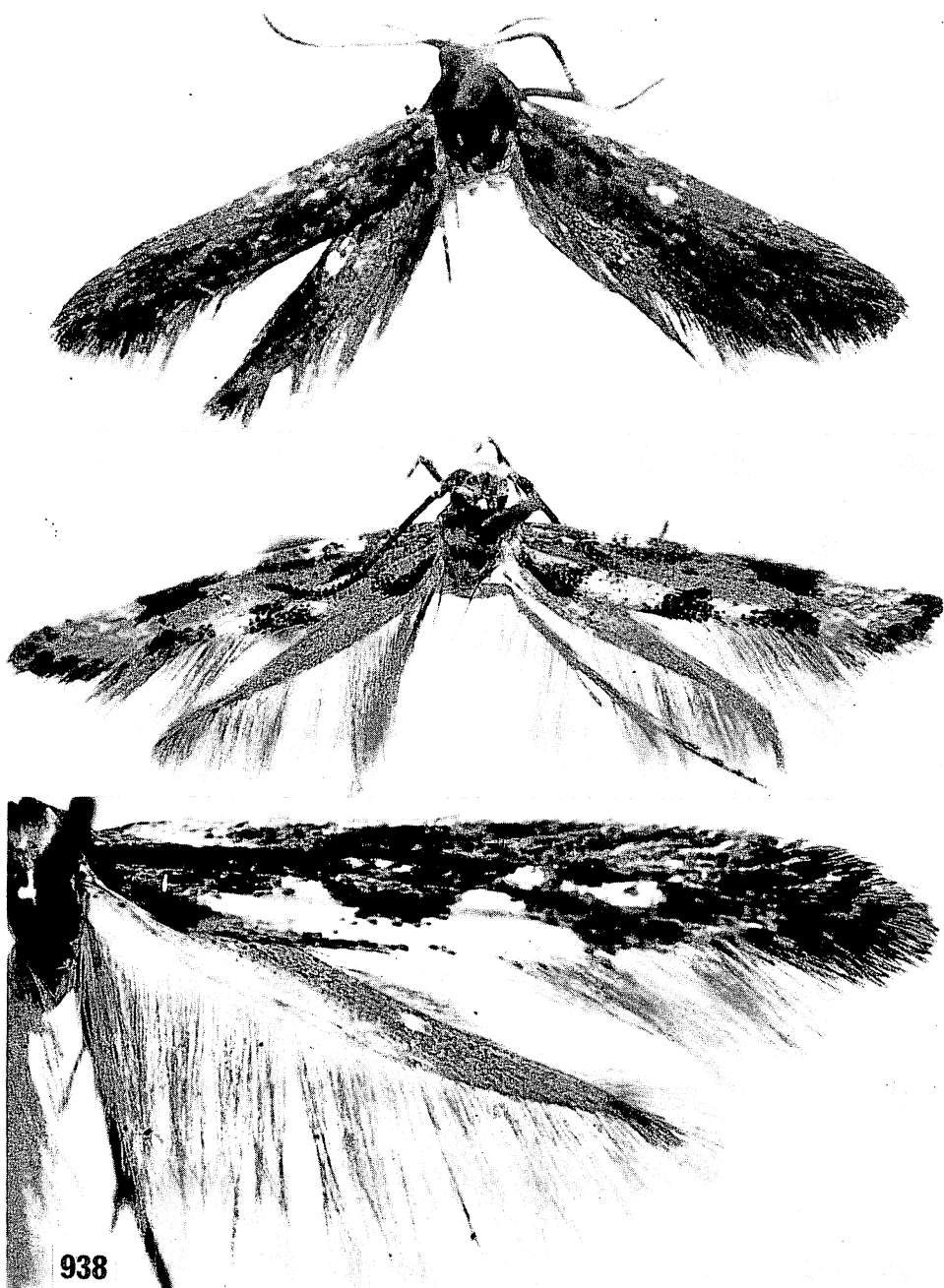


Figure 938—*Hyposmocoma*. Top, (*H.*) *nigrescens* Walsingham, holotype male (BM slide 4126); Kilauea, Hawaii; forewing 5 mm., solidly black with a few pale scales (the pale areas showing in the photograph are abrasions). Middle, (*E.*) *nigrodentata* Walsingham, holotype male (BM slide 4323); Kauai, 3,000 to 4,000 feet; expanse 9.5 mm.; forewings white with dark fuscous maculae. Bottom, (*E.*) *ningorella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4446); Haleakala, 5,000 feet, Maui; forewing 6.5 mm., brownish orange to fuscous with white maculae. There are long metapleural brushes which extend over the abdomen of the male. These three specimens are illustrated in *Fauna Hawaiiensis*.



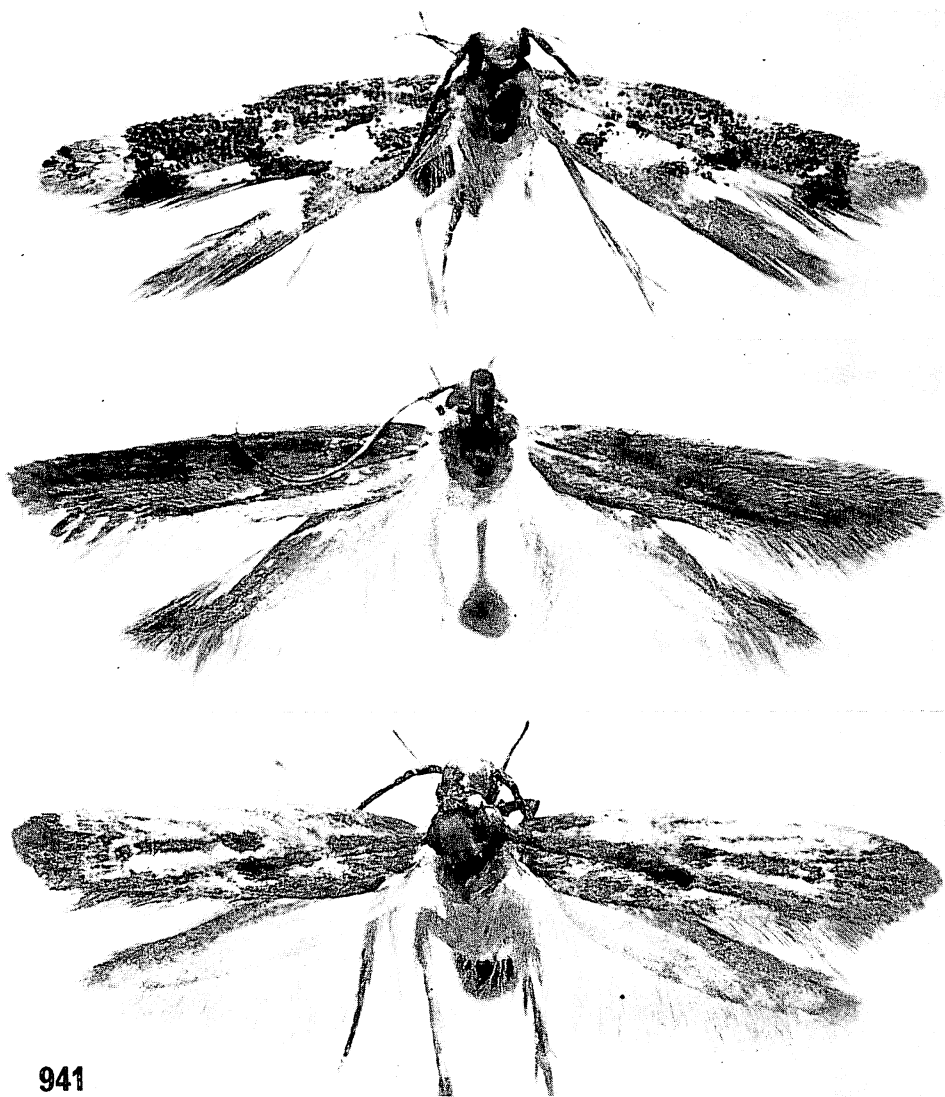
939

Figure 939—*Hyposmocoma* (*Euperissus*). Top, *ningorifera* (Walsingham) ("Neelysia"), holotype male (BM slide 4441); Haleakala, 5,000 feet, Maui; forewing 5 mm., dark fuscous with white maculae. Middle, *nipholoncha* Meyrick, holotype female (slide not made); Mt. Tantalus, Oahu; ex dead *Euphorbia* stem; forewing 8 mm., brownish fuscous and white. Bottom, *niveiceps* Walsingham, holotype male (BM slide 4130); Lanai, 3,000 feet; expanse 12 mm.; forewings fuscous with white maculae. The top and bottom specimens are illustrated in *Fauna Hawaiiensis*.





Figure 940—*Hypsmocoma* (*Hypsmocoma*). Top, *nividorsella* Walsingham, holotype male (BM slide 4082); Kauai, 3000 to 4,000 feet; expanse 15 mm.; forewings black and white. Middle, *notabilis* Walsingham, holotype male (BM slide 4093); Molokai, over 4,000 feet; forewing 9.5 mm., white tinged with yellow, brownish, and fuscous. Bottom, *numida* Walsingham, holotype male (BM slide 4125); Haleakala, 4,000 feet, Maui; expanse 11 mm. Because the submetallic scales have reflected too much light, the photograph does not portray adequately the contrast between the black scaling and the white maculae.



941

Figure 941—*Hyposmocoma* (*Euperissus*). Top, *obliterata* Walsingham, holotype male (BM slide 4324); Kauai, 3,000 to 4,000 feet; expanse 10 mm.; forewings white and fuscous. Middle, *obscura* Walsingham, allotype male (BM slide 4339); Olinda, 4,000 feet, Maui; forewing 8 mm., brownish or brownish fuscous with some yellowish and darker fuscous maculae. Bottom, *ocellata* Walsingham, holotype male (BM slide 4136); Kaholuamano, 4,000 feet, Kauai; expanse 13.5 mm.; forewings brownish fuscous with darker and paler areas. These three specimens are figured in *Fauna Hawaiiensis*.



Figure 942—*Hypsmocoma* (*Hypsmocoma*). Top, *ochreocervina* Walsingham, holotype male (BM slide 4346); Waianae Mts., about 3,000 feet, Oahu; forewing 5 mm., straw-colored and fuscous. Bottom, *ochreociliata* Walsingham, holotype male (BM slide 4357); Kilauea, Hawaii; forewing 7 mm., white with mostly fuscous maculae and yellow fringes. There is a small setal cluster on each metapleuron. These two specimens are figured in *Fauna Hawaiiensis*.

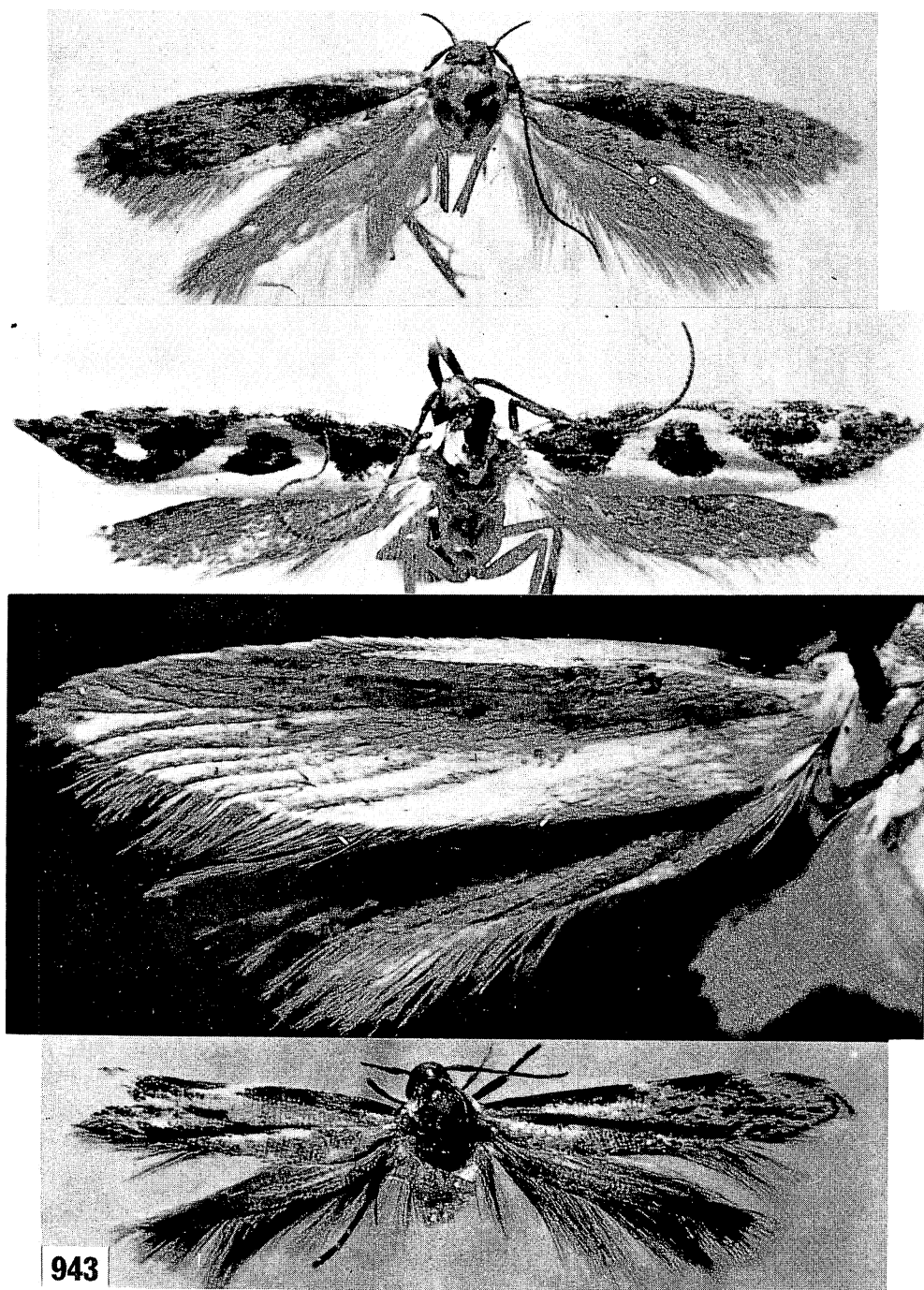


Figure 943—*Hyposmocoma*. Top, (*E.*) *ochreovittella* Walsingham, holotype male (BM slide 4334); Kona, 4,000 feet, Hawaii; expanse 15 mm.; forewings with mostly brown dark areas and yellowish pale areas flecked with brown. Note the long yellow brushes projecting from the axils of the hindwings. Second from top, (*E.*) *oculifera* Walsingham, holotype male (BM slide 4080); Kauai, 3,000 to 4,000 feet; expanse 17 mm.; forewings black and white. Third from top, (*E.*) *ossea* Walsingham, holotype male (BM slide 4149); Kona, 4,000 feet, Hawaii; forewing 8.5 mm., nearly white with a few brown maculae (the dark mark at the base of the forewing costa is glue). Bottom, (*H.*) *oxypetra* Meyrick, paratype (damaged, abdomen lost); Palolo, Oahu; expanse 10 mm.; forewings whitish and yellowish or cream-colored with dark brown or fuscous maculae. The three upper specimens are figured in *Fauna Hawaiiensis*.

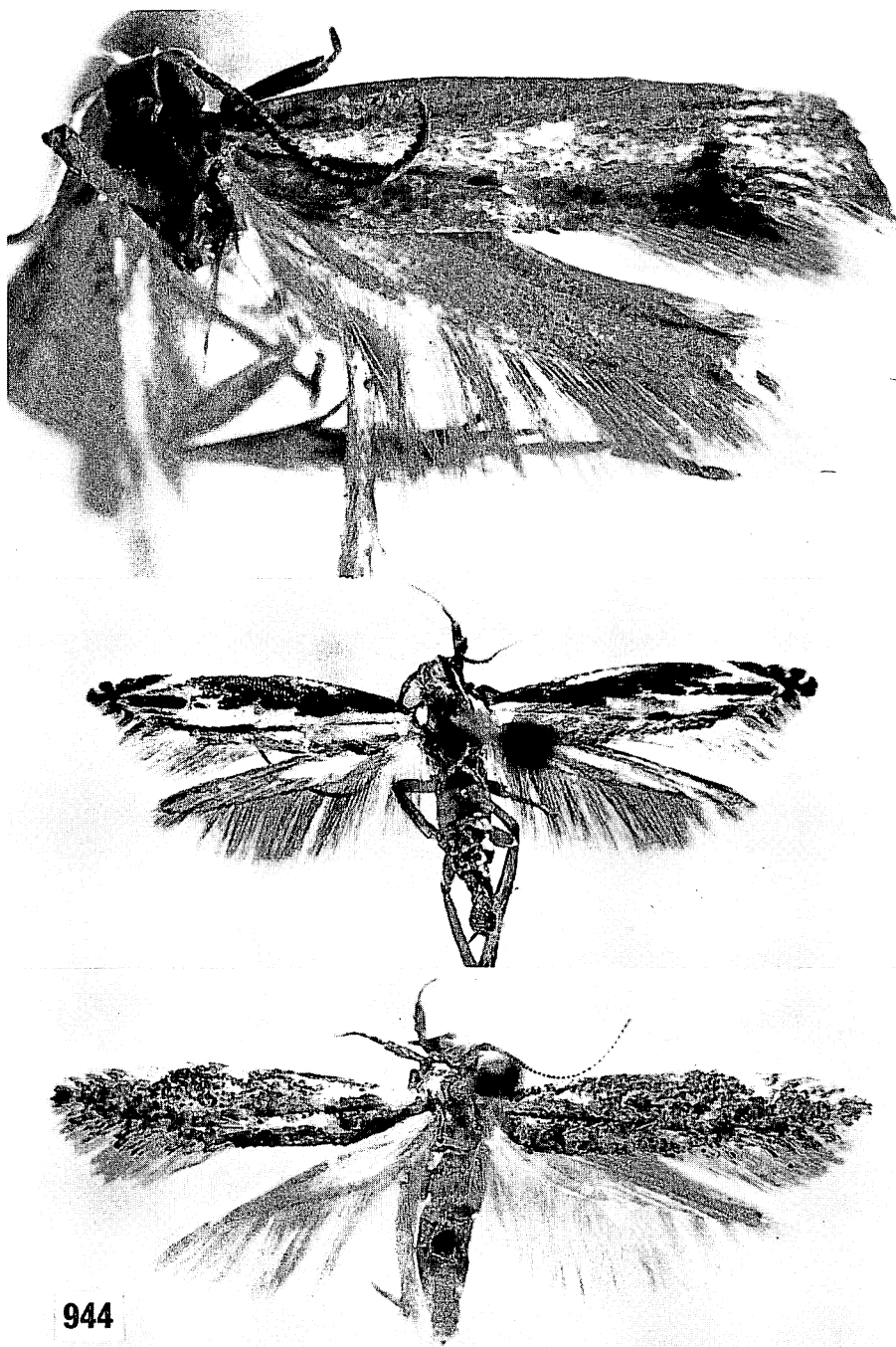


Figure 944—*Hyposmocoma* (*Euperissus*). Top, *pallidipalpis* Walsingham, holotype male (abdomen lost); Molokai, about 4,000 feet; forewing 5.5 mm., mostly concolorous bronze-brown with fuscous maculae (the pale areas on the photograph are light reflections; the moth is difficult to photograph). This specimen is illustrated in *Fauna Hawaiiensis*. Middle, *palmifera* (Meyrick) ("*Neelysia*"), holotype male (slide not made); Pauoa Flats, Oahu; ex dead *Wikstroemia*; forewing 5.5 mm., whitish and yellowish with black maculae. Bottom, *palmivora* Meyrick, holotype female; Kumuwela, Kauai; ex *Pritchardia*; forewing 7.5 mm., whitish ochreous tinged with ferrugineous and sprinkled with fuscous scales.

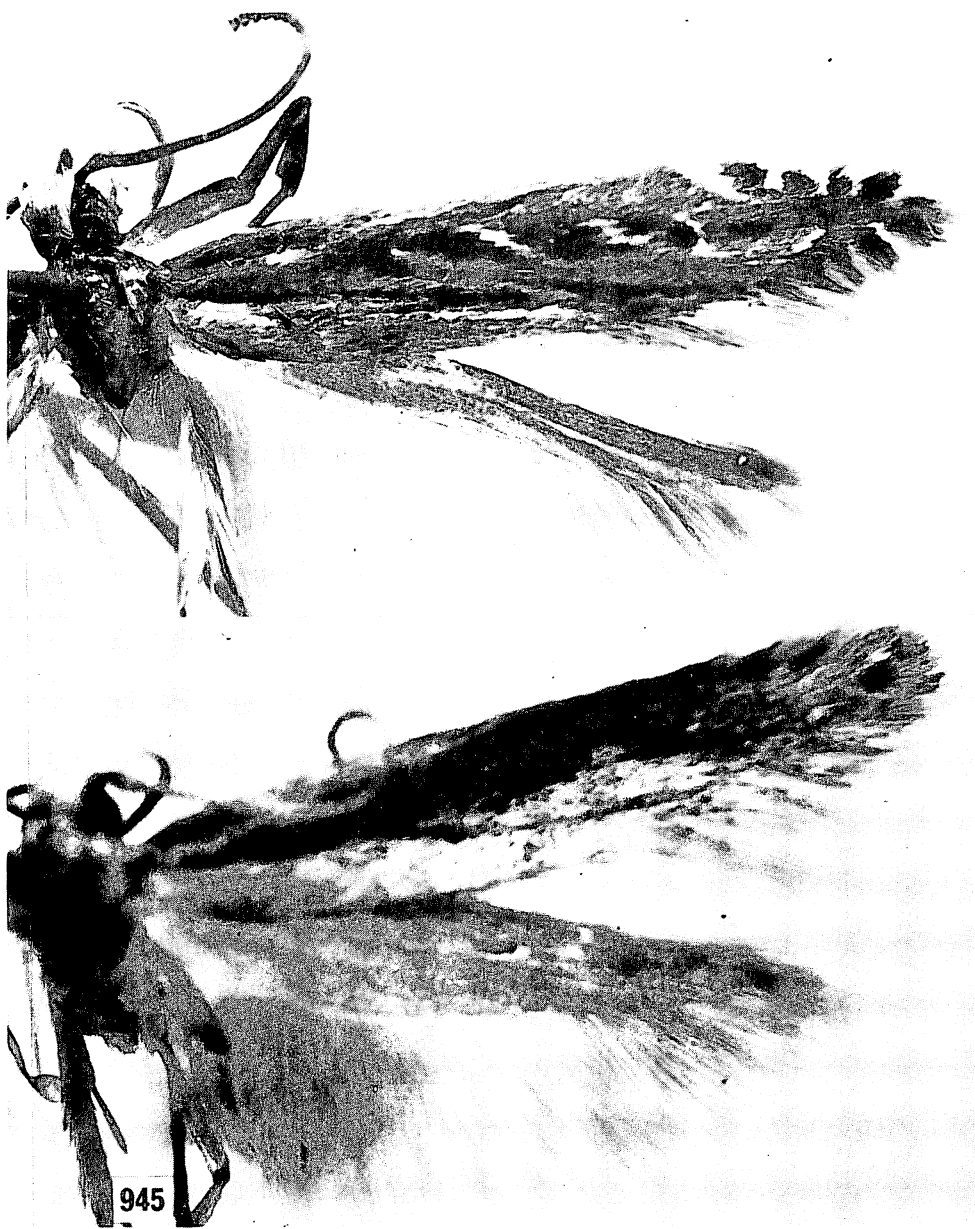


Figure 945—*Hypsmocoma*. Top, (*E.*) *paltodorella* (Walsingham) ("*Neelysia*"), allotype male (BM slide 4438); Kauai, 3,000 to 4,000 feet; forewing 5.5 mm., with various shades of cream-colored, brown, and fuscous squamae. Bottom, (*H.*) *paradoxa* Walsingham, holotype male (BM slide 4348); Kauai Mts., 3,000 to 4,000 feet; forewing 6.5 mm., yellow and fuscous. This specimen is illustrated in *Fauna Hawaiiensis*.

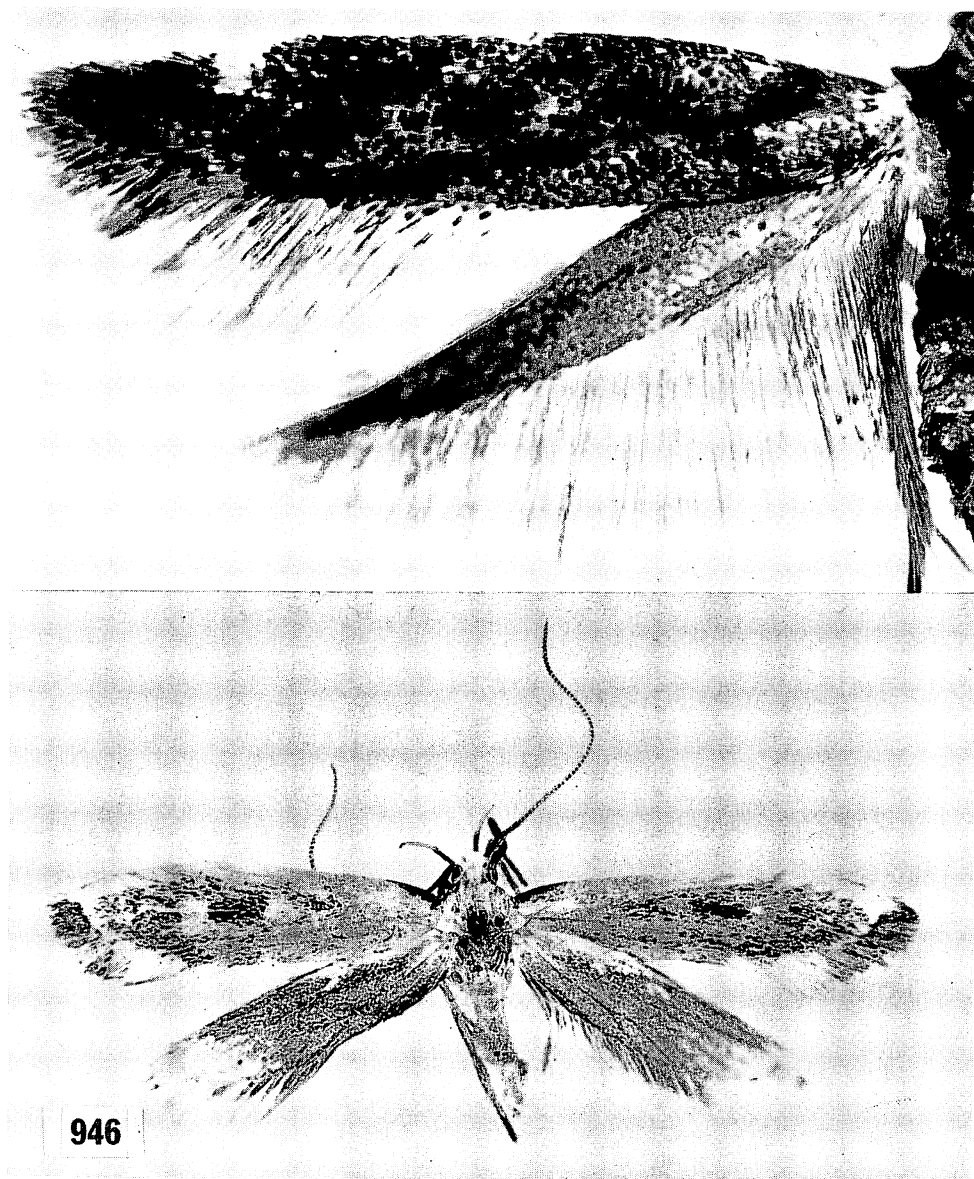


Figure 946—*Hyposmocoma*. Top, (*H.*) *parva* (Butler), holotype female (slide not made); Haleakala, 4,000 feet, Maui; forewing 6 mm., fuscous and white with a basal yellow tinge. This specimen is figured in *Fauna Hawaïensis*. Bottom, (*E.*) *subnitida* Walsingham, color form, male paratype; Kona, 4,000 feet, Hawaii; expanse 21 mm.; forewings whitish to straw-yellow with fuscous maculae. Compare the figure of the holotype on figure 975.



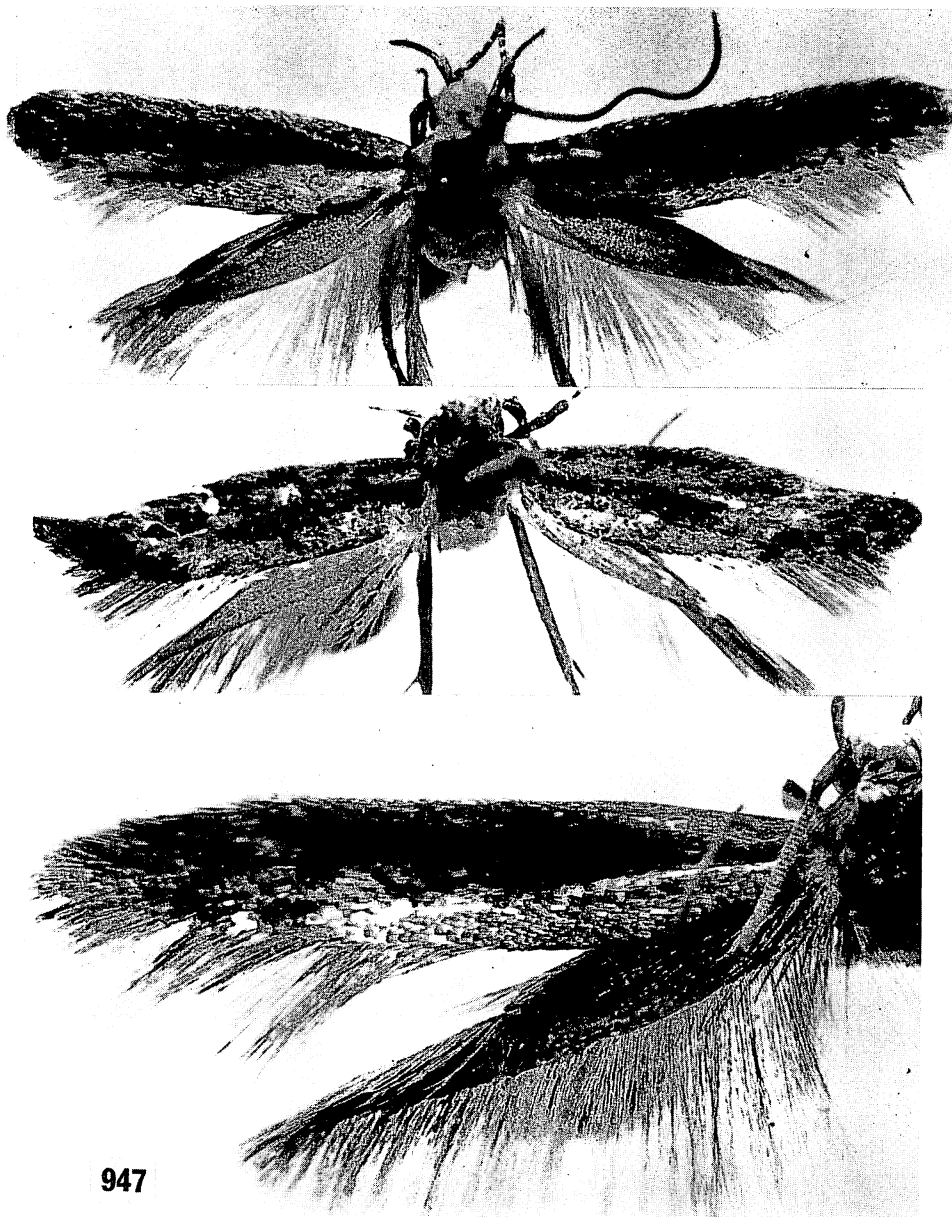


Figure 947—*Hypsomocoma*. Top, (*H.*) *partita* Walsingham, holotype male (BM slide 4089); Hilo, 2,000 feet, Hawaii; expanse 12 mm.; white and fuscous (the photograph does not show enough contrast between the pale posterior area and the dark anterior area). Middle, (*E.*) *passerella* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4742); Kauai, 3,000 to 4,000 feet; expanse 7.5 mm.; forewings mixed ferrugineous, cream-colored, and fuscous. Bottom, (*H.*) *patriciella* Walsingham, holotype male (BM slide 4118); Haleakala, 5,000 feet, Maui; forewing 6 mm., dark fuscous with a white vitta along fold and a few scattered white squamae. All these specimens are illustrated in *Fauna Hawaiiensis*.



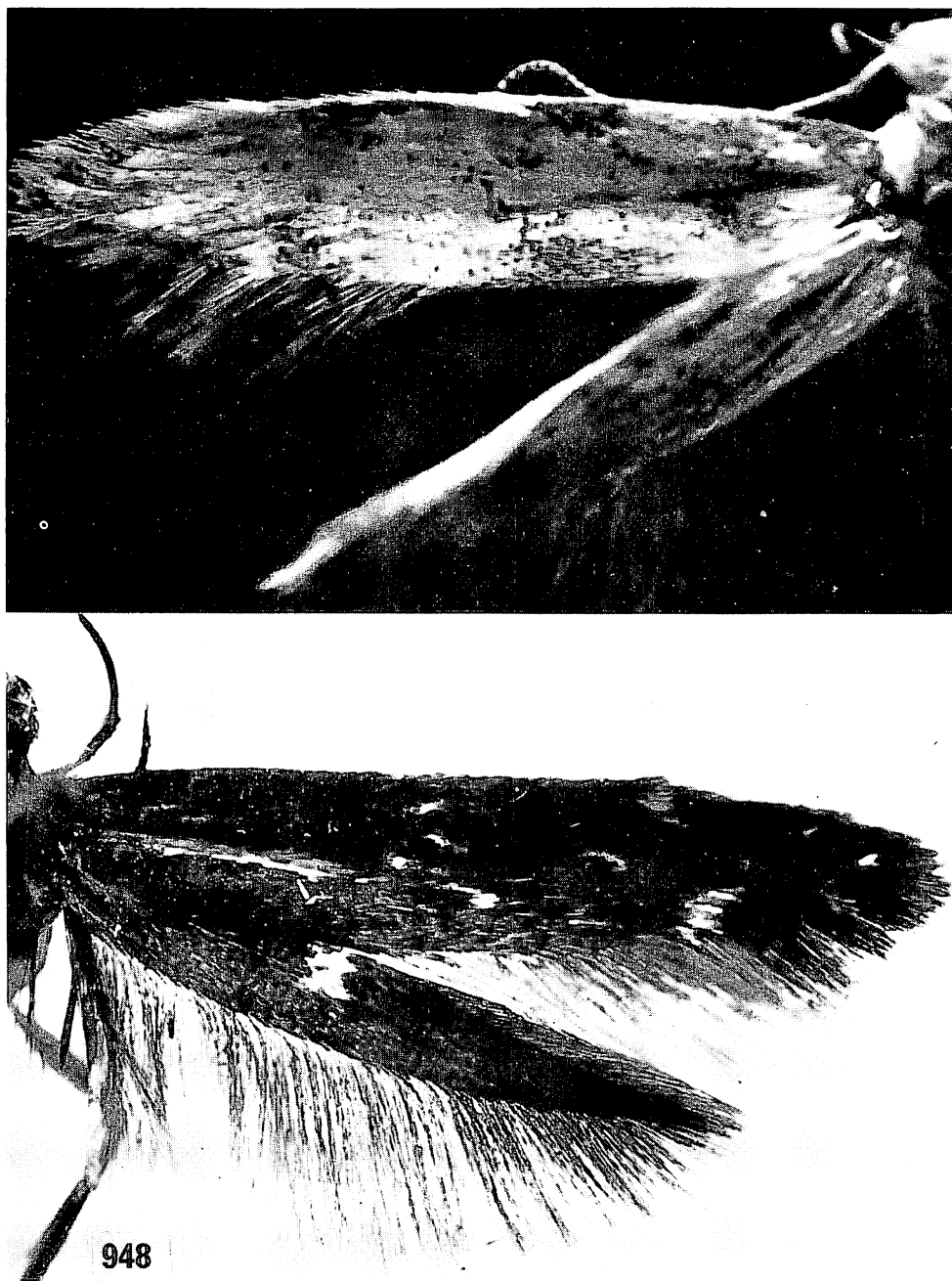
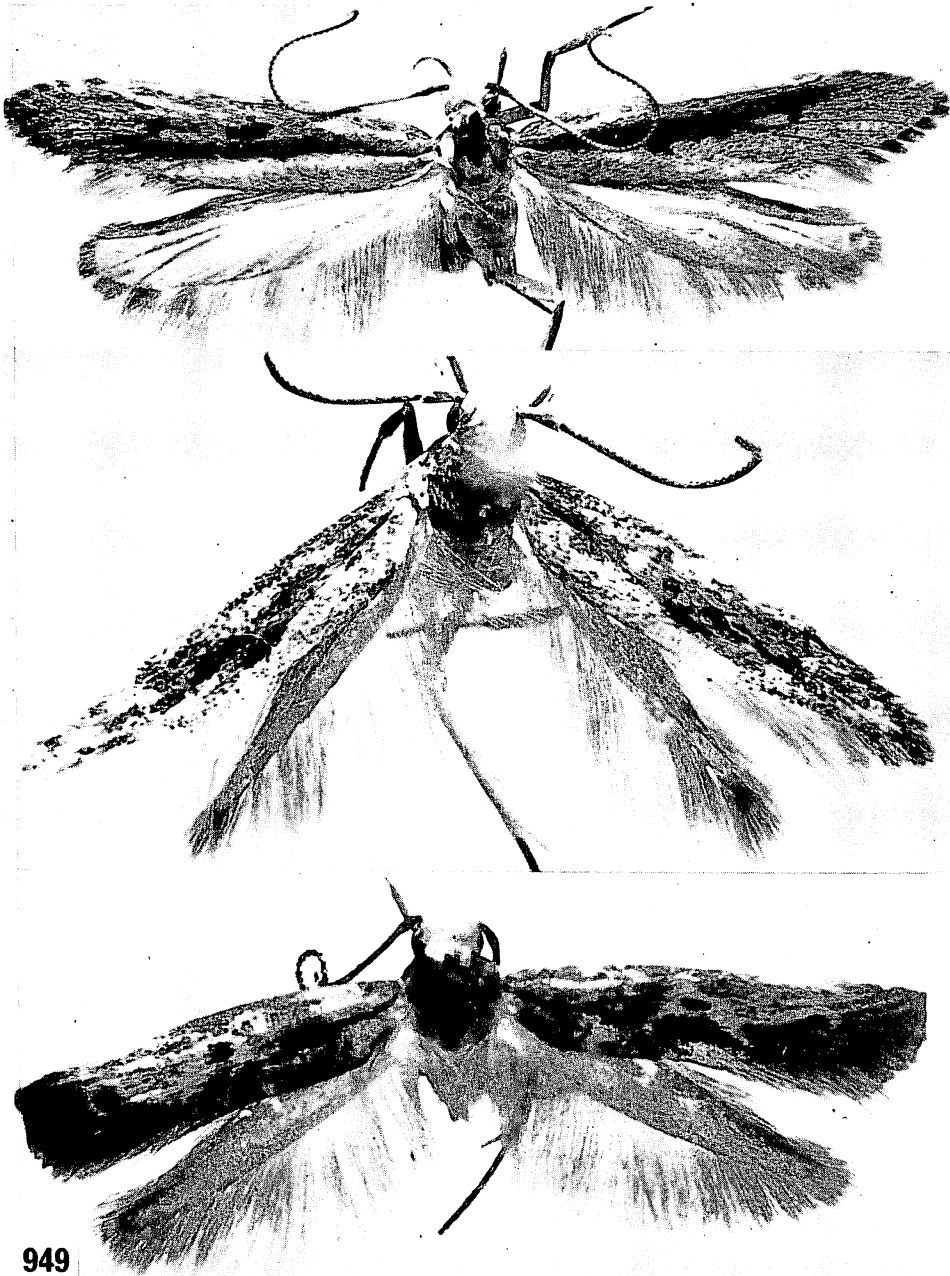


Figure 948—*Hyposmocoma*. Top, (*H. persimilis* Walsingham, holotype male (BM slide 4319); Kona, 4,000 feet, Hawaii; forewing 6.25 mm., white with fuscous maculae. Bottom, (*E. petalifera* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4442); Olinda, 4,000 feet, Maui; forewing 5.25 mm., nearly black with white maculae; hindwing also nearly black (the white area is an abrasion). These specimens are illustrated in *Fauna Hawaiiensis*.



949

Figure 949—*Hypsmocoma*. Top, (*E.*) *petroptilota* (Walsingham), holotype male (BM slide 4431); Kilauea, Hawaii; expanse 20 mm.; forewings pale brownish cinereous sprinkled with fuscous scales and with fuscous maculae. This specimen is illustrated in *Fauna Hawaiiensis*. Middle, (*H.*) *petroschia* Meyrick, lectotype male (BM slide 9571 Clarke); Koolau Mts., Oahu; forewing 4.5 mm., white sprinkled with brown. Bottom, (*E.*) *tricineta* Walsingham, allotype male (abdomen lost); Kona, over 2,000 feet, Hawaii; expanse 11.5 mm.; fuscous and white. There is a small cluster of long scales on each metapleuron.

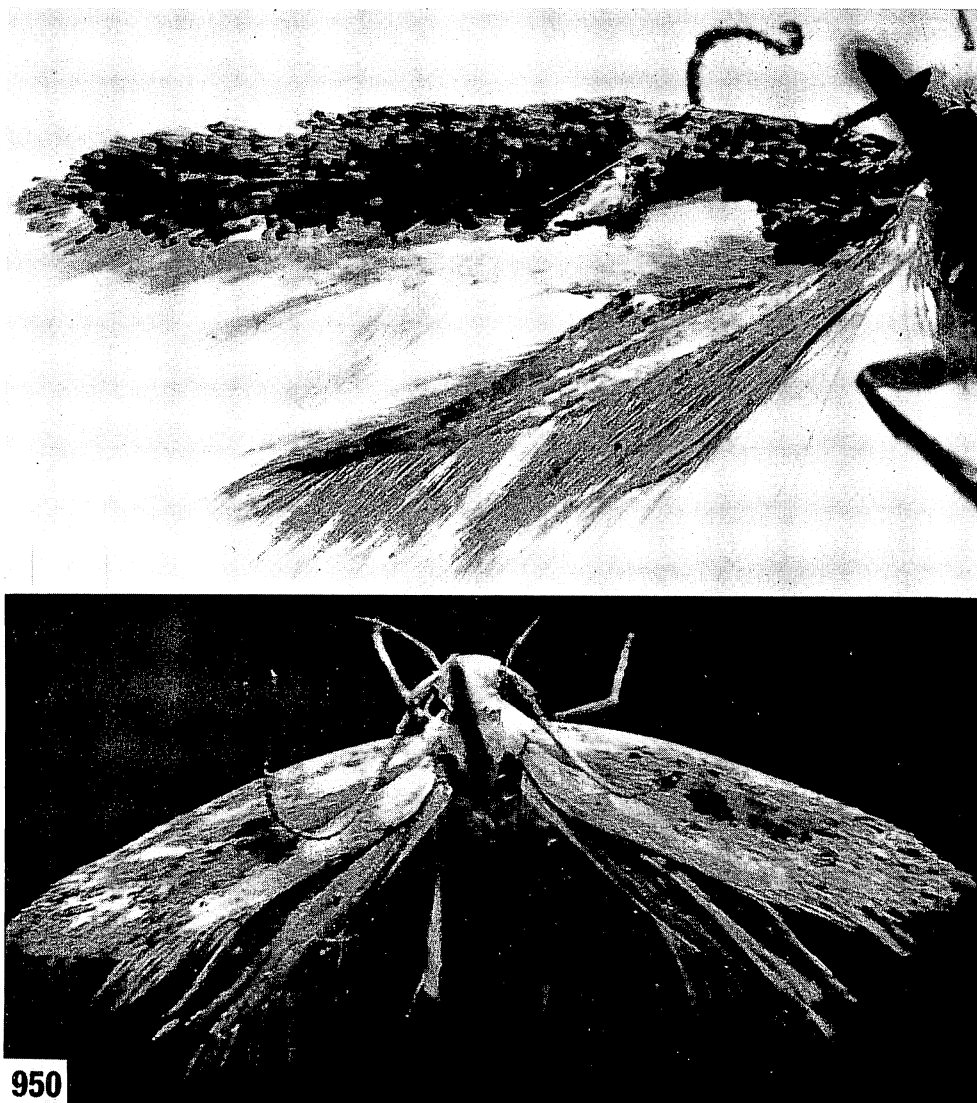
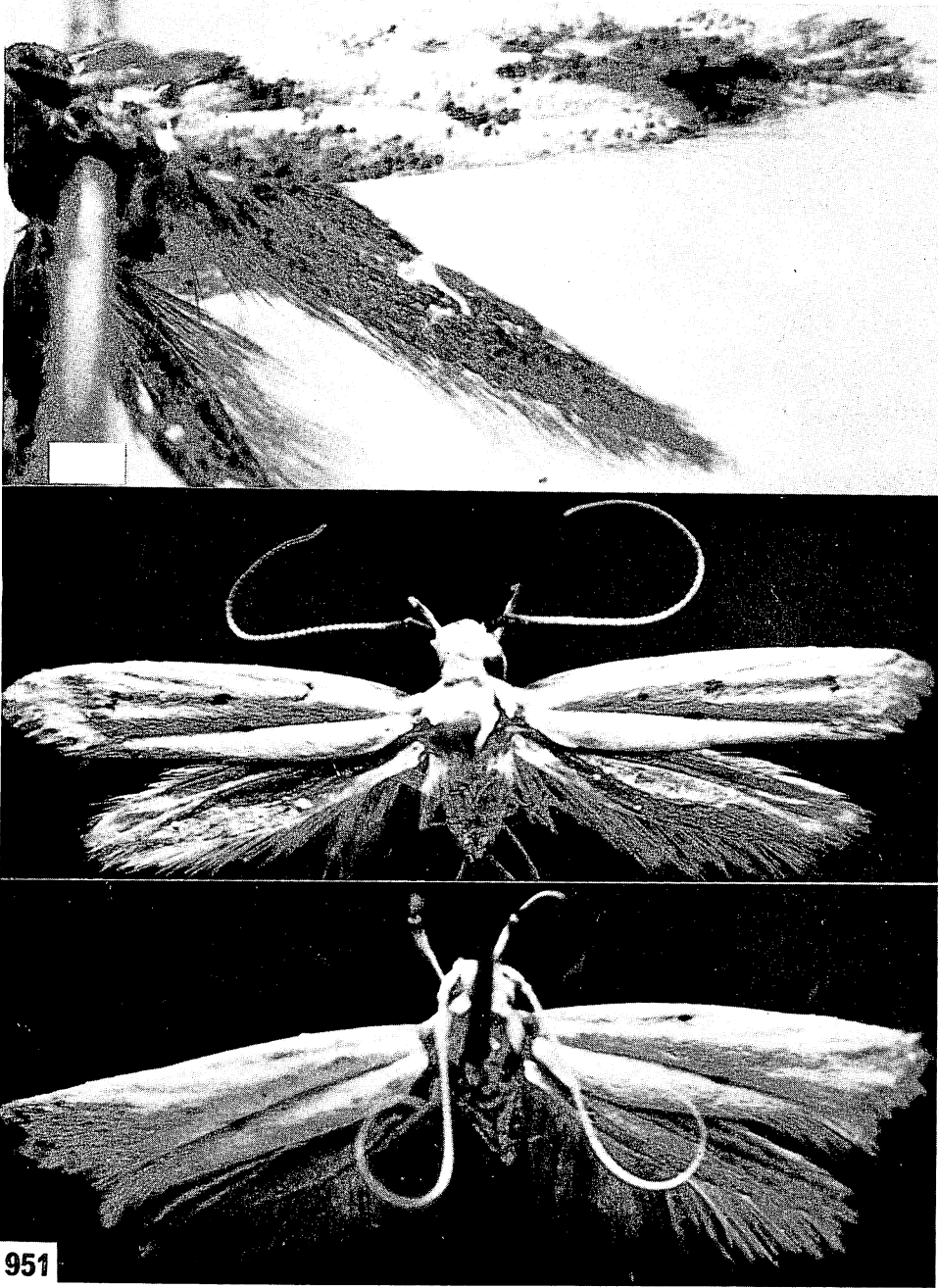
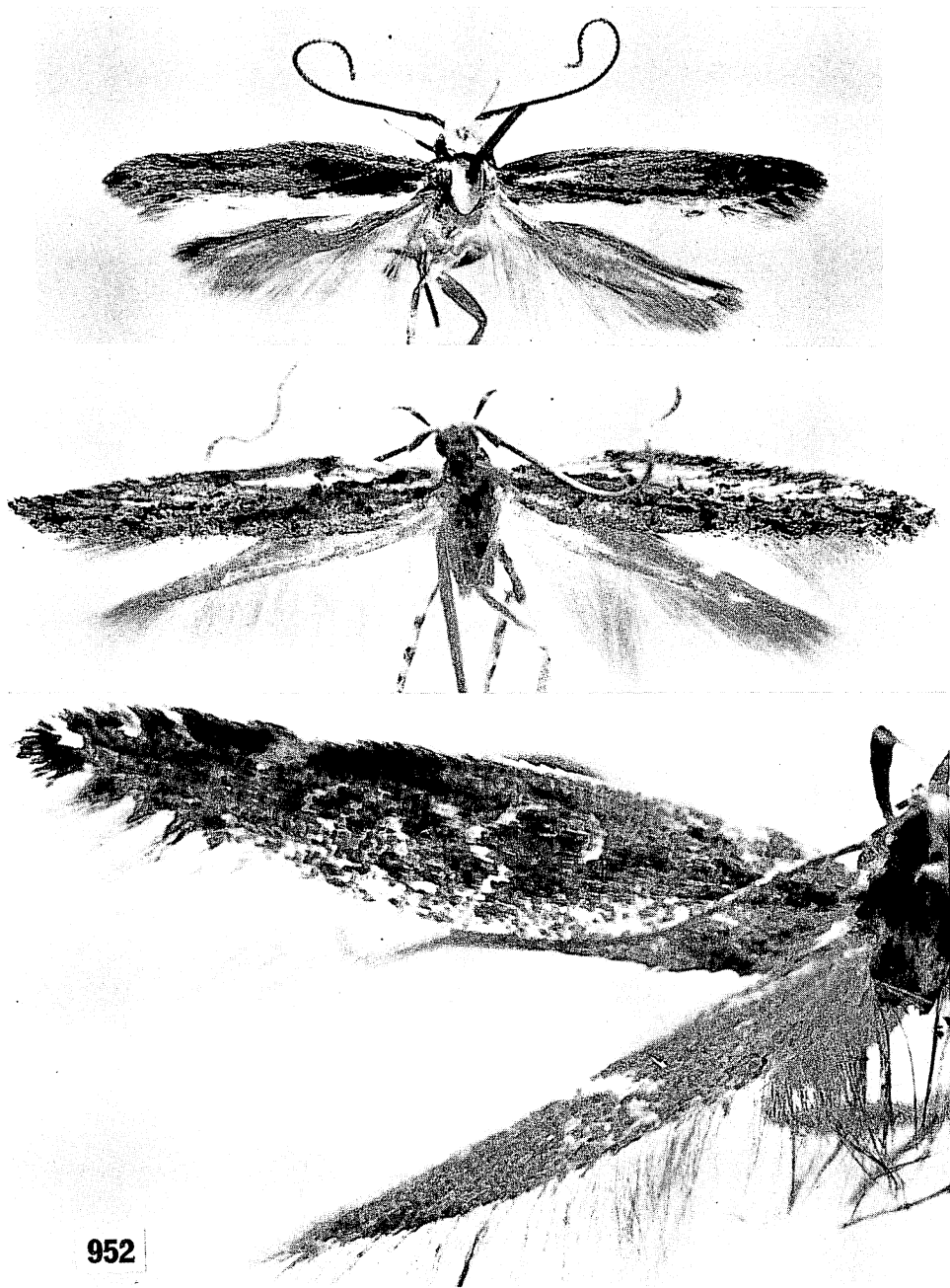


Figure 950—*Hyposmocoma*. Top, (*H.* *phalacra* Walsingham, allotype male (BM slide 4482); Kauai, 3,000 to 4,000 feet; forewing 4.5 mm., white and fuscous (the diagonal mark from costa to fold near the basal third is a damaged area). Bottom, (*E.* *phantasmatella* Walsingham, holotype male (abdomen lost); Kauai, 3,000 to 4,000 feet; expanse 10 mm.; forewings pale straw-colored with brown maculae. This specimen is illustrated in *Fauna Hawaiiensis*.



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Figure 951—*Hyposmocoma* (*Hyposmocoma*). Top, *pharsotoma* Meyrick, holotype male (BM slide 9576 Clarke); Koolau Mts., near Honolulu; forewing 4.25 mm., whitish ochreous sprinkled with fuscous and with fuscous maculae. Middle, *philocharis* (Meyrick) ("*Hyperdasyella*"), holotype male (BM slide 9578 Clarke); Koolau Mts., near Honolulu; expanse 13 mm.; forewings canary yellow with fuscous maculae. Bottom, *picticornis* Walsingham, holotype male (BM slide 4148); Molokai, over 3,000 feet; forewing 7.5 mm., white with brown maculae (the small subcostal black spot near the middle of the right forewing is a hole). This specimen is figured in *Fauna Hawaiiensis*.



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Figure 952—*Hyposmocoma* (*Euperissus*). Top, *pittospori* (Swezey) ("*Semnoprepia*"), holotype male (abdomen lost); Kuliouou, Oahu; ex dead *Pittosporum* wood; forewing 6.5 mm., dark brown to fuscous with a prominent whitish vitta along the posterior edge. Middle, *plumbifer* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4748); Kauai, 3,000 to 4,000 feet; expanse 14.5 mm.; forewings white with ferrugineous, brownish and fuscous squamae and maculae. Bottom, *pluviella* (Walsingham) ("*Neelysia*"), holotype female (BM slide 4464); Molokai, about 4,000 feet; forewing 5 mm., fuscous with white maculae. The middle and bottom specimens are figured in *Fauna Hawaiiensis*.

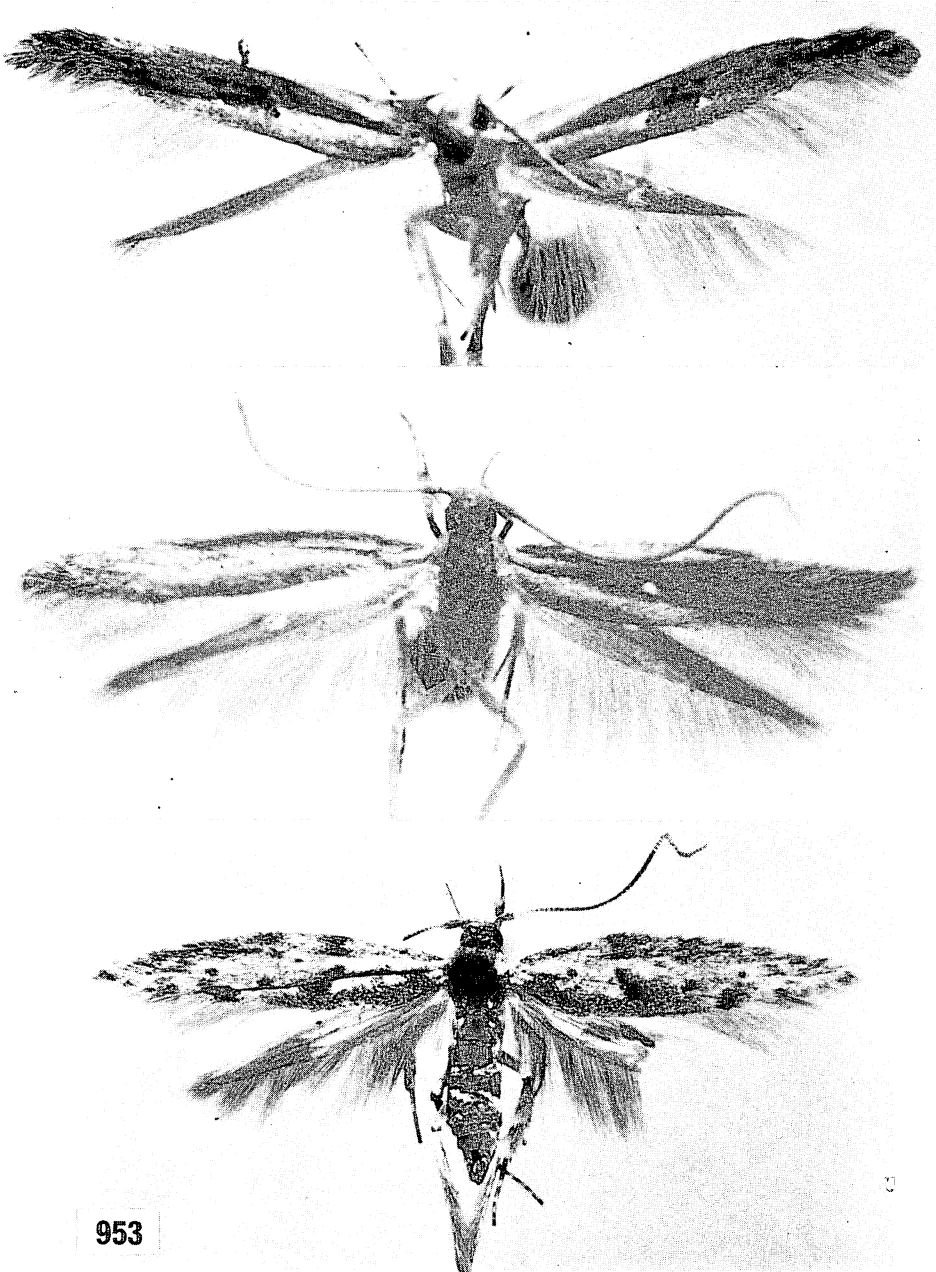


Figure 953—*Hypsmocoma* (*Euperissus*). Top, *poeciloceras* (Walsingham) ("Neelysia"), holotype male (BM slide 4445); Haleakala, below 4,000 feet, Maui; expanse 12 mm.; forewings brownish orange with white maculae and some fuscous squamae (the photograph has too much shadow, and this gives a partially inaccurate rendition). A pair of strong yellow brushes from the metapleura cross over the back of the abdomen. Middle, *polia* (Walsingham) ("Aphthonetus"), holotype male (BM slide 4750); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings white extensively sprinkled with yellowish-tipped scales (which may appear brownish under low magnification). Bottom, *prae fracta* (Meyrick) ("Aphthonetus"), holotype female (slide not made); Kumuweia, Kauai; ex *Pipturus* bark; forewing 7.75 mm., white sprinkled with grey and with greyish and brownish maculae. The top and middle specimens are illustrated in *Fauna Hawaiiensis*.

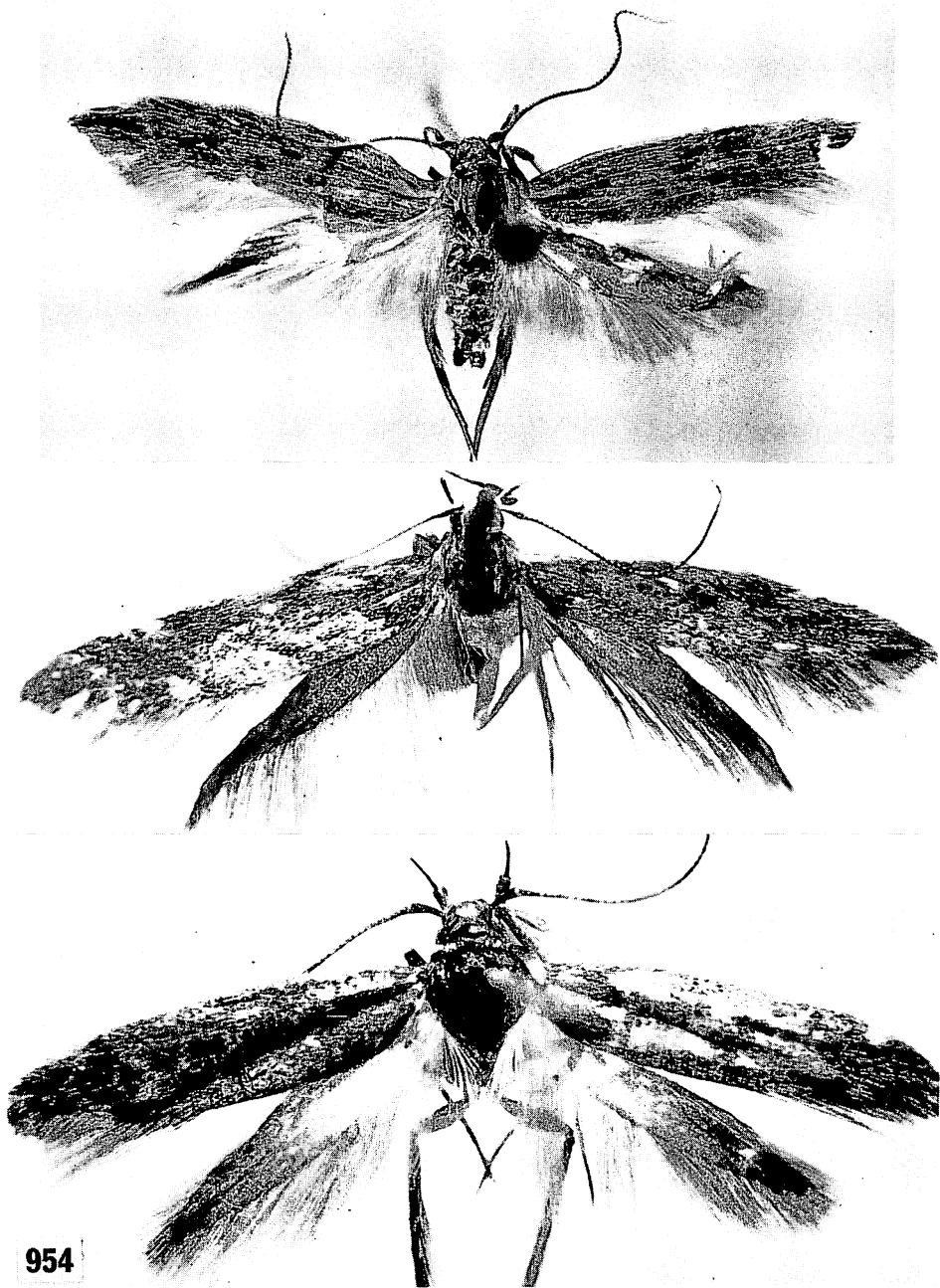
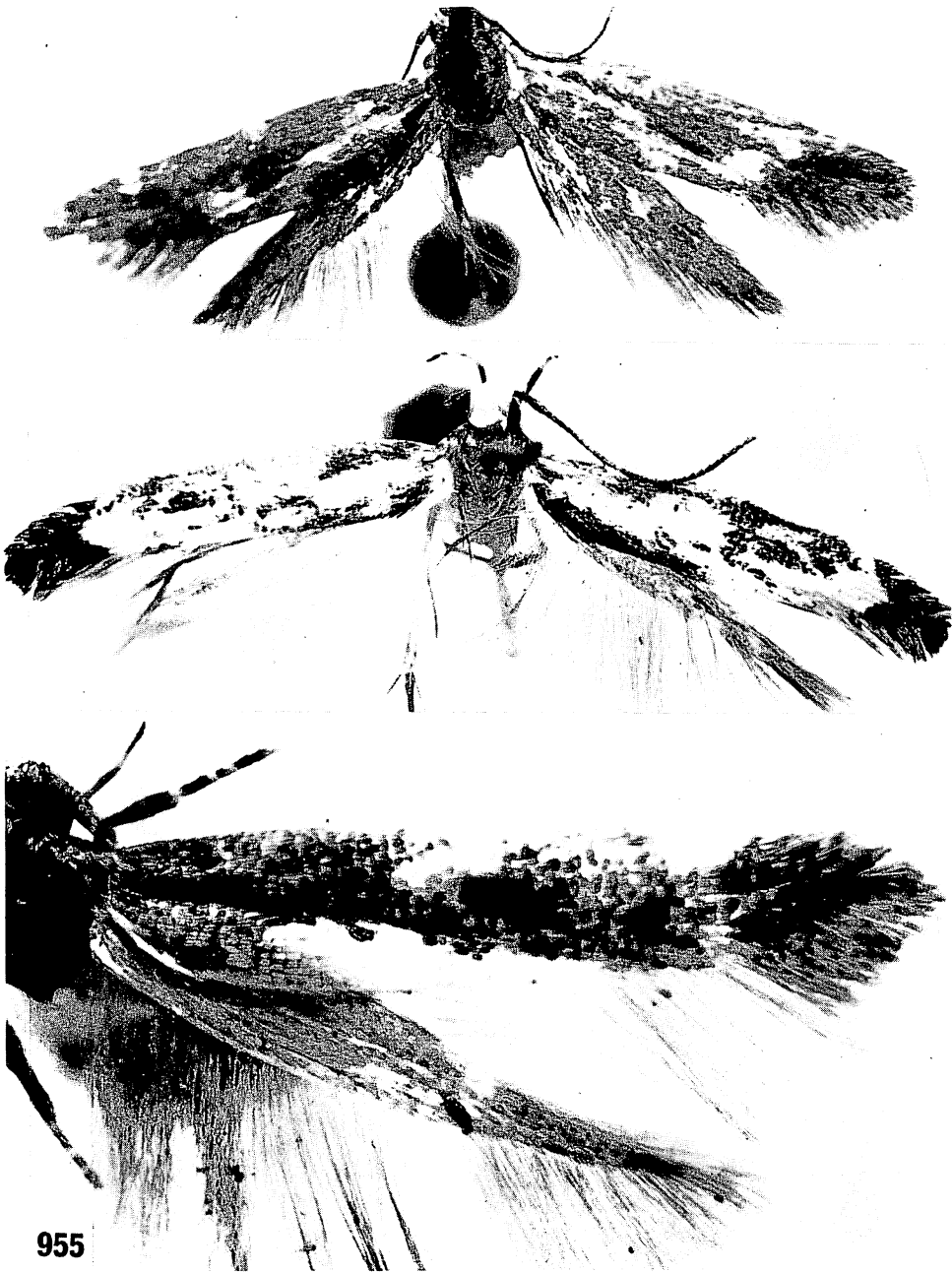


Figure 954—*Hyposmocoma*. Top, (*E.*) *pritchardiae* (Swezey) ("*Bubaloceras*"), holotype male (slide Z-I-18-61-2); Kumuwela, Kauai; ex *Pritchardia*; left forewing 9.5 mm., brownish ochreous with some fuscous squamae and maculae. Middle, (*H.*) *progressa* Walsingham, holotype female (BM slide 4471); Haleakala, under 4,000 feet, Maui; expanse 14 mm.; forewings cream-colored and fuscous. Bottom, (*H.*) *prophantis* Meyrick, lectotype female (BM slide 9570 Clarke); Koolau Mts., near Honolulu; expanse 11 mm.; forewings purplish fuscous with ochreous white maculae.



955

Figure 955—*Hypsoscoma*. Top, (*H.*) *propinqua* Walsingham, holotype male (BM slide 4123); Molokai, 4,000 feet; expanse 9 mm.; the lighting on the forewings is incorrect and does not adequately reveal the contrast between the fuscous background scaling and the white vitta along the fold and the white macula at the apex of the fold. Middle, (*E.*) *psaroderma* (Walsingham) ("*Neelysia*"), holotype male (abdomen lost); Waianae Mts., 3,000 feet, Oahu; expanse 9 mm.; forewings cream-colored and fuscous. Bottom, (*H.*) *pseudolita* Walsingham, holotype male (BM slide 4483); Waianae Mts., Oahu; forewing 4 mm., yellow and fuscous. These three specimens are illustrated in *Fauna Hawaiiensis*.



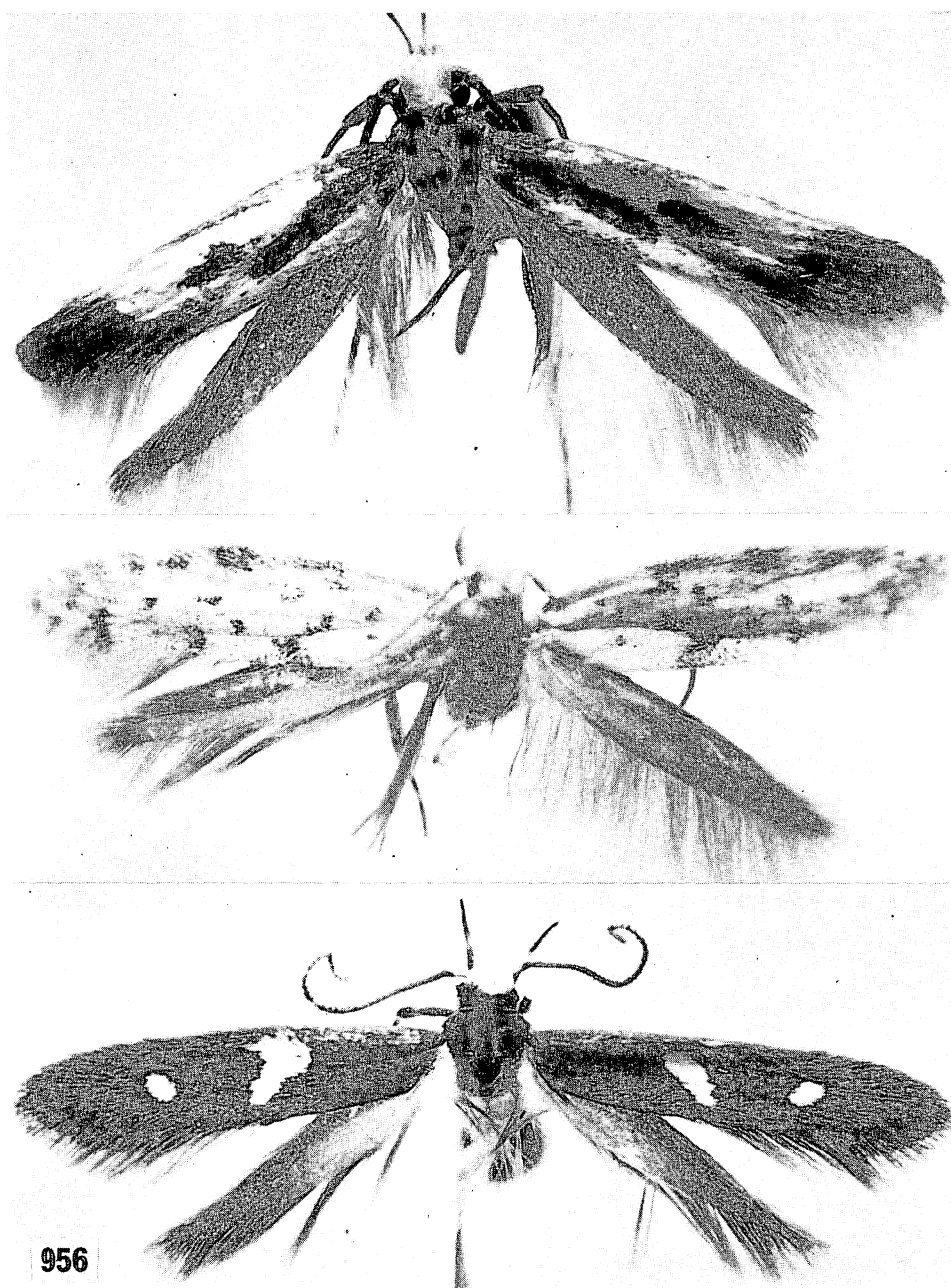


Figure 956—*Hyposmocoma* (*Euperissus*). Top, *pucciniella* Walsingham, holotype male (BM slide 4141); Kilauea, Hawaii; expanse 12 mm. as set; forewings fuscous and white. Middle, *puncticiliata* (Walsingham) ("Aphthonetus"), holotype male (BM slide 4755); Kona, 4,000 feet, Hawaii; expanse 15 mm.; forewings white sprinkled with yellow-tipped squamae and clusters of dark fuscous squamae. Bottom, *punctifumella* Walsingham, holotype male (BM slide 4131); expanse 12 mm.; forewings almost black with white maculae (the submedial macula on the left forewing has been enlarged by abrasion). These three specimens are illustrated in *Fauna Hawaiiensis*.

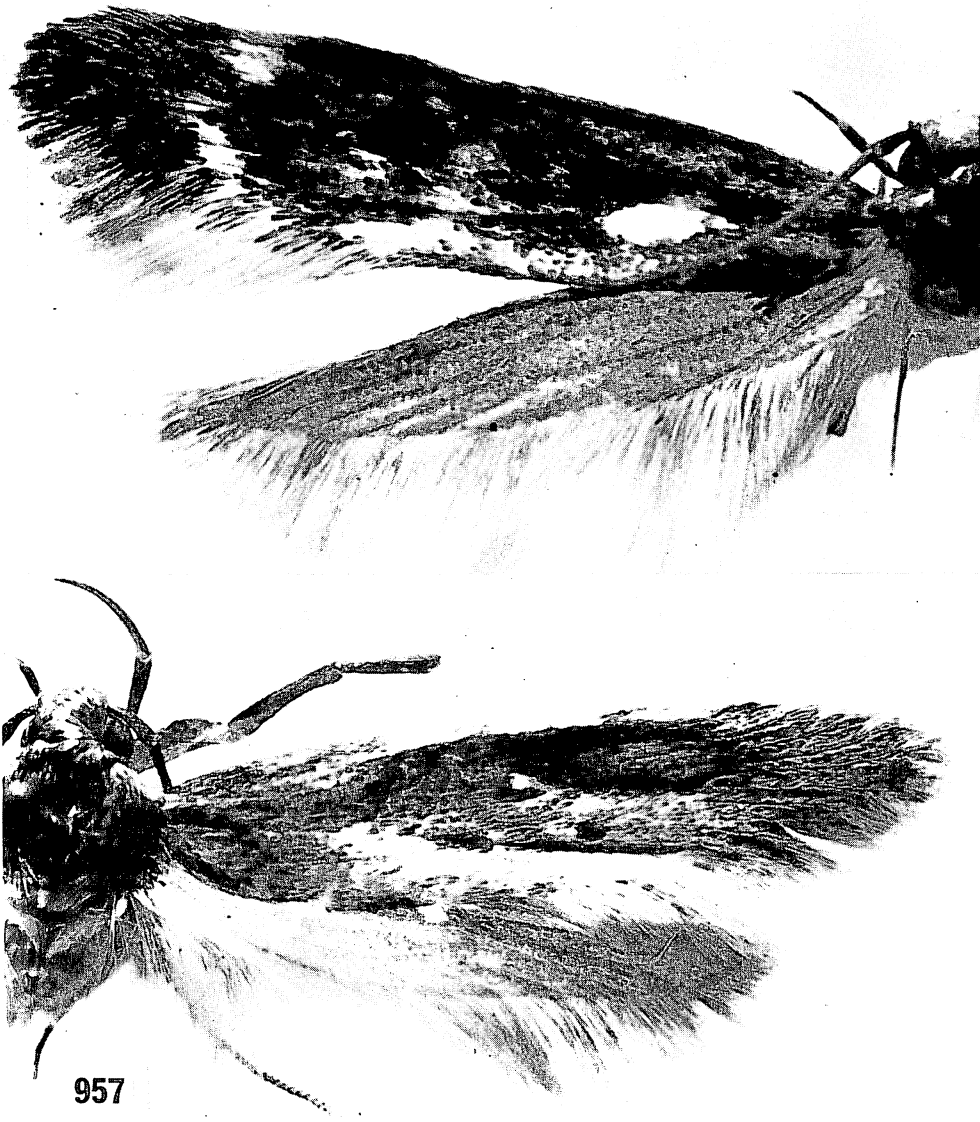


Figure 957—*Hyposmocoma*. Top, (*H.*) *punctiplicata* Walsingham, holotype female (abdomen lost); Molokai, above 4,500 feet; forewing 7 mm., fuscous with white maculae. Bottom, (*E.*) *quadripunctata* Walsingham, holotype male (abdomen lost); Kauai, 3,000 to 4,000 feet; forewing 8 mm., mostly brownish with dark fuscous maculae. These specimens are illustrated in *Fauna Hawaiiensis*.

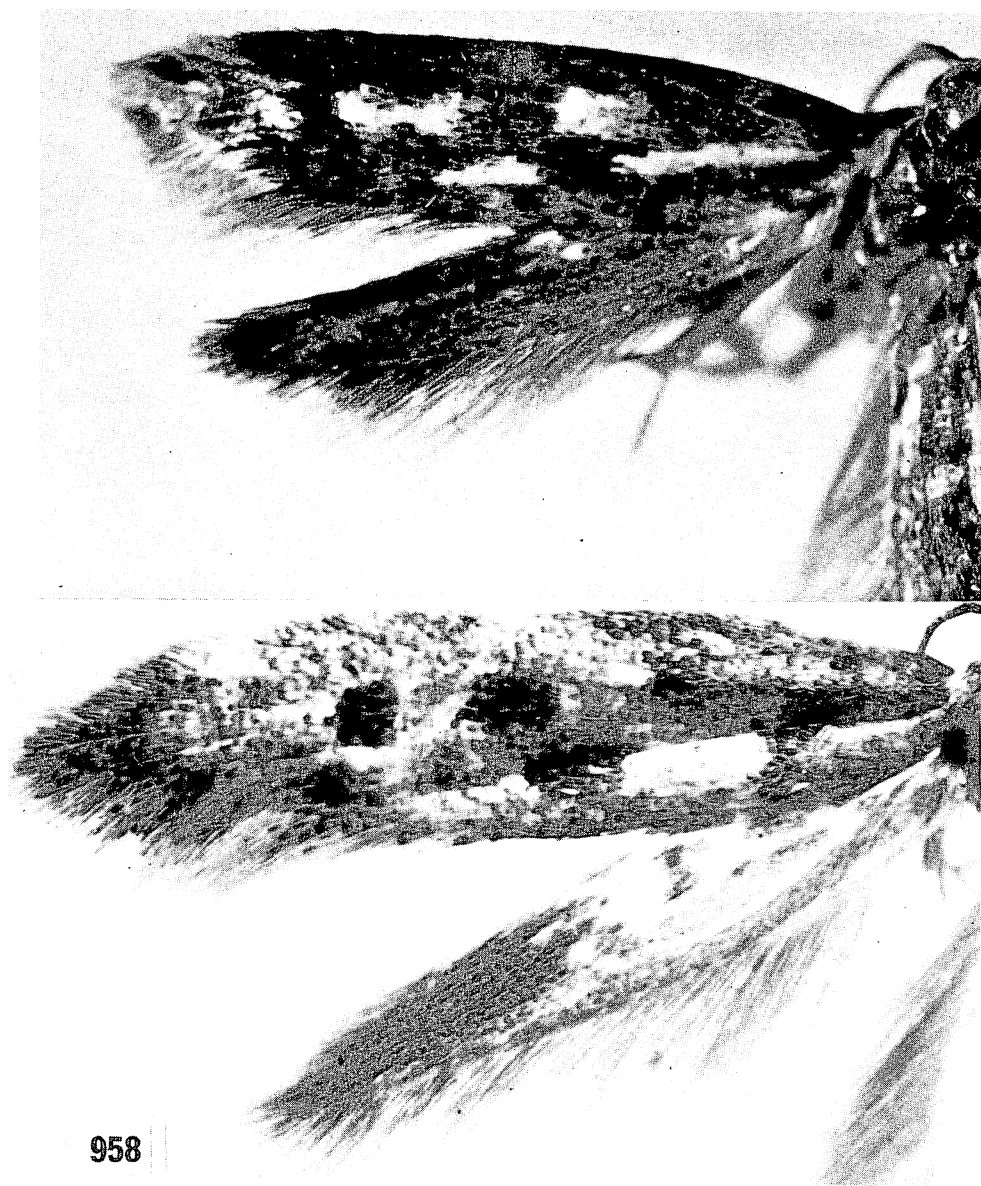


Figure 958—*Hyposmocoma*. Top, (*E.*) *quadristriata* Walsingham, holotype male (abdomen lost); Molokai, about 4,500 feet; forewing 5.5 mm., mostly fuscous with cream-colored maculae. Bottom, (*H.*) *quinquemaculata* Walsingham, holotype male (BM slide 4359); Kona, 4,000 feet, Hawaii; forewing 7.5 mm., white with fuscous maculae and sprinkled with fuscous squamae. These specimens are illustrated in *Fauna Hawaiiensis*.



Figure 959—*Hyposmocoma* (*Euperissus*). Top, *radiatella* Walsingham, allotype male (BM slide 4495); Kona, 4,000 feet, Hawaii; expanse 17 mm.; forewings white with yellowish and fuscous vittae and maculae. Middle, *rediviva* (Walsingham) ("*Neelysia*"), holotype male, (abdomen lost); Kaholuamano, 4,000 feet, Kauai; expanse 11 mm. as set; forewings brownish orange and white with flecks of fuscous. A brush of fine hair extends over abdomen from each metapleuron. This specimen is figured in *Fauna Hawaiiensis*. Bottom, *repandella* (Walsingham) ("*Neelysia*"), allotype male (BM slide 4437); Molokai, above 4,000 feet; forewing 4.5 mm., white and fuscous. There is a cluster of long scales on each metapleuron below the anterior edge of each hindwing.



Figure 960—*Hyposmocoma*. Top, (*H.*) *rhabdophora* Walsingham, holotype female (BM slide 4531); Molokai, above 4,000 feet; forewing 6.5 mm., golden yellow except for a fuscous basal costal vitta. Middle, (*E.*) *roseofulva* Walsingham, holotype male (BM slide 4344); Kauai, 3,000 to 4,000 feet; expanse 17 mm.; forewings brown behind the fold, mostly pinkish costad of the fold, and with brown vittae and maculae (the pale submedial spot on the right forewing is an abrasion). Bottom, (*E.*) *rotifer* (Walsingham) ("*Neelysia*"), holotype female (BM slide 4463); Molokai, 3,000 feet; expanse 10 mm.; forewings mostly fuscous orange or bronze with strongly contrasting white maculae and some fuscous. These three specimens are illustrated in *Fauna Hawaiiensis*.

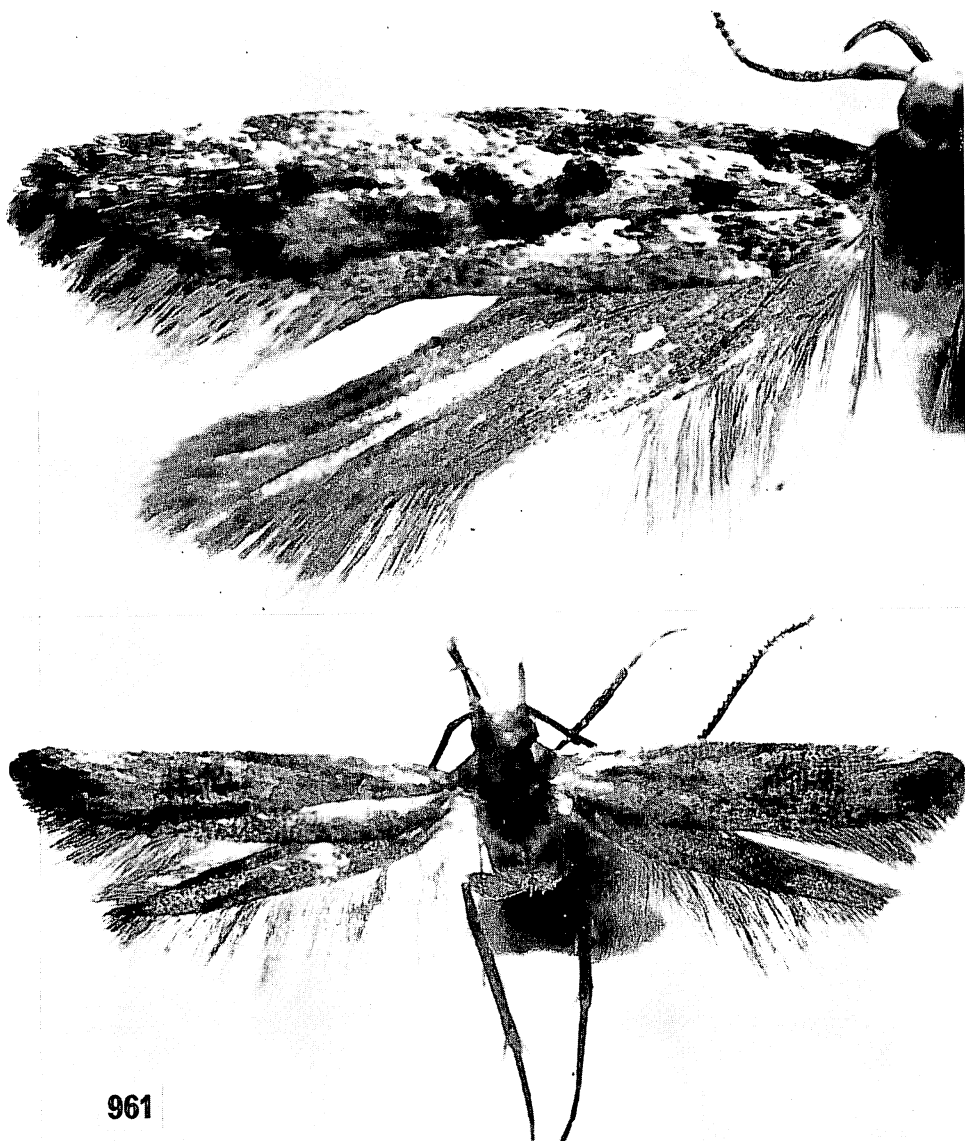


Figure 961—*Hyposmocoma*. Top, (*H.*) *rubescens* Walsingham, allotype male (BM slide 4488); Kauai, 3,000 to 4,000 feet; forewing 7 mm., yellowish and fuscous. Bottom, (*E.*) *rusius* Walsingham, holotype male (BM slide 4351); Molokai, over 3,000 feet; expanse 9 mm.; forewings yellow and brownish fuscous. This specimen is illustrated in *Fauna Hawaiënsis*.

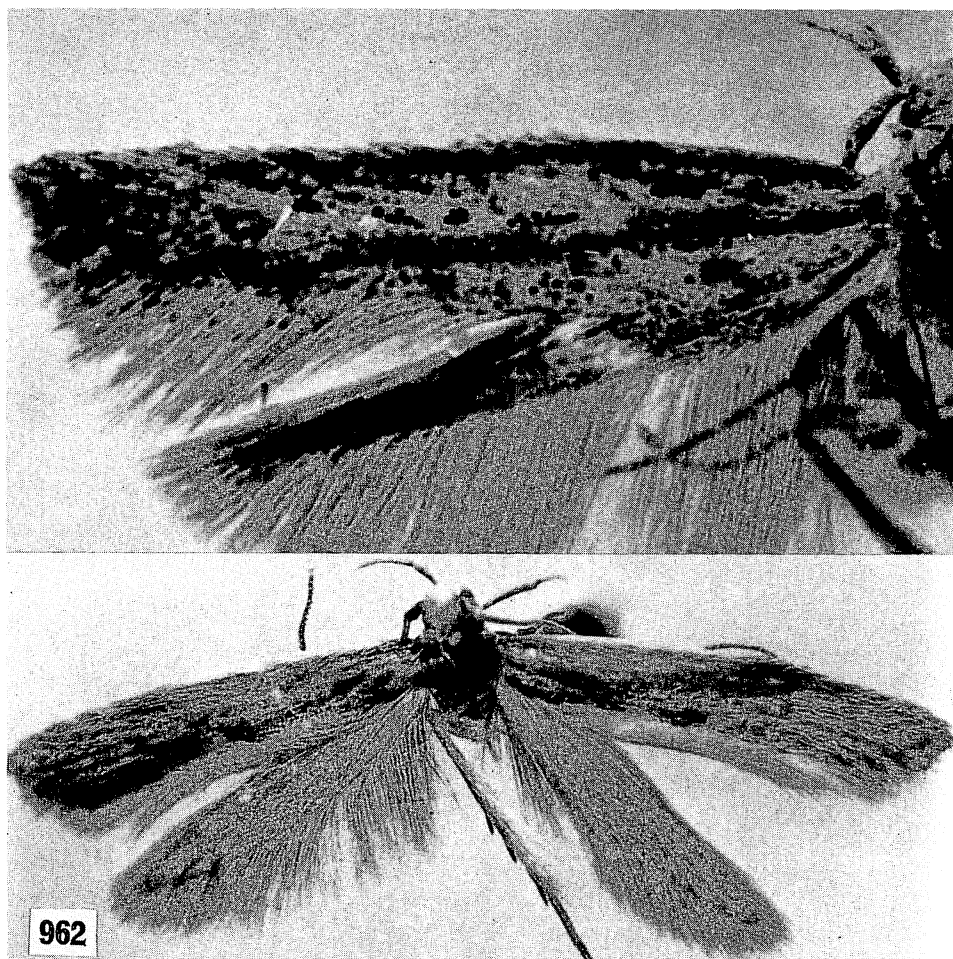


Figure 962—*Hypsmocoma*. Top, (*E.*) *rutella* (Walsingham) ("*Rhinomactrum*"), holotype male (BM slide 4422); Kauai, 3,000 to 4,000 feet; forewing 5.75 mm., ferrugineous spotted with white and dark fuscous. This specimen is illustrated in *Fauna Hawaïensis*. Bottom, (*H.*) *sabulella* Walsingham, allotype male (BM slide 4099); Halemanu, 4,000 feet, Kauai; expanse 15 mm.; forewings pale brown with darker brown maculae, with darker brown from base to apex of cell (not visible in the photograph), and with a very pale posterior vitta, as shown.



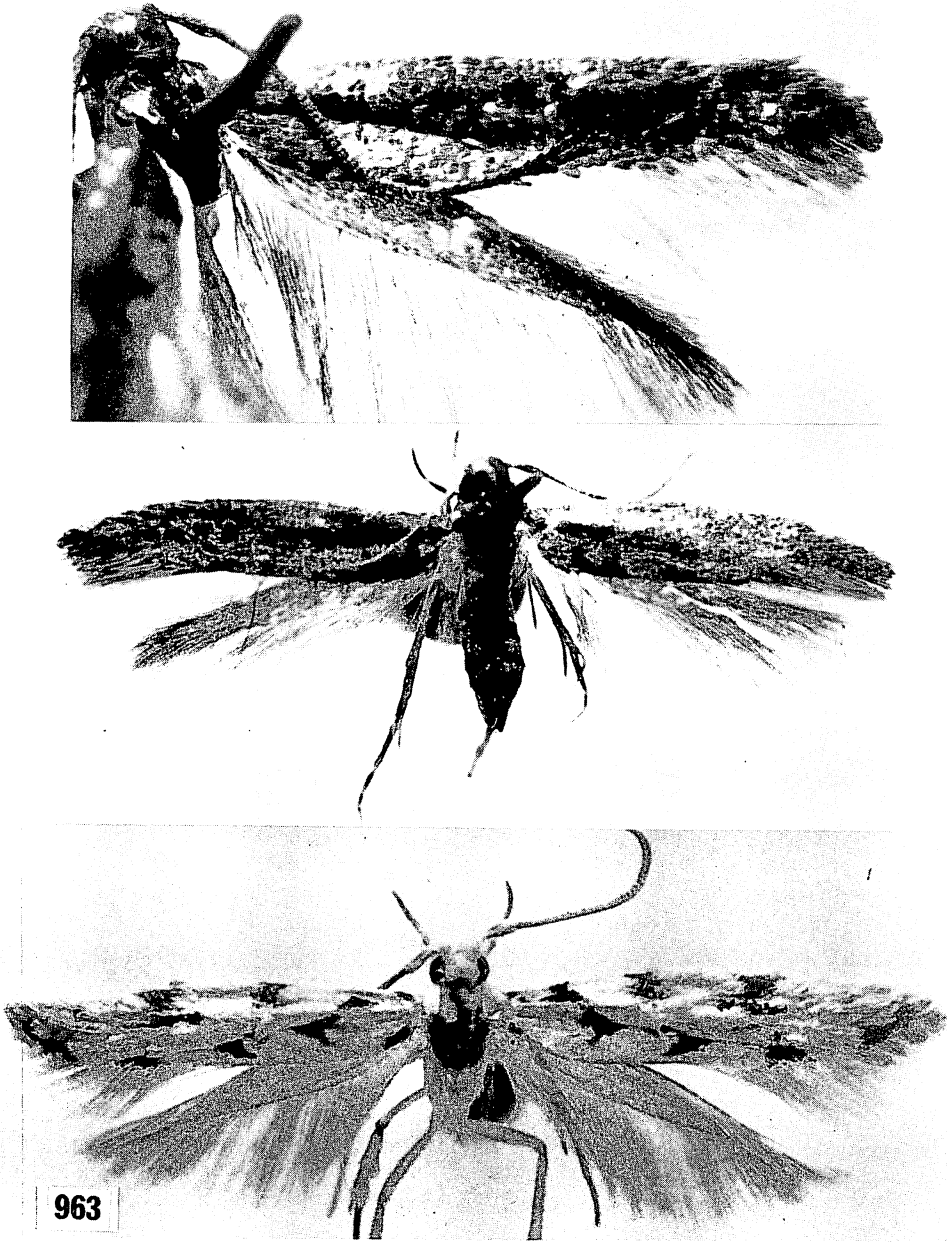


Figure 963—*Hyposmocoma*. Top, (*H. saccophora* Walsingham, allotype male (BM slide 4329); Waianae Mts., Oahu; forewing 3.25 mm., fuscous with a few small white and yellowish maculae. Middle, the same, holotype female (BM slide 14301); Mt. Kaala, 3,000 feet, Oahu; ex lichenivorous larva in case on rocks; expanse 8 mm. Bottom, (*E. sagittata* (Walsingham) ("*Aphthonetus*"<sup>3</sup>), holotype male (BM slide 4757); white, cream-colored, and green with prominent black maculae. There is a tuft of long hair from the posterior axil of each hindwing. The middle and bottom specimens are illustrated in *Fauna Hawaiiensis*.





Figure 964—*Hypsoscoma*. Top, (*H.*) *saliaris* Walsingham, allotype male (BM slide 4481); Kona, 4,000 feet; forewing 5 mm., white and fuscous. Middle, (*E.*) *scandens* Walsingham, holotype male (BM slide 4340); Kauai, 3,000 to 4,000 feet; expanse 16 mm.; forewings brown, white, and fuscous. Bottom, (*H.*) *scapulella* (Walsingham) ("*Rhinomactrum*"), holotype female (BM slide 5290); Olaa, Hawaii; forewing 4 mm., creamy white and dark fuscous.

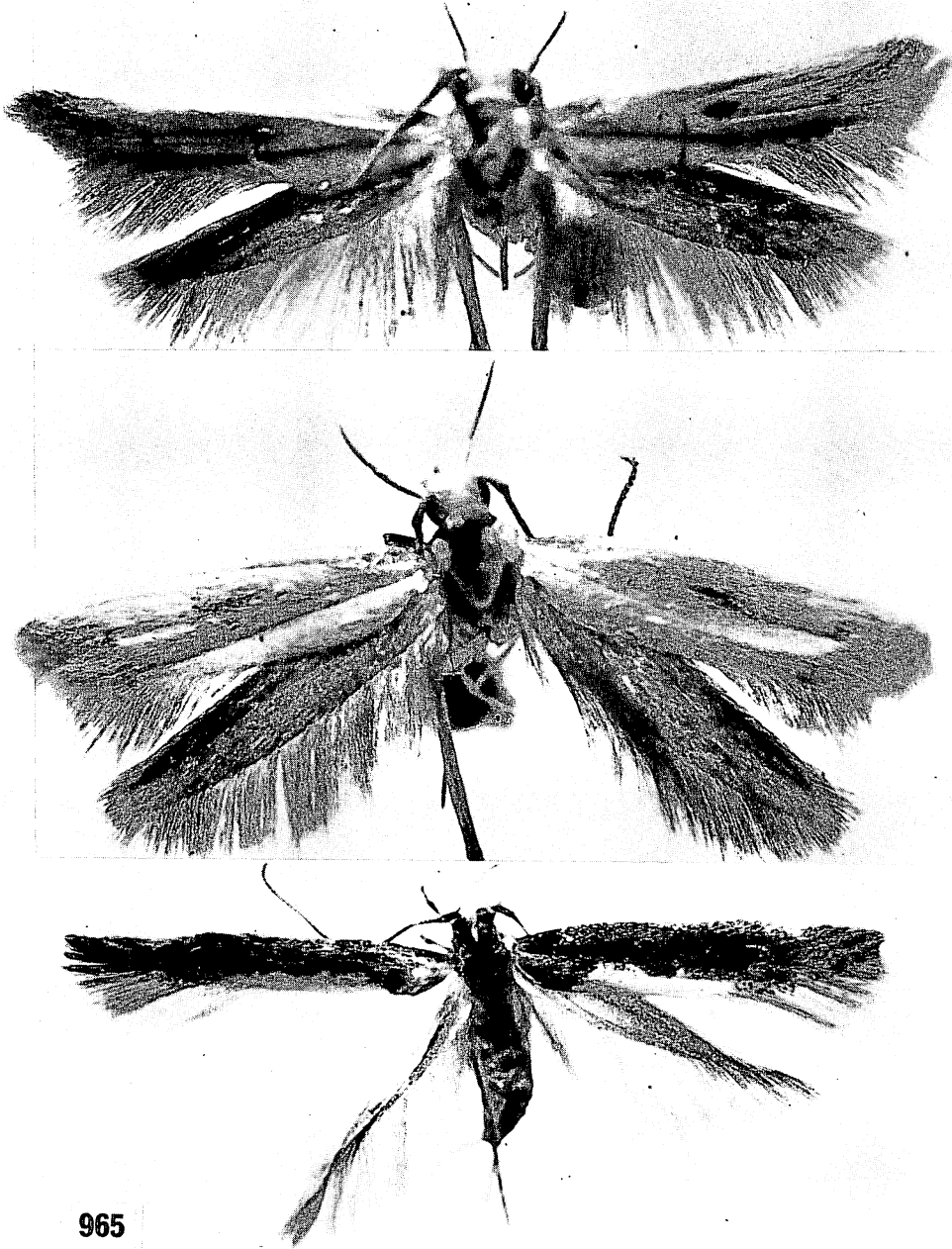


Figure 965—*Hypsmocoma*. Top, (*E.*) *scepticella* Walsingham, holotype male (BM slide 4142); Olinda, 4,000 feet, Maui; expanse 13.5 mm.; forewings yellow with fuscous maculae (this is a poor photograph which does not adequately portray this fine yellow species; compare the middle figure of the color form). There is a small tuft of long squamae on each metapleuron. Middle, the color form called *scepticella dubia* Walsingham, holotype male (BM slide 4143); Haleakala, 4,000 feet, Maui; expanse 13 mm.; forewings beautiful yellow with fuscous maculae. The metapleural tufts are similar to those of the typical form. Bottom, (*H.*) *schismatica* Walsingham, allotype female (slide not made); Kaholuamano, 4,000 feet, Kauai; expanse 13 mm.; forewings fuscous and creamy yellow. The top and middle specimens are illustrated in *Fauna Hawaiana*.

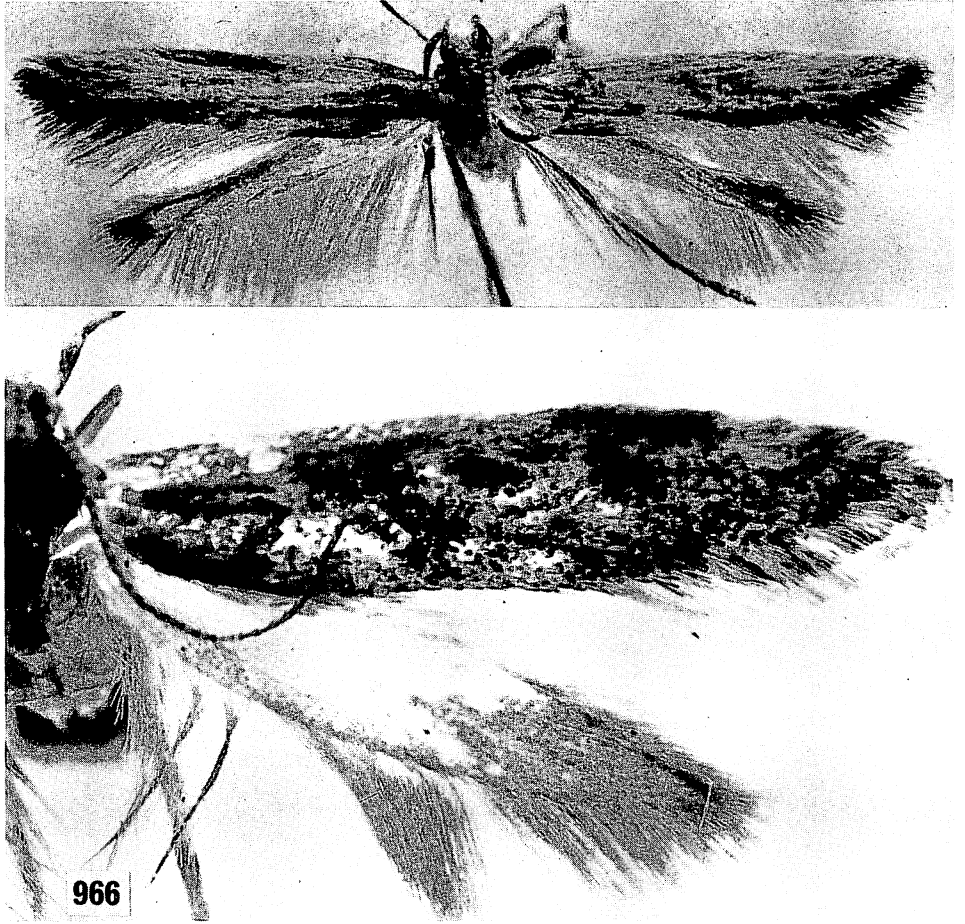


Figure 966—*Hypsmocoma*. Top, (*E.*) *sciurella* (Walsingham) ("*Neelaysia*"), holotype male (BM slide 4513); Olinda, 4,000 feet, Maui; expanse 10 mm.; forewings brownish orange with a fuscous macula on the fold. The metapleura are abraded on this specimen. Bottom, (*H.*) *scolopax* Walsingham, holotype male (BM slide 4489); Kauai, 3,000 to 4,000 feet; forewing 7 mm., white and fuscous. These specimens are illustrated in *Fauna Hawaiensis*.

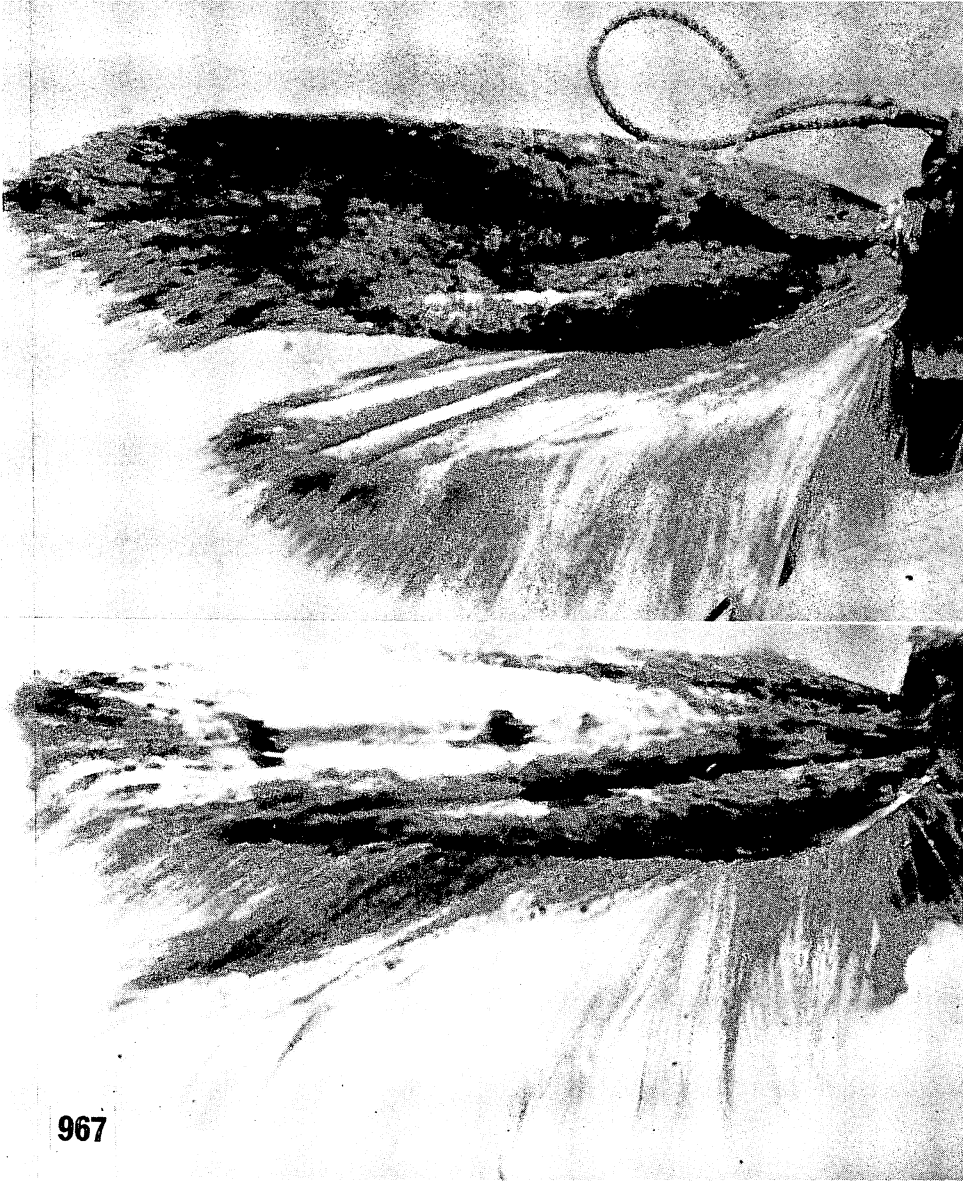


Figure 967—*Hypsomocoma*. Top, (*H.*) *semicolon* (Walsingham) ("*Dysphoria*"), holotype male (BM slide 4395); Kaholuamano, 4,000 feet, Kauai; forewing 9 mm., almost entirely brown. Bottom, (*E.*) *semifuscata* Walsingham, holotype male (BM slide 4140); Kona, 3,000 feet, Hawaii; forewing 6 mm., fuscous and white (the area that appears to be a reflection is made up mostly of pale scales). These specimens are figured in *Fauna Hawaiiensis*.

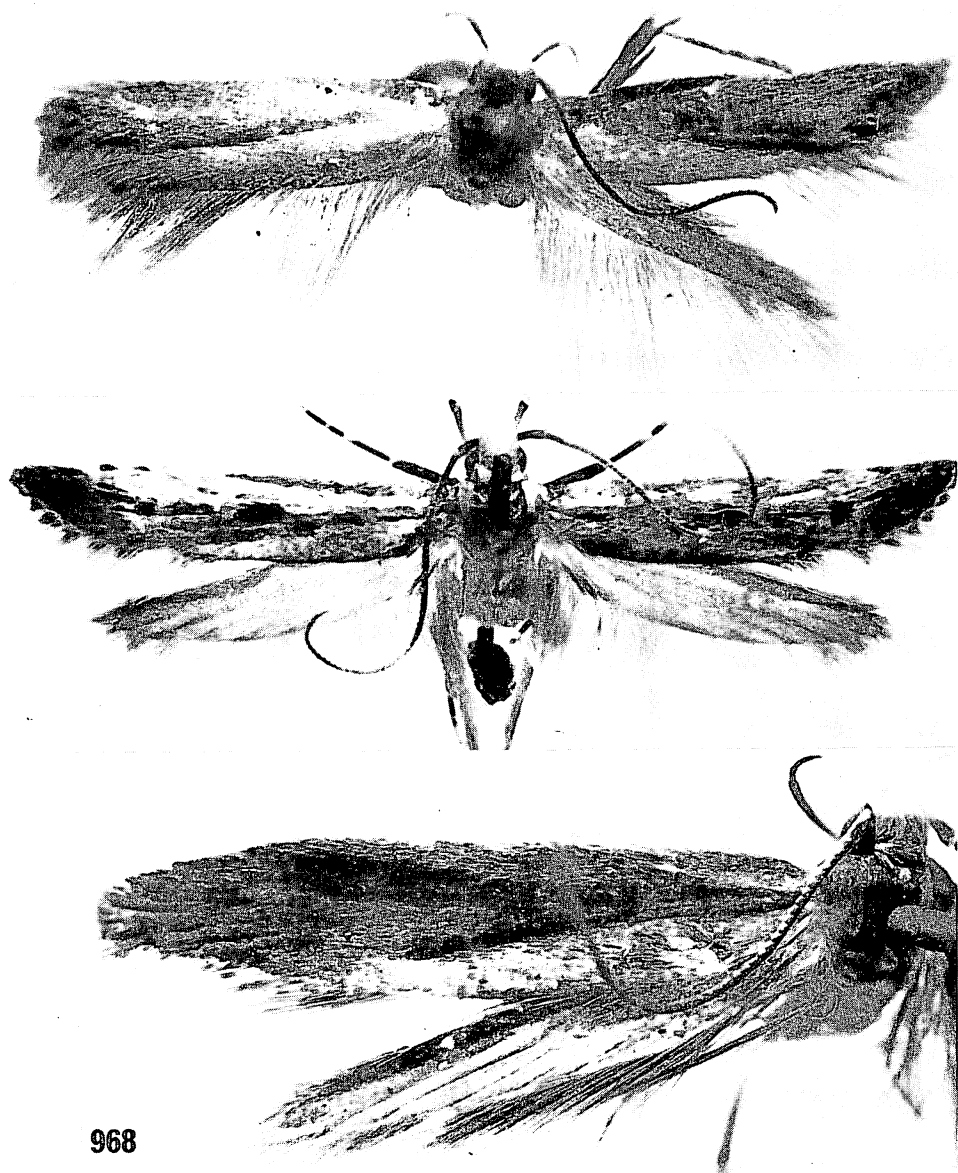


Figure 968—*Hyposmocoma*. Top, (*H.*) *semifusa* (Walsingham) ("*Neelysia*"), holotype female (BM slide 4469); Molokai, about 4,000 feet; expanse 9 mm., as set; forewings brownish or brownish orange shaded with fuscous. Middle, (*E.*) *semiustus* (Walsingham) ("*Hyperdasyella*"), holotype male (BM slide 4426); Kauai, 3,000 to 4,000 feet; expanse 18.5 mm.; forewings pale brownish with darker brown to fuscous maculae. The underside of the forewing has a prominent cluster of long, erectile hairs, some of which can be seen projecting from beneath the costa near basal third. Bottom, (*H.*) *sideritis* Walsingham, allotype male (BM slide 4338); Olinda, 4,000 feet, Maui; forewing 6 mm., all brown. The top and middle specimens are illustrated in *Fauna Hawaïiensis*.



Figure 969—*Hyposmocoma*. Top, (*E.*) *sideroxyloni* (Swezey) ("*Aphthonetus*"), holotype female; Puu Peahinaia, Koolau Mts., Oahu; forewing 6.5 mm., mostly dark brown with whitish ochreous and ochreous areas and maculae. Bottom, (*H.*) *similis* Walsingham, holotype male (BM slide 4355); Kona, 4,000 feet, Hawaii; forewing 6.5 mm., white and fuscous. This specimen is figured in *Fauna Hawaiiensis*.

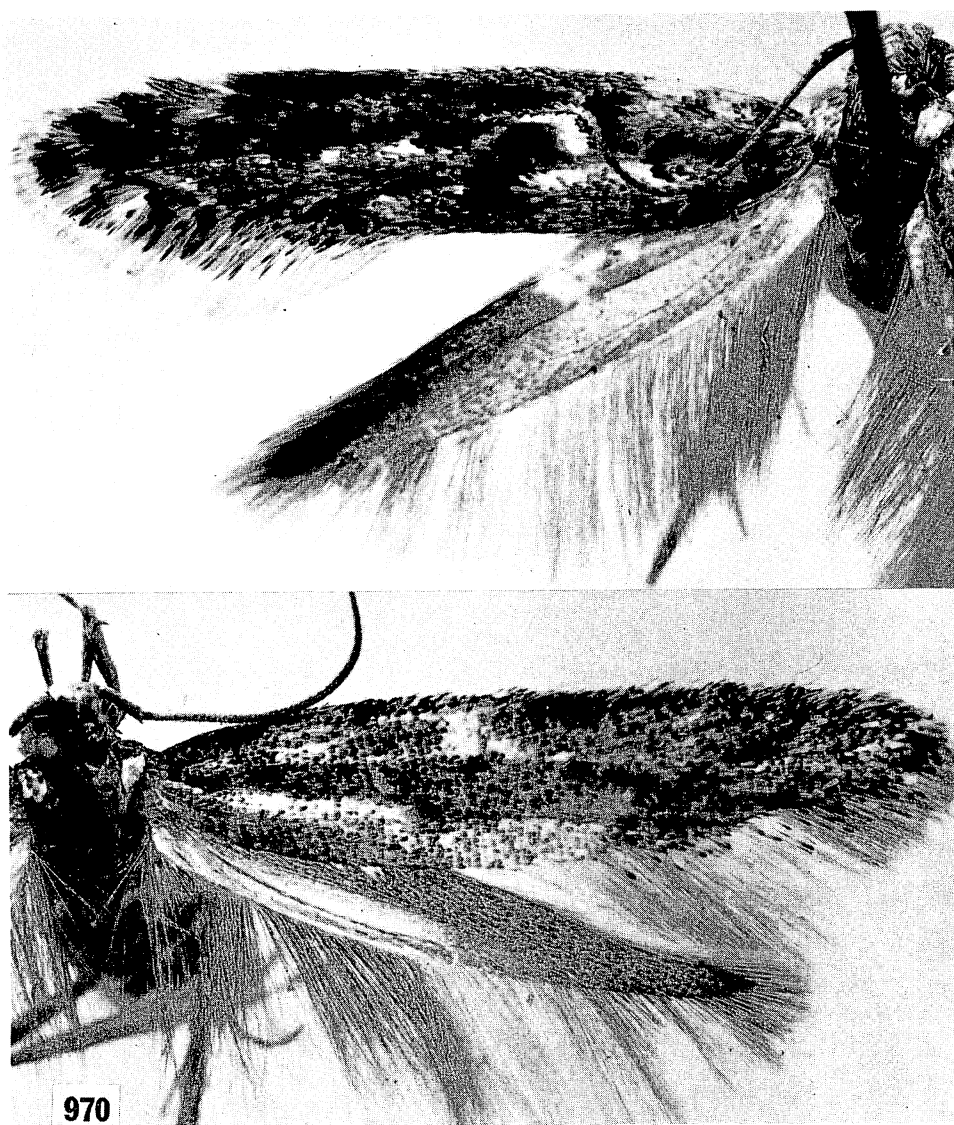
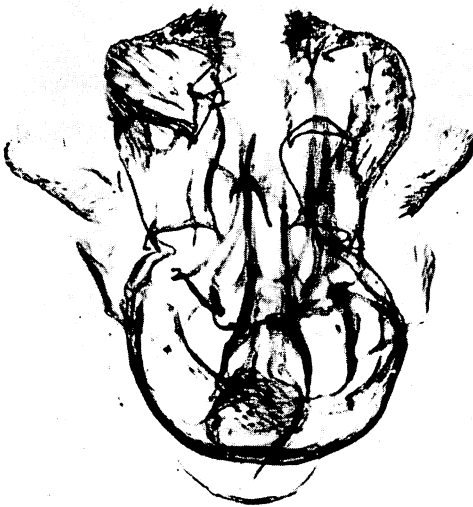
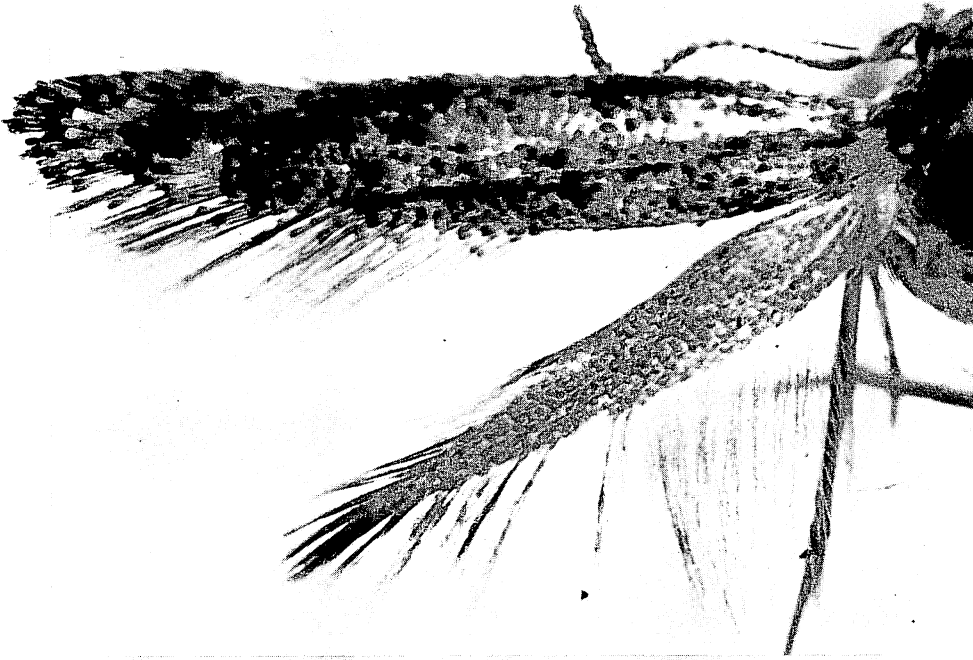


Figure 970—*Hypsoscoma*. Top, (*H.* *somatodes* Walsingham, holotype male (BM slide 5490); Kilauea, Hawaii; forewing 7 mm., white, yellowish, and fuscous (the white macula about a third of the distance from the base costad of the fold and in the curve of the antenna is a hole). There is a moderate metapleural tuft. This photograph is much too dark and does not show enough contrast in color; the background scaling is paler than is indicated here. Bottom, (*E.* *spurcata* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4747); Haleakala, 5,000 feet, Maui; forewing 7.5 mm., mixed white and fuscous. The metapleura bear feeble tufts of a few long hairs. These specimens are figured in *Fauna Hawaiensis*.





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E 232

Figure 971—*Hyposmocoma* (E.) *sordidella* (Walsingham). Top, holotype male (BM slide 5232), Kauai, 3,000 to 4,000 feet; forewing 4.5 mm., greyish white with pale and dark fuscous squamae (the pale area near the base of the forewing is a reflection, not pale scaling, and the two pale preapical fascia do not show clearly in this photograph). Below, male genitalia. Because of the convexity of the genitalia, not all of the parts are clearly defined, so that a misleading impression may be conveyed by this illustration. This specimen (BM slide 5232b) has been remounted; see figure 972. Compare the "*Aphthonetus*" *exsul* group of male genitalia.



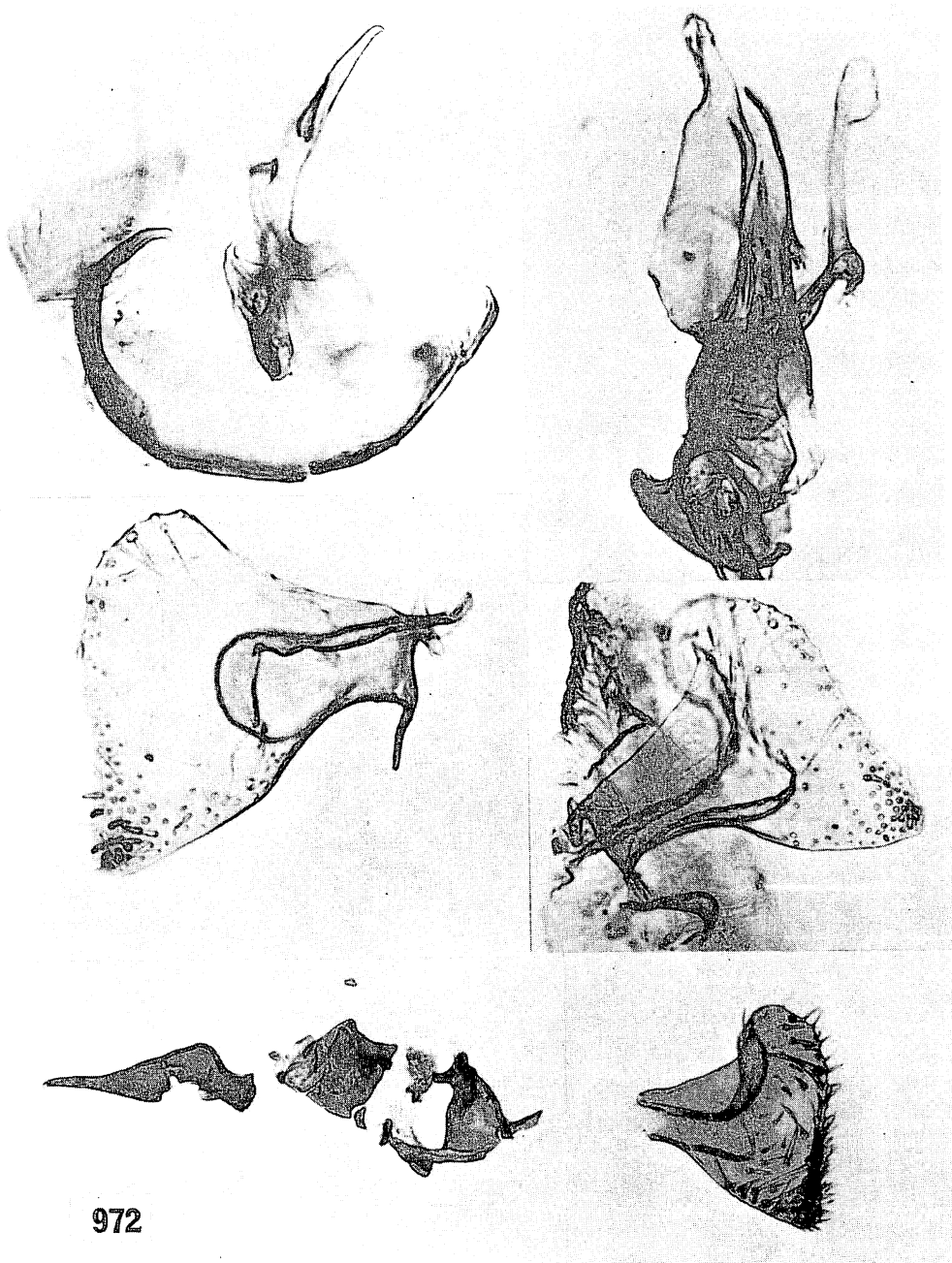


Figure 972—*Hypsmocoma* (*E.*) *sordidella* (Walsingham), male genitalia. Top and middle, holotype (BM slide 5232b); Kauai, 3,000 to 4,000 feet. Top left, tegumen and brachia from beneath. Top right, aedeagus and adhering anellar lobes. Middle left, right valva. Middle right, left valva and crushed genital flap. The bottom two figures are from the paratype (BM slide 7258) and show the tegumen, brachia, and a valva. The slide was crushed in shipment, and the parts were recovered from the fragments and remounted.

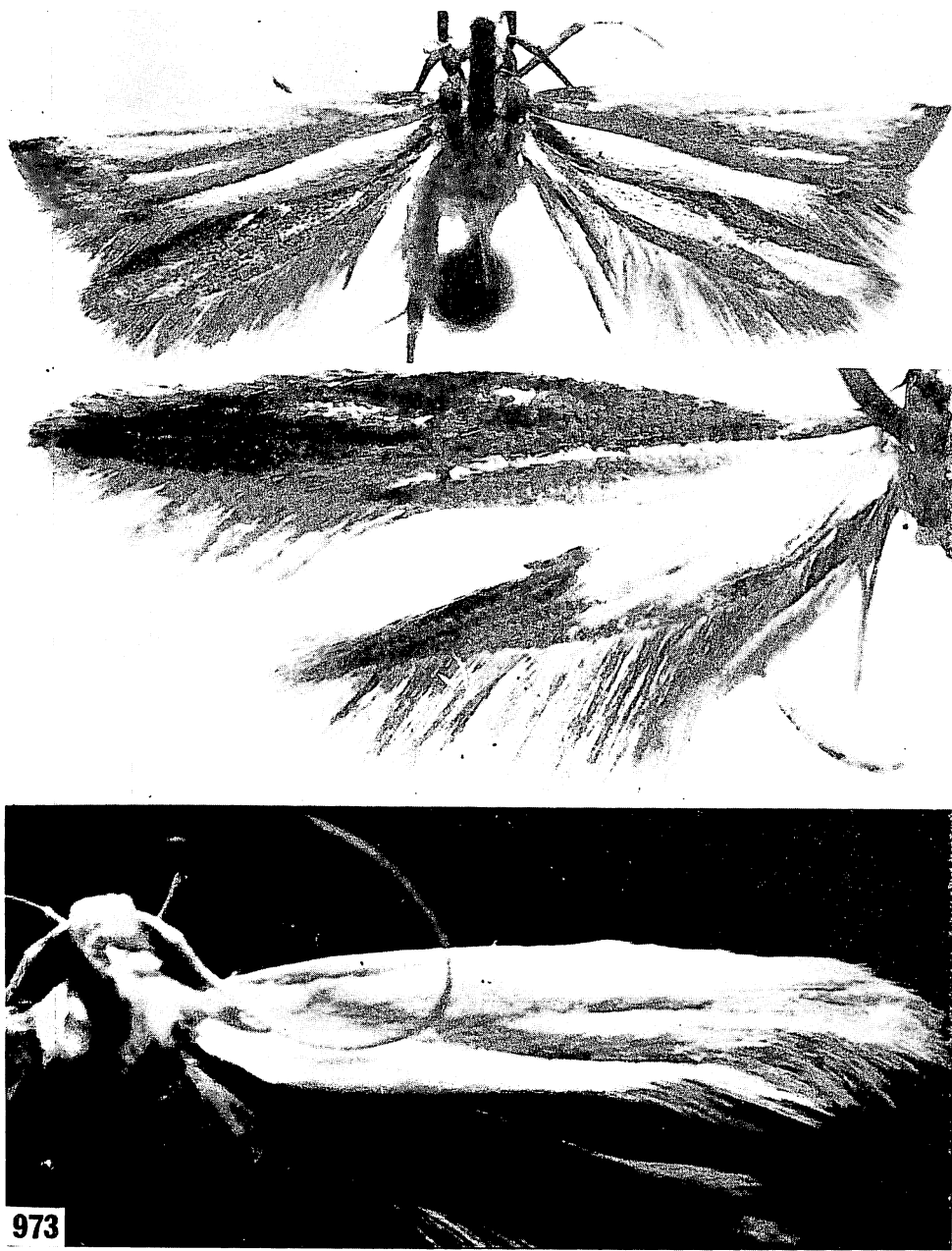


Figure 973—*Hypsmocoma*. Top, (*E.*) *stigmatella* Walsingham, allotype male (BM slide 4144); Molokai, about 4,500 feet; expanse 13 mm.; forewings yellow with fuscous maculae. Middle, (*H.*) *straminella* Walsingham, allotype male (BM slide 4115); Kona, 4,000 feet, Hawaii; forewing 6.5 mm., whitish with a dark medial vitta (this photograph gives a misleading impression because what appear to be a pale vitta along the fold and a pale vitta beyond the middle are actually reflections; the submedial pale macula is an abrasion). Note the heavy subcostal brush on the hindwing (mostly out of focus). Bottom, (*E.*) *subargentea* Walsingham, holotype male (BM slide 4150); Kauai, 3,000 to 4,000 feet; forewing 8 mm., mostly white. This specimen is illustrated in *Fauna Hawaiiensis*.

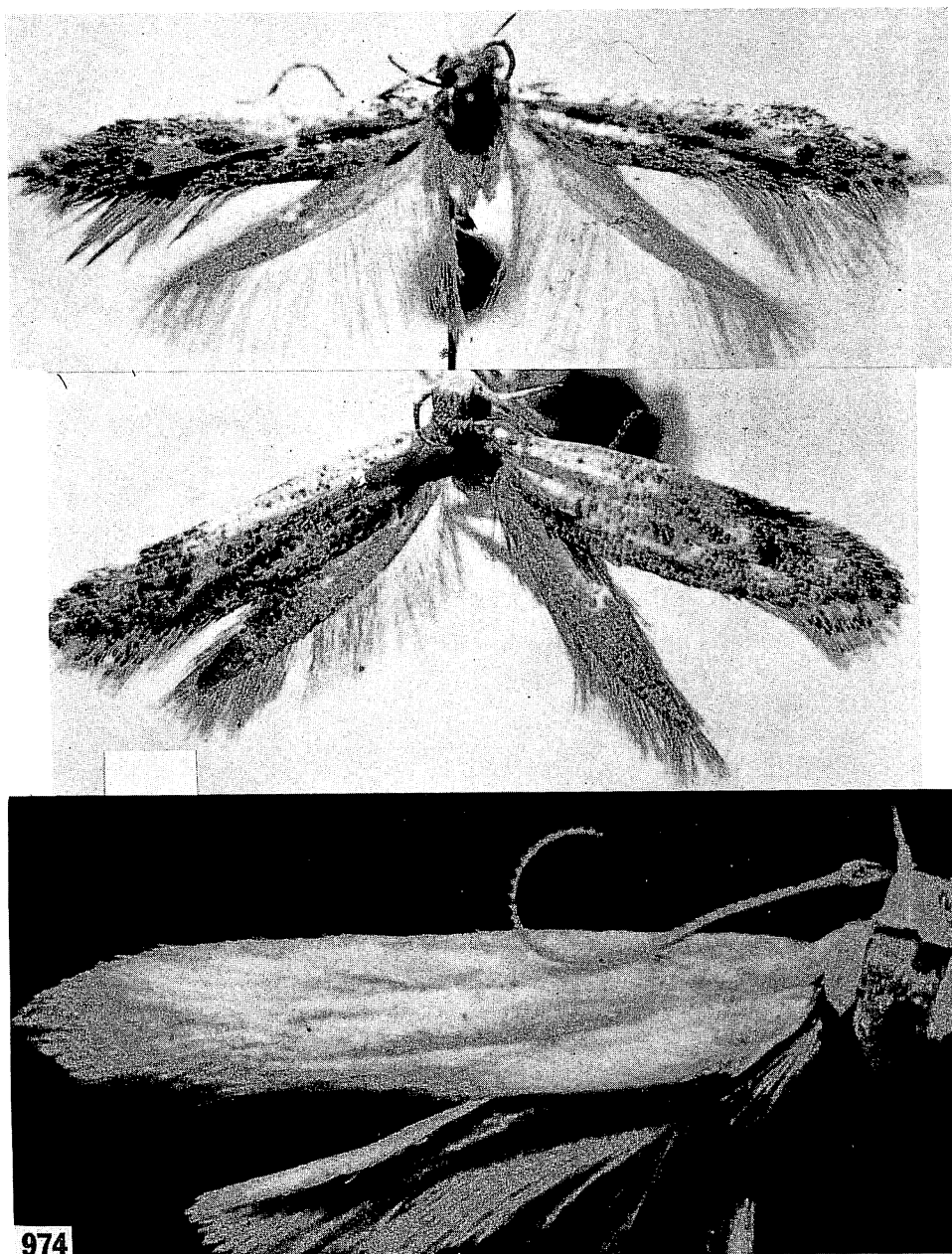
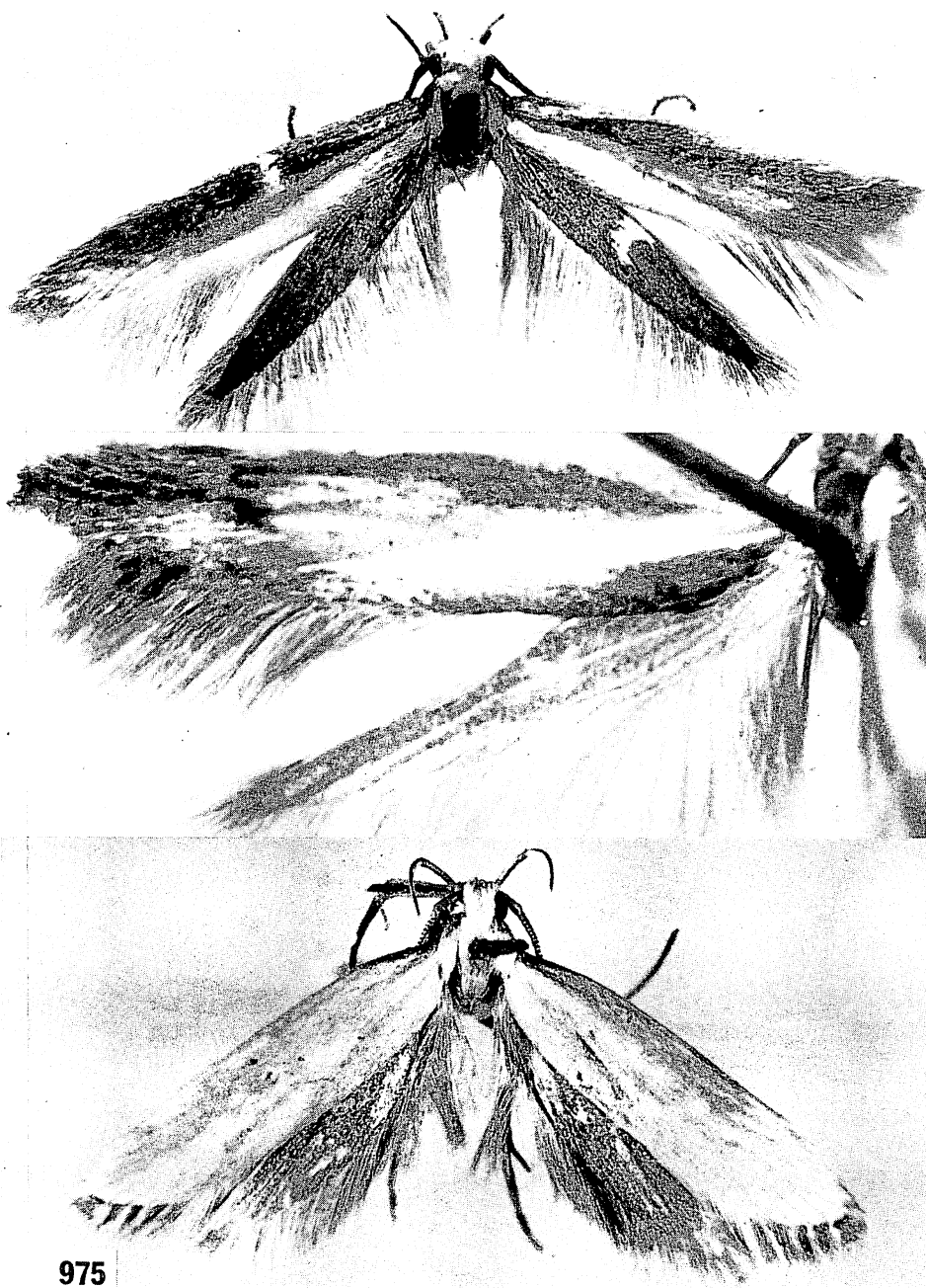


Figure 974—*Hypsmocoma*. Top, (*E.*) *subaurata* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4443); Kaholuamano, 4,000 feet, Kauai; expanse 12 mm.; forewings with yellow and fuscous squamae with white and fuscous maculae. Each metapleuron bears a strong, dark-tipped brush (the dark apex of the left one can be seen near the left coxa). Middle, (*H.*) *subcitrella* Walsingham, allotype male (BM slide 5231); Kaholuamano, 4,000 feet, Kauai; forewing 4.25 mm., white, cream-colored, and fuscous. This specimen was reared from the larval case shown in figure 801. Bottom, (*E.*) *subburnea* (Walsingham), holotype male (BM slide 4394); Molokai, about 4,000 feet; forewing 8.5 mm., creamy white with some small yellow and fuscous maculae. The top and bottom specimens are illustrated in *Fauna Hawaïensis*.



975

Figure 975—*Hyposmocoma*. Top, (*H.*) *subflavidella* Walsingham, holotype male (BM slide 4106); Haleakala, 5,000 feet, Maui; forewing 6 mm., anterior part brown or brownish fuscous, posterior part mostly straw-colored or cream-colored giving a strongly vittate appearance (the pale costal spot on the left forewing and the pale area near the middle of the hindwing are abrasions). Middle, (*E.*) *sublimata* Walsingham, holotype female (BM slide 4533); Haleakala, 5,000 feet, Maui; forewing 6.5 mm., mostly creamy white shaded on each edge with brown. Bottom, (*E.*) *subnitida* Walsingham, holotype male (BM slide 4502); Kilauea, Hawaii; forewing 9 mm., mostly yellow and straw-colored (compare the photograph of the color form in figure 946). The middle and bottom specimens are illustrated in *Fauna Hawaïensis*.

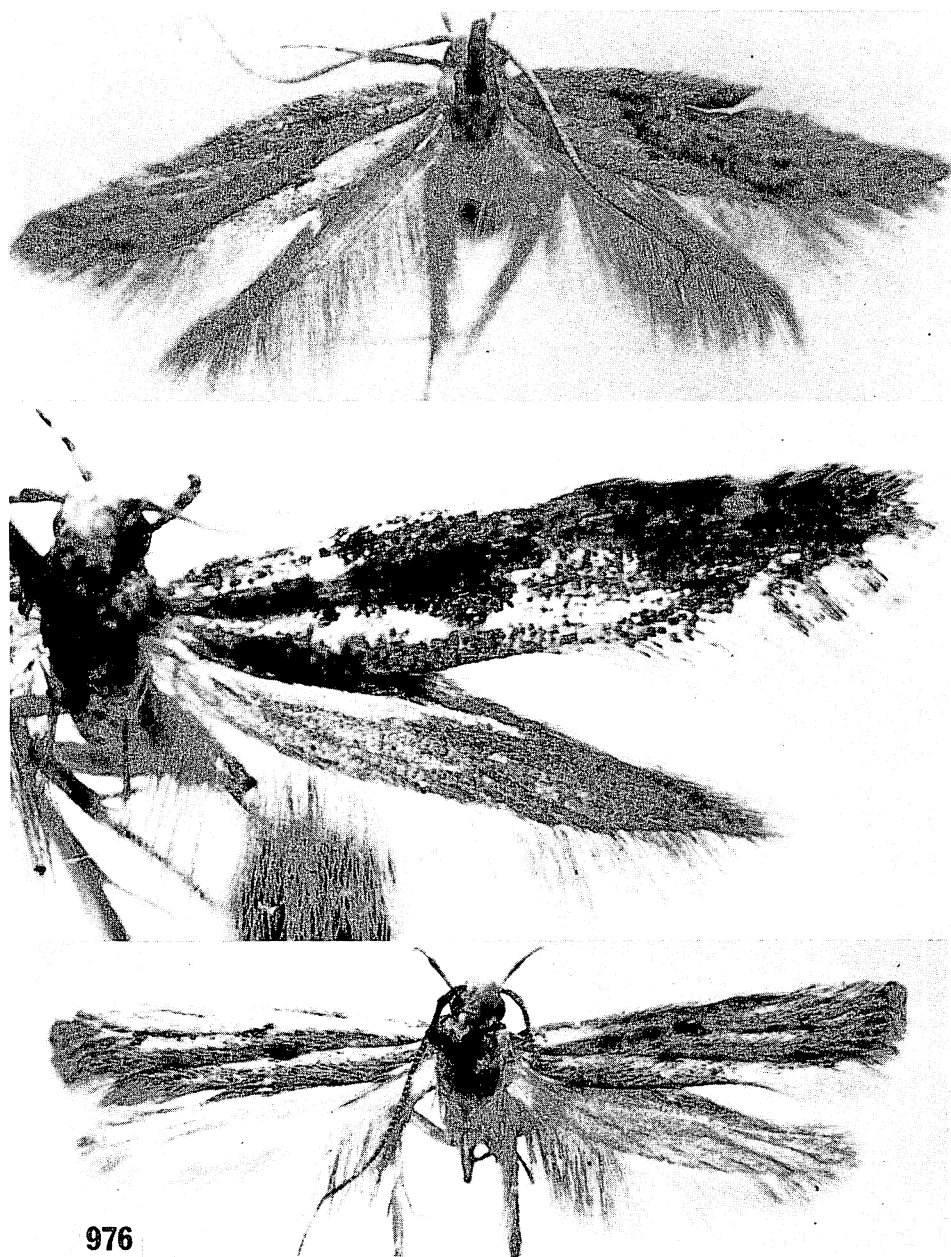
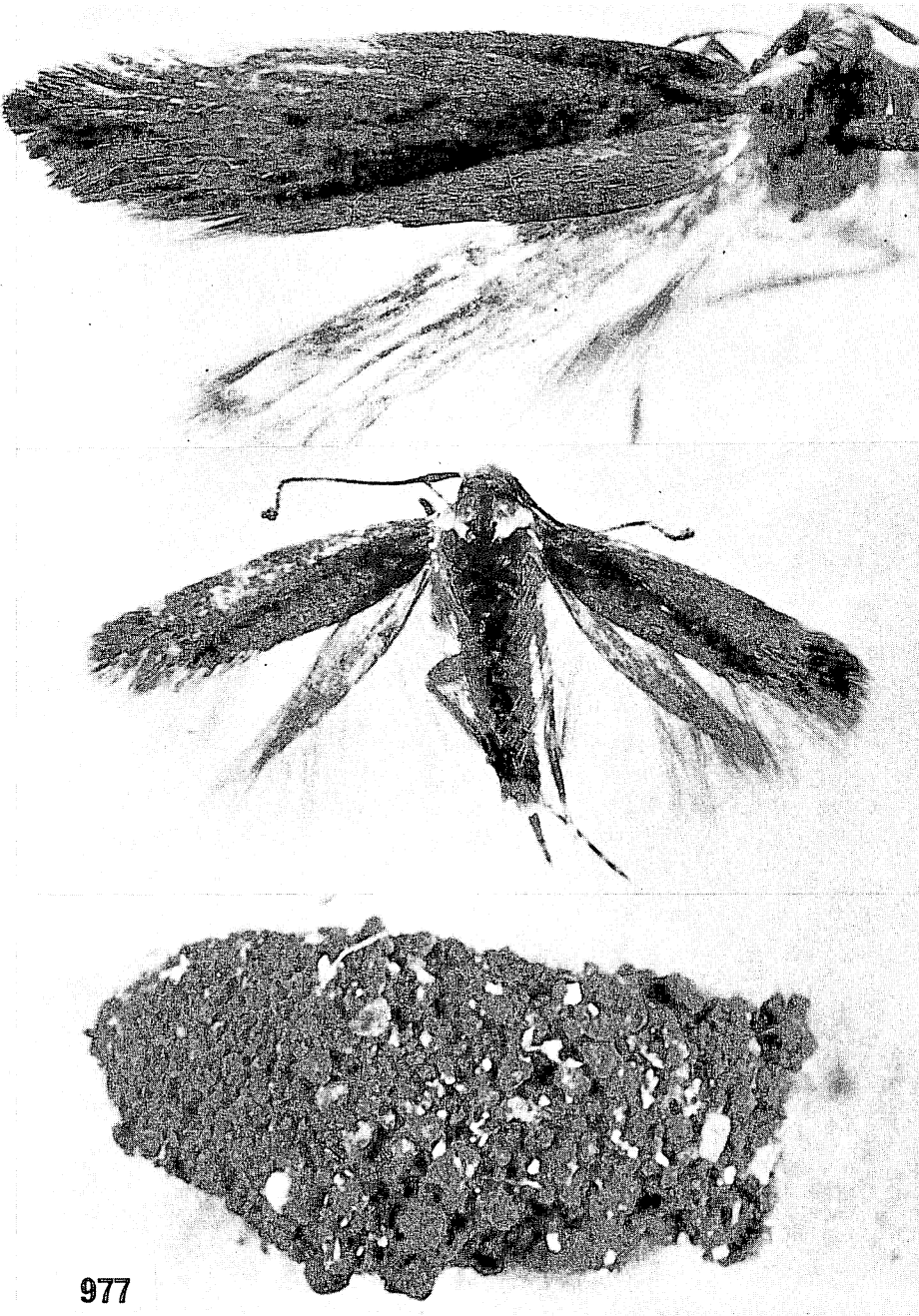


Figure 976—*Hyposmocoma*. Top, (*E.*) *subocellata* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4751); Haleakala, 5,000 feet, Maui; forewing 7.5 mm., with background scaling that generally has yellowish- or brownish-tipped white squamae but also has extensive areas of more yellow, brownish, and fuscous squamae. Middle, (*H.*) *subscolopax* Walsingham, holotype male (BM slide 5488); Kilauea, Hawaii; forewing 6.5 mm. (strongly curled on this specimen), white, yellowish, and fuscous. There is a small cluster of a few long scales on each metapleuron. Bottom, (*E.*) *subsericea* Walsingham, holotype male (BM slide 4345); Molokai, 4,000 feet; expanse 17 mm.; forewings straw-colored, yellow and fuscous. These three specimens are illustrated in *Fauna Hawaiiensis*.



977

Figure 977—*Hypsoscoma* (*Hypsoscoma*). Top, *sudorella* Walsingham, holotype male (BM slide 4335); Kauai, 3,000 to 4,000 feet; forewing 8 mm., almost entirely brown with a few scattered dark maculae. This specimen is illustrated in *Fauna Hawaïensis*. Middle, *swezeyi* (Busck) ("Petrochroa"), female; Kaimuki, Oahu; forewing 3.5 mm., fuscous with a pale subapical fascia. Bottom, the larval case from which the above specimen of *swezeyi* emerged; 4 mm. long; covered with red soil particles.





Figure 978—*Hypsmocoma* (*Hypsmocoma*). Top, *syrrhaptus* Walsingham, holotype male (BM slide 4347); Kauai, 3,000 to 4,000 feet; forewing 5.5 mm., yellow and fuscous. Bottom, *tarsimaculata* Walsingham, holotype male (BM slide 4356); Kauai, 3,000 to 4,000 feet; forewing 7 mm., white with black maculae; there is a small tuft on each metapleuron. These specimens are illustrated in *Fauna Hawaiiensis*.

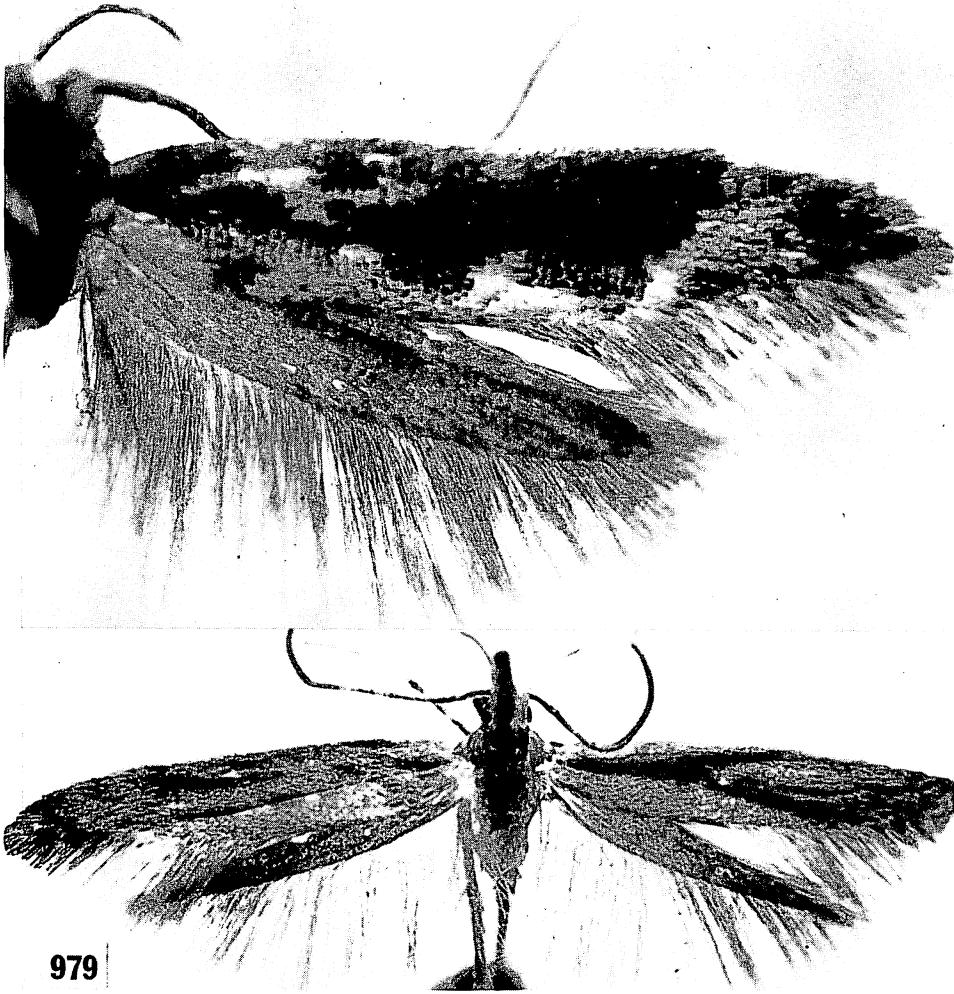


Figure 979—*Hyposmocoma*. Top, (*H.*) *tenuipalpis* Walsingham, holotype male (BM slide 4085); above Pelekunu, Molokai; forewing 7.5 mm., fuscous and white with some yellow squamae. Bottom, (*E.*) *terminella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4449); Haleakala, 5,000 feet, Maui; expanse 11 mm., forewings dark brown flecked with yellow. These two specimens are illustrated in *Fauna Hawiienis*.





Figure 980—*Hypsmocoma*. Top, (*H.*) *tetraonella* Walsingham, holotype male (BM slide 5489); Kona, 4,000 feet, Hawaii; forewing 5 mm., white, yellowish, and fuscous (the photograph is too dark, and the pale costal area at about the basal third is an abrasion). This specimen is illustrated in *Fauna Hawaiiensis*. Middle, (*E.*) *thermoxyla* Meyrick, lectotype male (BM slide 9567 Clarke); Koolau Mts., near Honolulu; expanse 16 mm.; forewings brown to purplish brown. Bottom, (*H.*) *thialma* Meyrick, holotype female (abdomen lost); Olinda, Maui; forewing 5.25 mm., brownish fuscous with a broad cream-colored, yellow, and white vitta from base to apex.

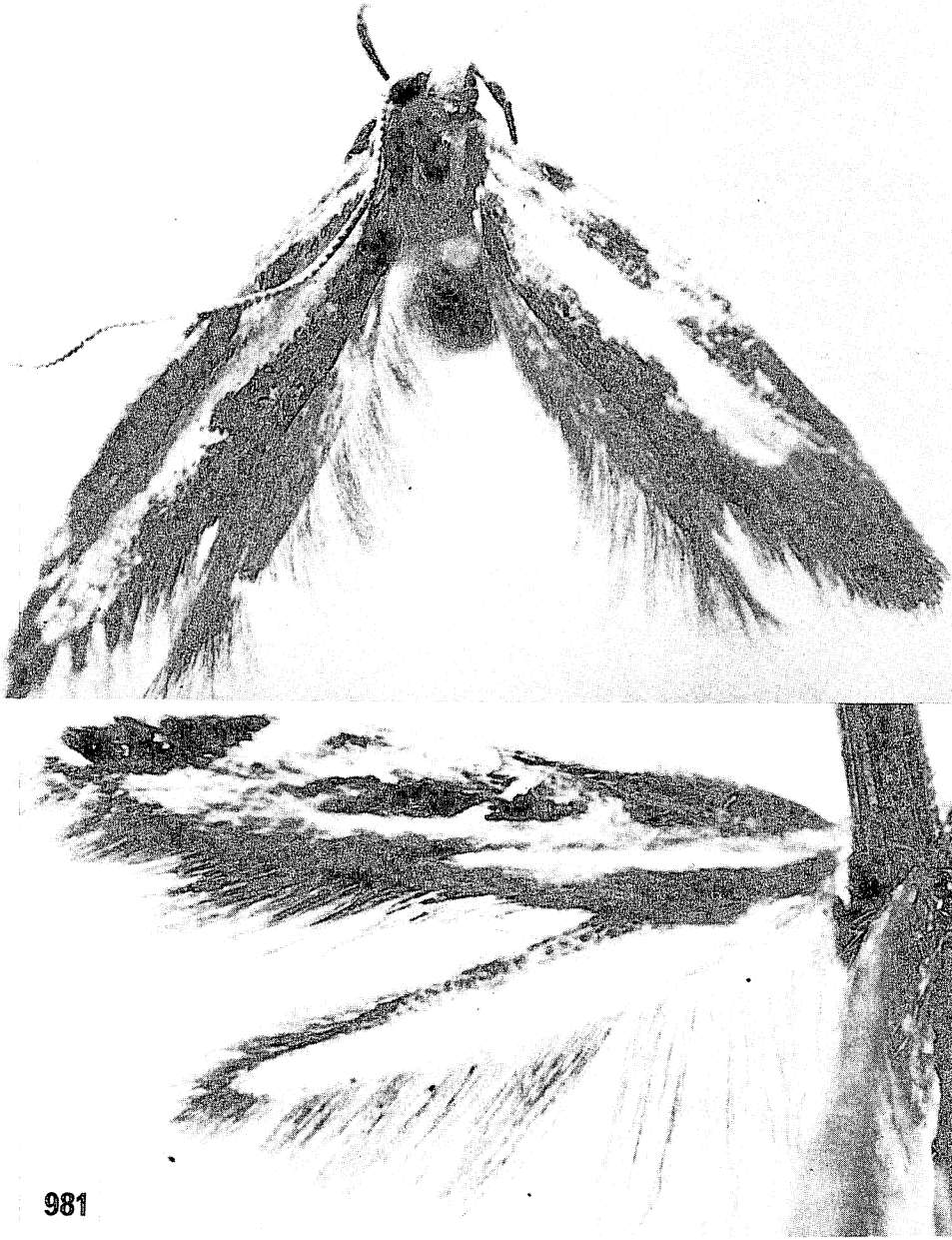


Figure 981—*Hypsocoma*. Top, (*H.*) *thoracella* Walsingham, holotype male (BM slide 4104); Lanai, 2,000 feet; forewing 6 mm., bronzy brown and white. Bottom, (*E.*) *tigrina* (Butler) ("*Neelysia*"), holotype male (BM slide 4434); Haleakala, Maui; forewing 4.5 mm., mostly yellow with fuscous maculae and a white vitta along the fold. These specimens are illustrated in *Fauna Hawaiiensis*.

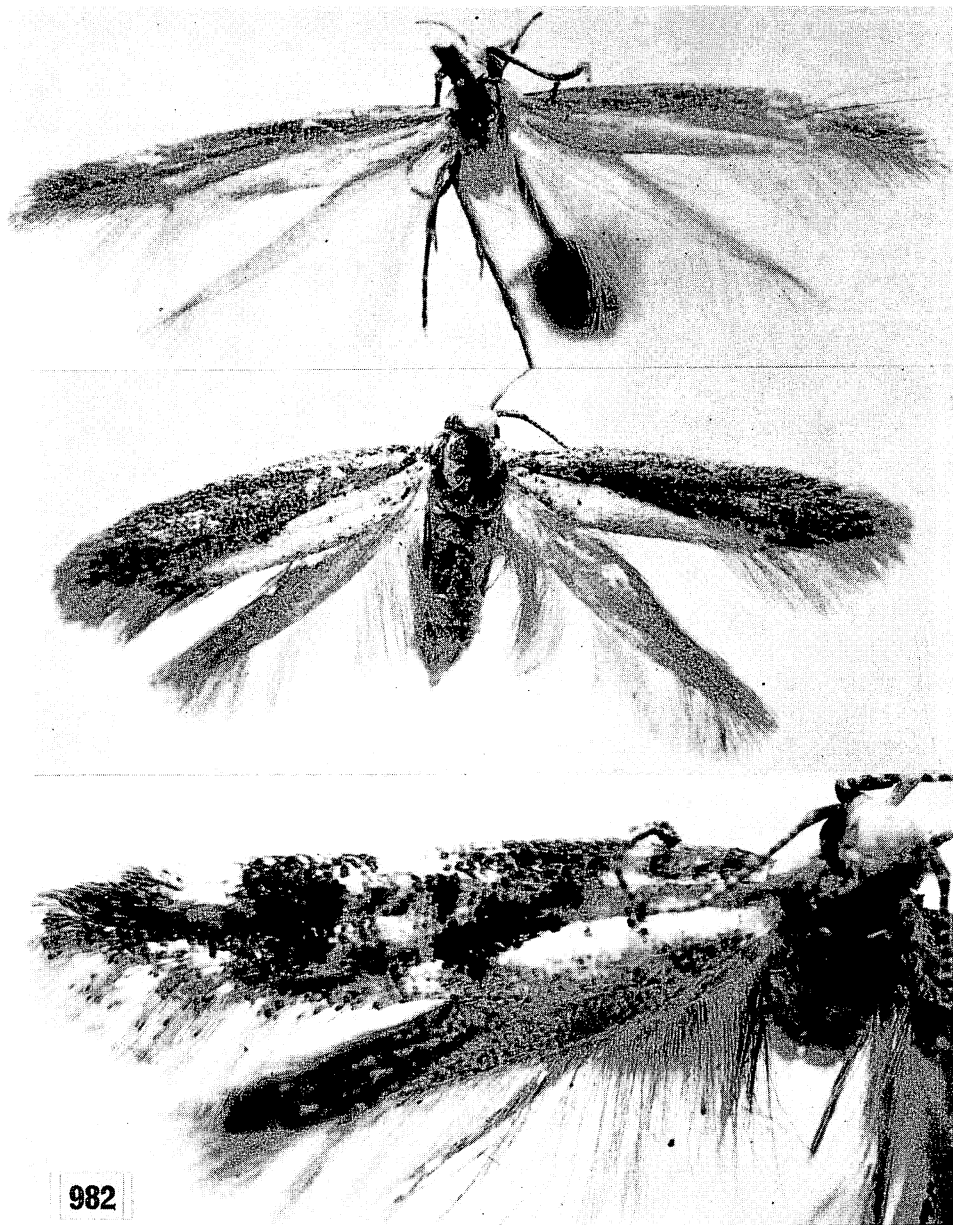
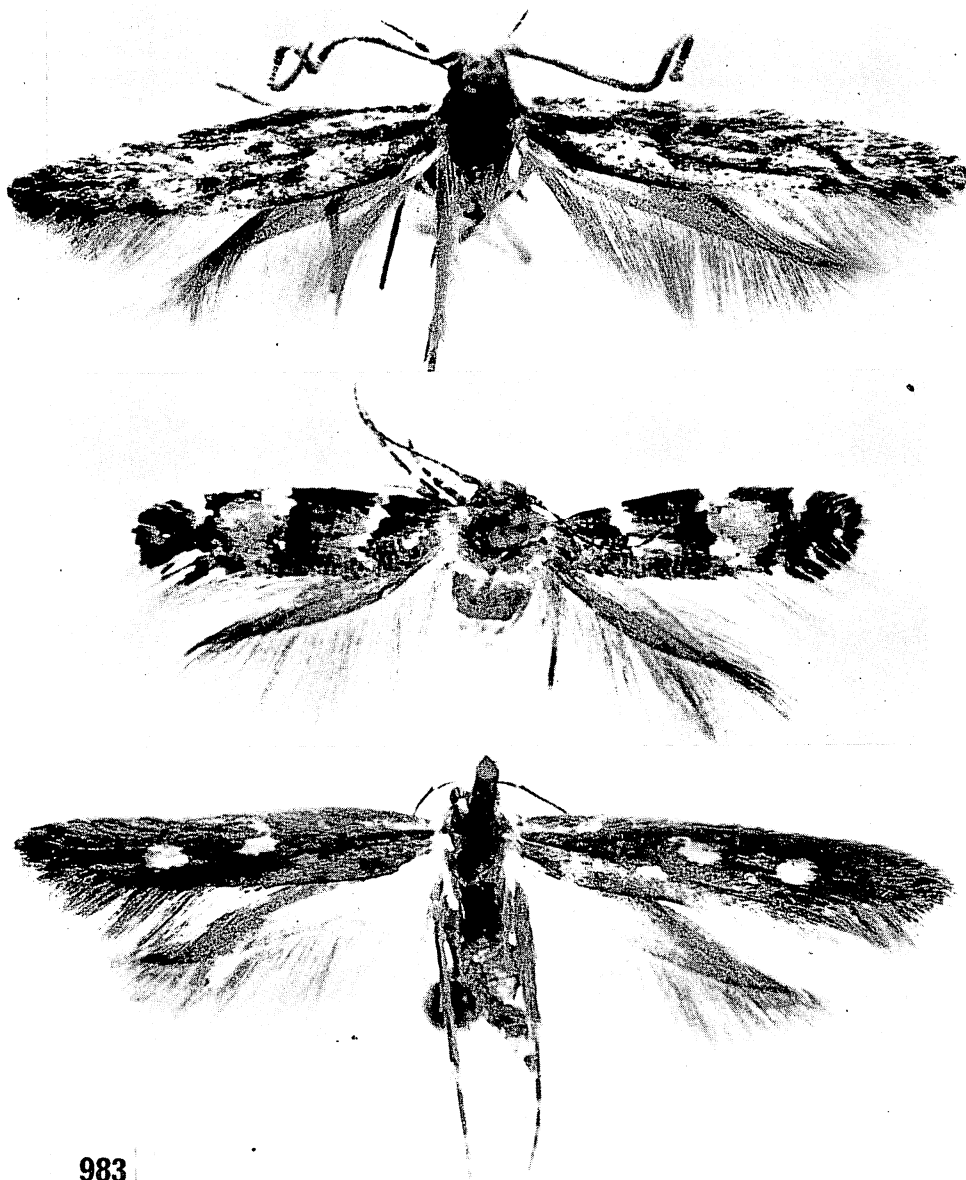


Figure 982—*Hyposmocoma*. Top, (*E.*) *tischeriella* (Walsingham) ("*Neelysia*"), holotype male (BM slide 4458); Kaholuamano, 4,000 feet, Kauai; expanse 11 mm.; forewings mostly orange (the photograph is inadequate). There is a brush from the posterior axil of each hindwing and another on each metapleuron beneath the anterior corner of the hindwing base. Middle, (*H.*) *tomentosa* Walsingham, holotype female (BM slide 7068); Kona, 3,000 feet, Hawaii; expanse 13.5 mm.; forewings white and fuscous. Bottom, (*H.*) *torella* Walsingham, holotype male (BM slide 4485); Molokai; forewing 5.5 mm., white, yellow, and fuscous. These specimens are illustrated in *Fauna Hawaiensis*.



983

Figure 983—*Hyposmocoma*. Top, (*E.*) *trichophora* (Walsingham) ("*Aphthonetus*"), holotype male (BM slide 4749); Kauai, 3,000 to 4,000 feet; expanse 12 mm.; forewings have white, yellowish, brownish, and fuscous scaling and maculae. Middle, (*H.*) *trifasciata* (Swezey) ("*Petrochroa*"), holotype female (abdomen lost); Laupahoehoe, Hawaii; ex larval case found on a rock; forewing 2.5 mm., with an unusual pattern: black with grey and fuscous at base and with white fasciae, the first of which is followed by an orange area and the second by a larger orange area. Bottom, (*E.*) *trilunella* Walsingham, holotype female (slide not made); Haleakala, 5,000 feet, Maui; expanse 16 mm., forewings fuscous with white maculae. The top and bottom specimens were illustrated in *Fauna Hawaïensis*.

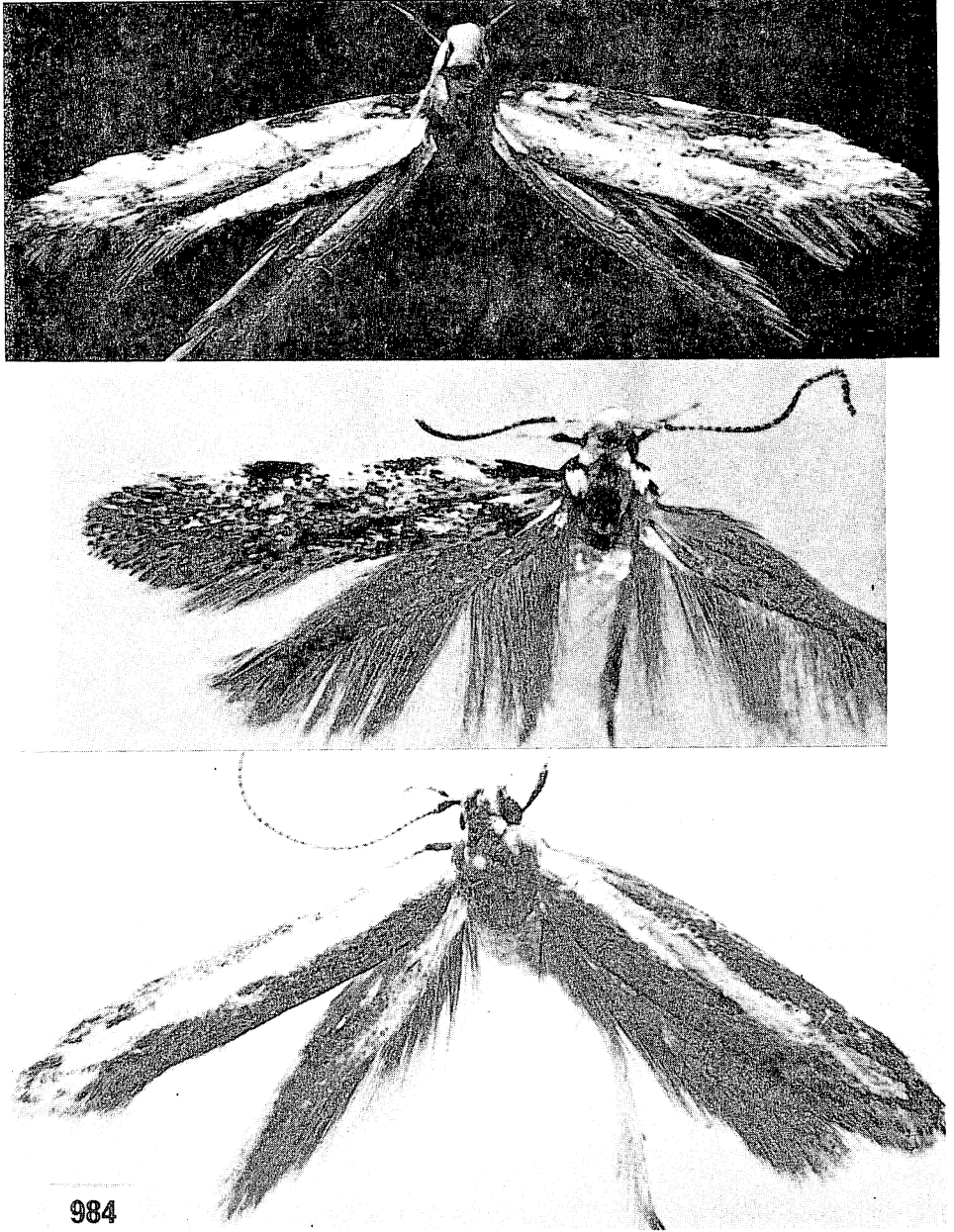


Figure 984—*Hyposmocoma* (*Hyposmocoma*). Top, *trimaculata* Walsingham, holotype male (BM slide 4320); Waianae Mts., 2,000 feet, Oahu; expanse 10 mm.; forewings almost white with brown and fuscous maculae. Middle, *trimelanota* Meyrick, holotype male; Kilauea, Hawaii; forewing 5 mm., white sprinkled with dark brown and fuscous scaling and maculae and with three dark costal maculae. Bottom, *tripartita* Walsingham, holotype male (BM slide 4103); Molokai, 4,000 feet; forewing 6.5 mm., brown and white. The top and bottom specimens are figured in *Fauna Hawaiiensis*.

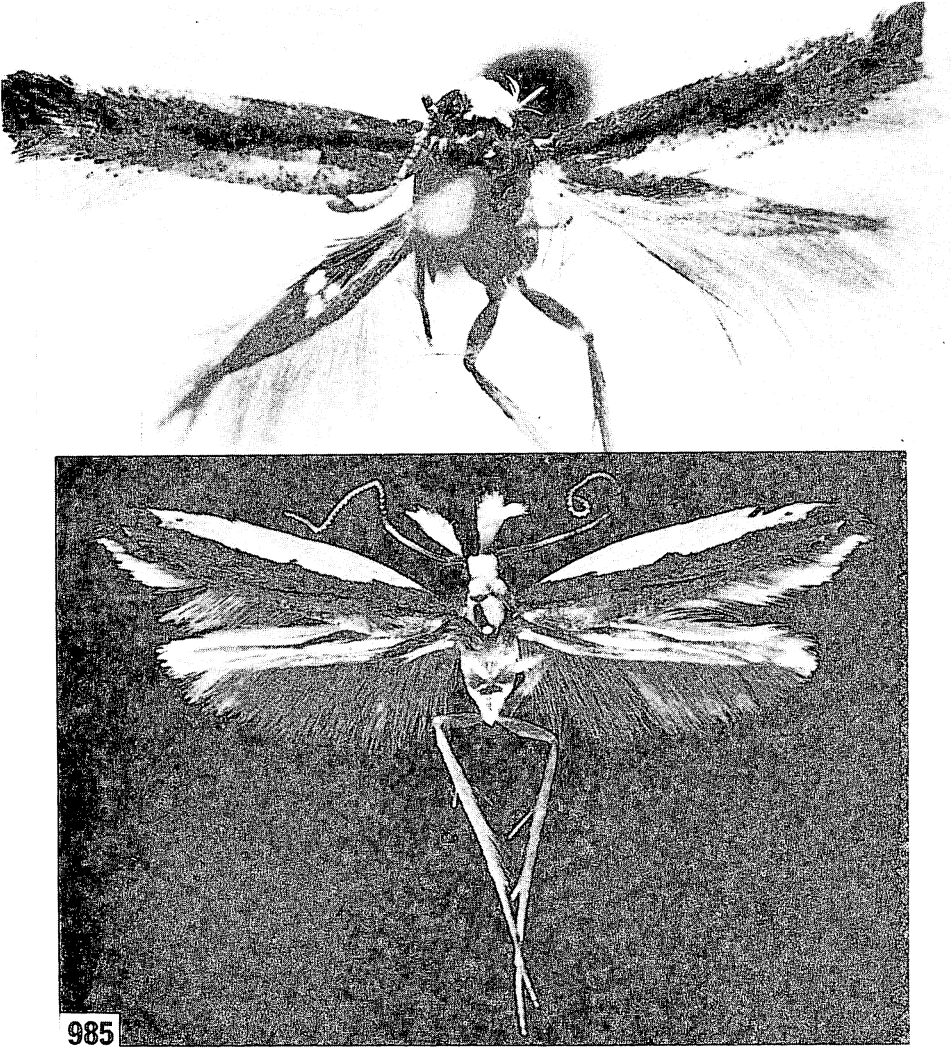


Figure 985—*Hypsomocoma*. Top, (*H.*) *triptila* Meyrick, lectotype male (BM slide 9577 Clarke); Koolau Mts., Oahu; expanse 12.5 mm.; forewings brown and white with fuscous maculae. Note the subcostal brush on the left hindwing. Bottom, (*E.*) *trivittella* (Swezey) ("*Euhypsomocoma*"), lectotype (here designated; (an abdomen is glued to the mount; no slide made); near Lihue, Kauai; forewing 7 mm., with three vittae: the costal one is white, the submedial one is pale brown, and the posterior one is pinkish. Note the large labial palpal brushes. This is a beautiful species.

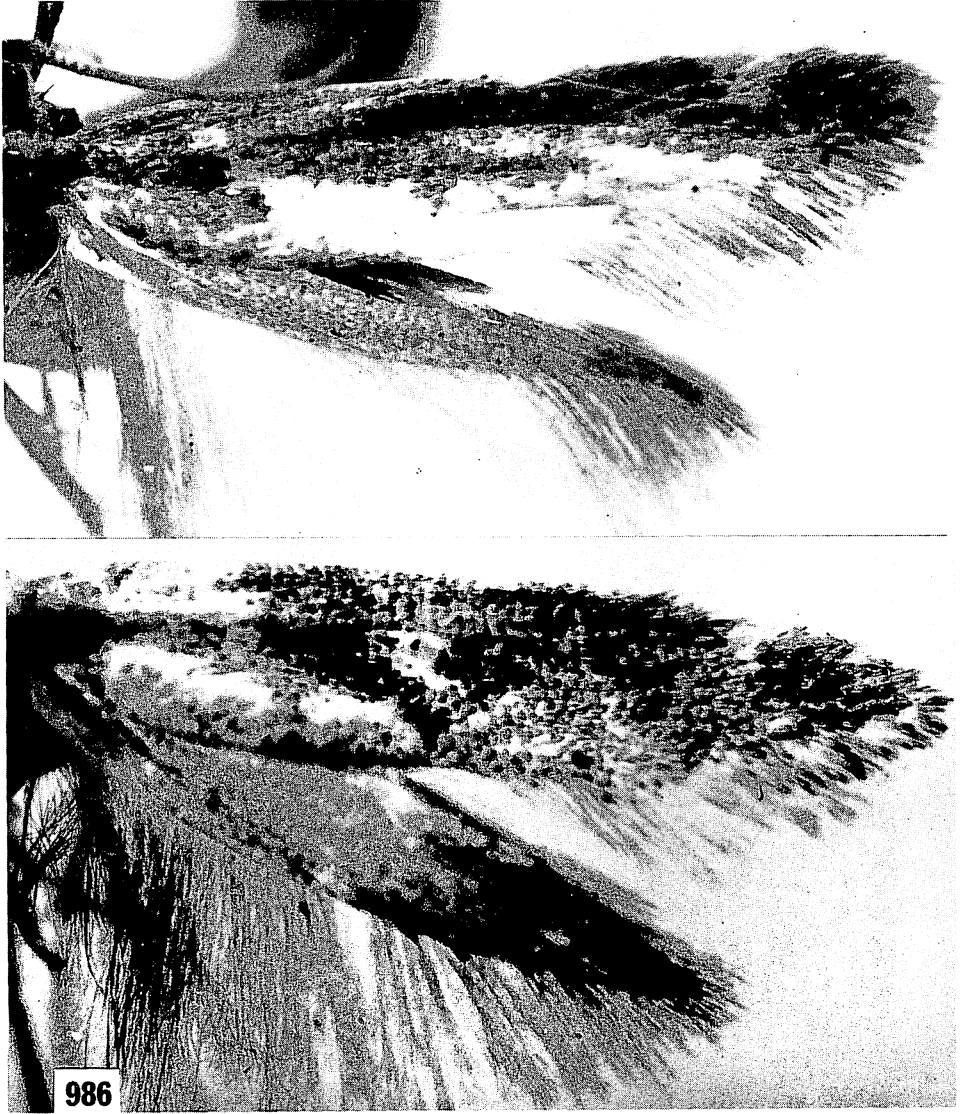


Figure 986—*Hypsmocoma* (*Hypsmocoma*). Top, *trossulella* Walsingham, holotype male (BM slide 4090); Waianae Mts., about 2,000 feet, Oahu; forewing about 5 mm., white or cream-colored and fuscous. This specimen is illustrated in *Fauna Hawaiiensis*. Bottom, *turdella* Walsingham, allotype female (BM slide 4491); Lanai, 2,000 feet; forewing 5.5 mm., white and pale brown to fuscous (the pale spot near the middle of the forewing is an abrasion).



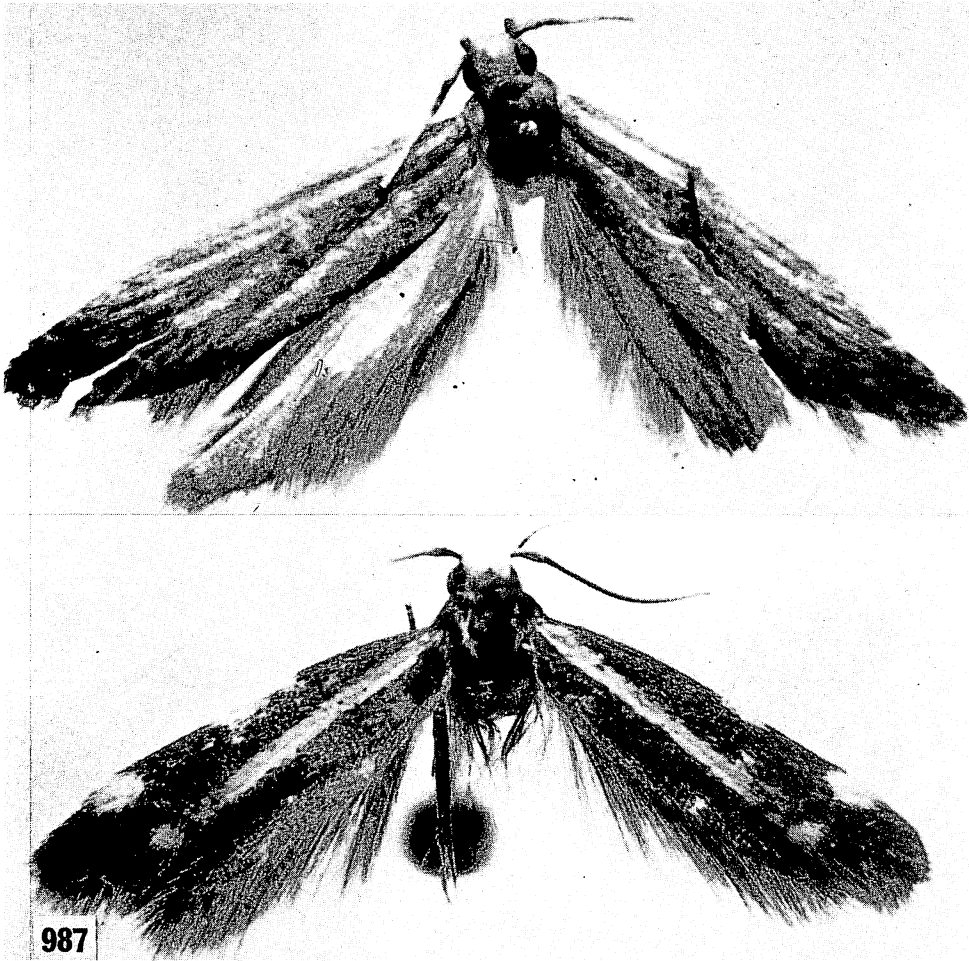


Figure 987—*Hyposmocoma*. Top, (*E.*) *unicolor* (Walsingham) ("*Hyperdasysella*"), holotype male (BM slide 4425); Molokai, above 4,500 feet; forewing 9.5 mm., reddish brown with some small dark maculae. Bottom, (*H.*) *unistriata* Walsingham, holotype male (BM slide 4120); above Pelekunu, Molokai; forewing 6 mm., fuscous and white. This specimen is illustrated in *Fauna Hawaiiensis*.



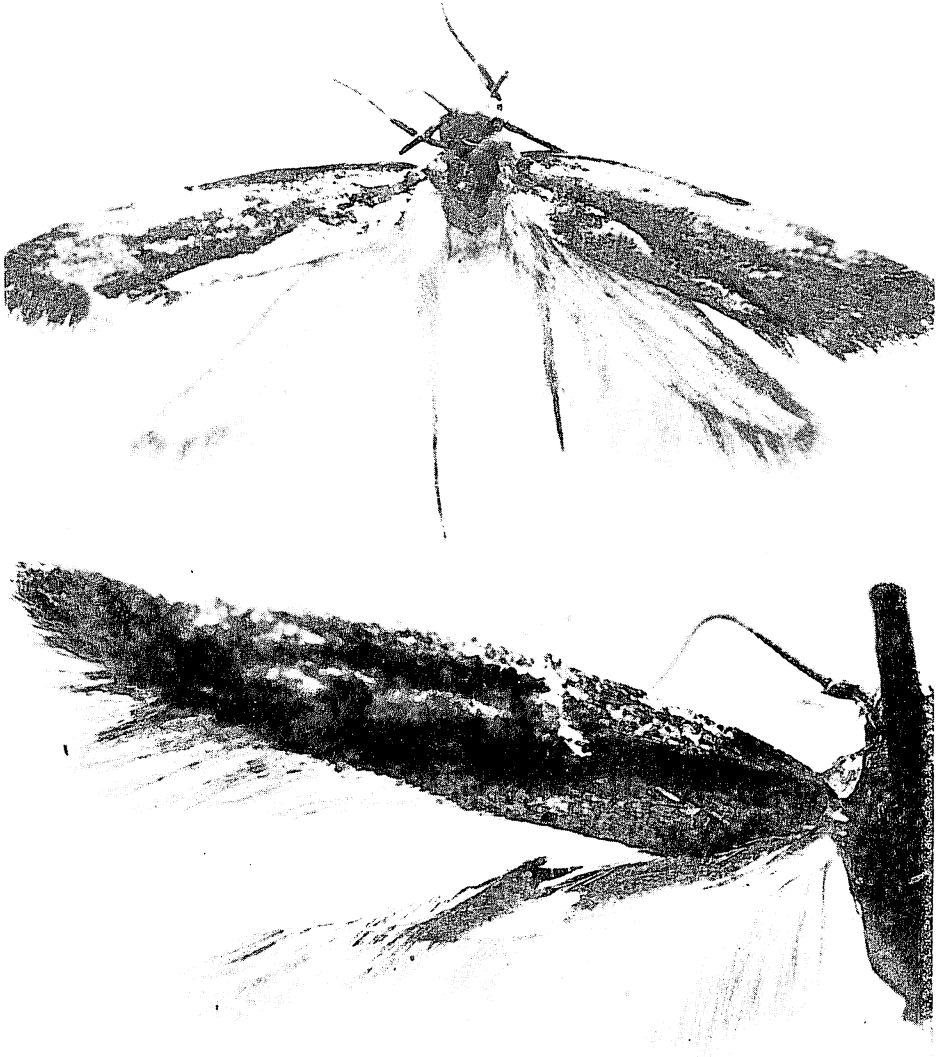
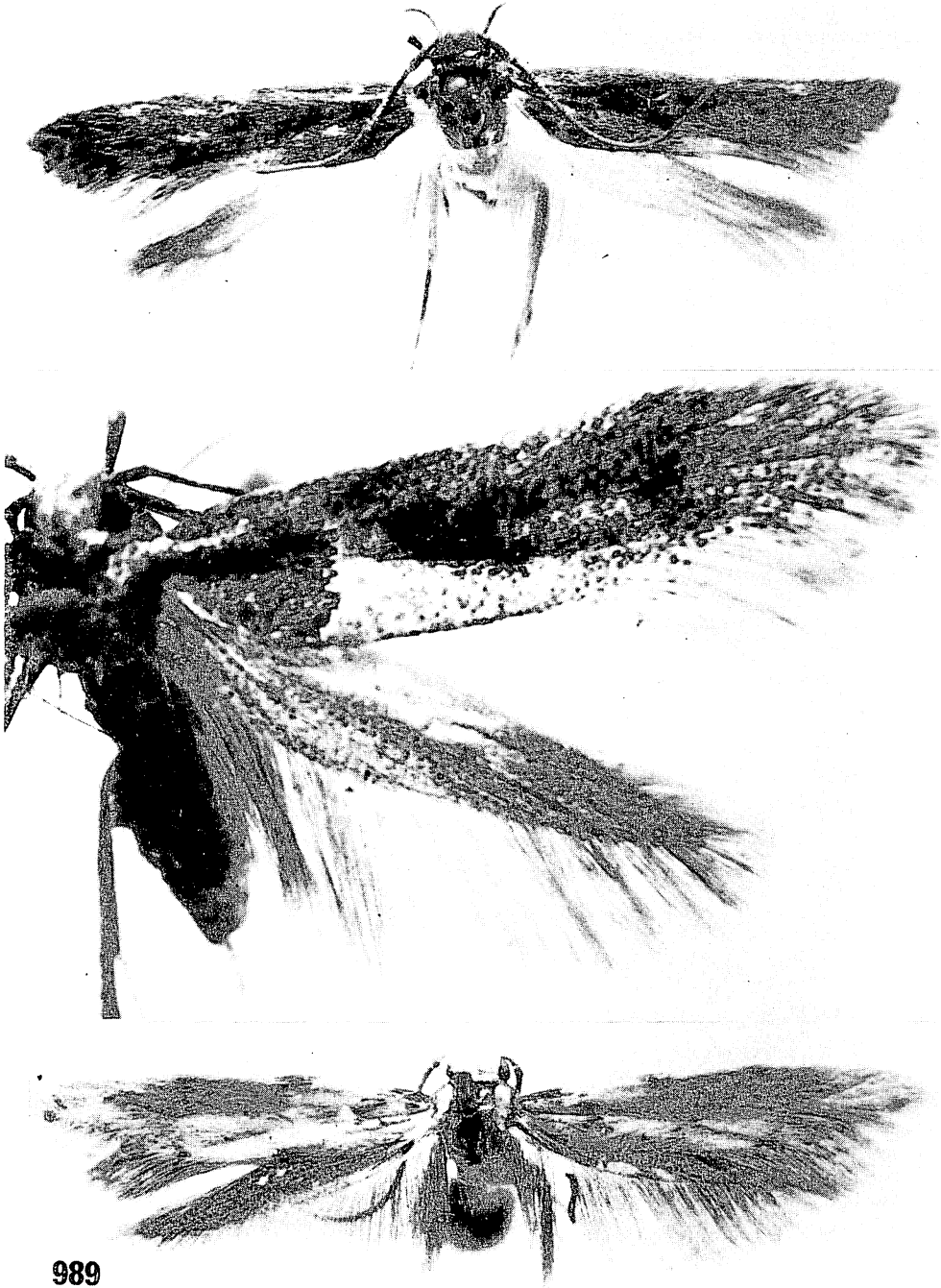
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Figure 988—*Hyposmocoma*. Top, (*H.*) *vermiculata* Walsingham, holotype male (BM slide 4133); Kilauea, Hawaii; expanse 14 mm.; forewings fuscous with darker and paler maculae. Bottom, (*E.*) *veterella* (Walsingham) ("Aphthonetus"), holotype female (BM slide 4715); Halemanu, 4,000 feet, Kauai; forewing 5.5 mm., white and brownish fuscous (the photograph is partly out of focus, poorly illuminated, and too dark). These specimens were used for the *Fauna Hawaïensis* illustrations.



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Figure 989—*Hyposmocoma*. Top, (*E.*) *vicina* Walsingham, holotype male (BM slide 4336); Waianae Mts., 1700 feet, Oahu; expanse 15 mm.; forewings a brown shade of fuscous with yellowish areas. Middle, (*H.*) *vinicolor* Walsingham, holotype female (slide not made); Waianae Mts., 3,000 feet, Oahu; forewing 6 mm., brownish, fuscous, and white. Bottom, (*H.*) *virgata* Walsingham, allotype male (BM slide 4111); Molokai, about 4,000 feet; expanse 12.5 mm.; forewings golden yellow with fuscous maculae (the photograph is somewhat misleading). The top and middle specimens are illustrated in *Fauna Hawaiiensis*.

(Continued from page 1224.)

**Hyposmocoma (Euperissus) agnetella** (Walsingham), **new combination** (figs. 780, palpus; 809, wing venation; 868, moth; 1003, male genitalia; 1219, female genitalia).

*Neelysia agnetella* Walsingham, 1907b:538, pl. 17, fig. 10.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) albocinerea** (Walsingham), **new combination** (figs. 785, palpus; 816, wing venation; 869, moth; 1016, male genitalia, abdomen; 1215, female genitalia).

*Aphthonetus albocinerea* Walsingham, 1907b:527, pl. 16, fig. 17.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

It would appear from the original description that all 31 specimens of the type series are females, but at least one of the paratypes is a male whose genitalia I have figured.

**Hyposmocoma (Euperissus) alticola** Meyrick (figs. 824, wing venation; 870, moth; 1034, male genitalia; 1228, female genitalia).

*Hyposmocoma alticola* Meyrick, 1915a:343.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

The more or less L-shaped valvae of this species are typical of the *Neelysia* group to which it should be assigned.

**Hyposmocoma (Euperissus) anthinella** (Walsingham), **new combination** (figs. 780, palpus; 809, wing venation; 871, moth; 1003, 1004, male genitalia).

*Neelysia anthinella* Walsingham, 1907b:535, pl. 17, fig. 4.

Endemic. Lanai (type locality: holotype male, 2,000 feet; allotype female, 3,000 feet).

Hostplant: unknown.

A microscope slide preparation (BM 7710) of the allotype female was made, but the preparation is inadequate for photography because of decomposition of the abdomen and attack by mold.

**Hyposmocoma (Euperissus) argentea** Walsingham (figs. 783, palpus; 826, wing venation; 872, moth; 1040, male genitalia; 1207, 1228, female genitalia).

*Hyposmocoma argentea* Walsingham, 1907b:596, 734, pl. 21, fig. 17.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

The female has a narrow, elongate, dentate signum on the bursa copulatrix. In his supplementary remarks on page 734 of *Fauna Hawaiiensis*, Walsingham records this species from the northwest Koolau Mountains of Oahu. I have

not studied any Oahu material and prefer not to accept the Oahu record until it can be verified. There are no specimens from Oahu in the *Fauna Hawaiiensis* collection in the British Museum. Perhaps Walsingham's page 734 statement contains an error.

**Hyposmocoma (Euperissus) argomacha** Meyrick (figs. 872, moth; 796, abdomen, female genitalia; 866c, wing venation).

*Hyposmocoma argomacha* Meyrick, 1935a:67.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: *Smilax*.

The elongate, whitish larvae bore the dead stems of the hostplant and do not make cases.

The holotype is a female. The male paratype lacks its abdomen. These specimens are now in the Bishop Museum.

**Hyposmocoma (Euperissus) argyresthiella** (Walsingham), **new combination** (figs. 781, palpus; 810, wing venation; 873, moth; 1004, male genitalia; 1219 female genitalia).

*Neelysia argyresthiella* Walsingham, 1907b:544, pl. 17, fig. 22.

Endemic. Kauai, Oahu, Molokai, Hawaii [type locality: Kaawaloa, Kona, above 2,000 feet, holotype male (abdomen lost); Kona, 4,000 feet, allotype female].

Hostplant: the larvae, presumably found on Oahu, of what was determined as this species by Dr. Swezey, have been reared from silken tunnels in moss. I have not compared the Swezey material with the types.

This species was originally labeled by Walsingham as belonging to *Hyposmocoma*, but it was described in *Fauna Hawaiiensis* as a *Neelysia*. The male has a pair of long brushes which arise from the metapleura and cross over the abdomen. I have not verified the extensive distribution, and material from the various islands should be studied with great care because of the possibility that more than one species is involved.

**Hyposmocoma (Euperissus) arundinicolor** (Walsingham), **new combination** (figs. 770, wing venation; 783, palpus, 873, moth; 990, male genitalia; 1207, 1214 female genitalia).

*Hyperdasys arundinicolor* Walsingham, 1907b:641, pl. 24, fig. 23.

*Hyperdasylella arundinicolor* (Walsingham) Fletcher, 1940:18.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) aspersa** (Butler), **new combination** (figs. 785, palpus; 818 wing venation; 873, moth; 1215, female genitalia).

*Laverna aspersa* Butler, 1882:44.

*Aphthonetus aspersa* (Butler) Walsingham, 1907b:529, pl. 16, fig. 22.

Endemic. Oahu (type locality: mountains near Honolulu; Blackburn's code numbers on the female holotype are "82.9 106").

Hostplant: unknown.

I have not seen the male.

**Hyposmocoma (Euperissus) auroargentea** Walsingham (figs. 827, wing venation; 874, moth; 1041 male genitalia; 1229, female genitalia).  
*Hyposmocoma auroargentea* Walsingham, 1907*b*:570, pl. 19, fig. 16.

Endemic. Maui (type locality: Haleakala, 5,000 feet or higher).  
 Hostplant: unknown.

**Hyposmocoma (Euperissus) barbata** Walsingham (figs. 778, 784, palpus; 875, moth; 1229, female genitalia).  
*Hyposmocoma barbata* Walsingham, 1907*b*:635, pl. 24, fig. 12.

Endemic. Molokai (type locality: above 3,000 feet).  
 Hostplant: unknown.

Only the female holotype is known, and, without the male, I cannot place the species in a species group. Walsingham noted that the hairy labial palpi agree with the *Aphthonetus* group "but vein 6 is separate in the forewings and 6 and 7 of the hindwings are not stalked." I have not made a slide preparation of the wings.

**Hyposmocoma (Euperissus) basivittata** (Walsingham), **new combination** (figs. 780, palpus; 810, wing venation; 876, moth; 1005, male genitalia; 1220, female genitalia).  
*Neelysia basivittata* Walsingham, 1907*b*:539, pl. 17, fig. 12.

Endemic. Maui (type locality: Haleakala, 5,000 feet).  
 Hostplant: unknown.

**Hyposmocoma (Euperissus) bitincta** (Walsingham), **new combination** (figs. 785, palpus; 818, wing venation; 877, moth; 1015, 1017, abdomen; 1017, male genitalia; 1215, female genitalia).  
*Aphthonetus bitincta* Walsingham, 1907*b*:521, pl. 16, fig. 3.

Endemic. Kauai?, Oahu? (according to Swezey, 1954:6, but specimens not examined by me), Maui (type locality: Haleakala, 4,000 feet, holotype male; 5,000 feet, allotype female).

Hostplant: larvae in dead bark of *Acacia koa* (record based upon Oahu specimens determined by Swezey).

I have questioned the Kauai and Oahu records, because I have not studied the genitalia of such specimens and have not compared them with the Maui types.

**Hyposmocoma (Euperissus) brevistrigata** Walsingham (figs. 783, palpus; 828, wing venation; 878, moth; 1051, male genitalia; 1230, female genitalia).  
*Hyposmocoma brevistrigata* Walsingham, 1907*b*:633, pl. 24, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).  
 Hostplant: unknown.

This moth was not correctly associated with its allies in *Fauna Hawaiiensis*. It belongs with the atypical *Neelysia* group associated with *mactella*. The only

female I have seen is damaged. The valvae of the male genitalia are small and subtriangular. The males have a well-developed brush of long yellowish hairs, which end in darker, wine-colored apices, on each side of the metathorax beneath the anterior axil of the hindwing. On each side of the abdomen at the ends of the metathoracic brushes is a patch of elongate, raised scales. This combination recalls that found in such species as (*Neelysia*) *mactella* and its associates; see the discussion under *mactella*, below. The abdominal squamae are not as large as on *exaltata* and its allies. Although Walsingham mentioned the fact that the males of this species lack subcostal brushes on the hindwings, he overlooked, or at least did not mention, the well-developed and conspicuous brushes of long hairs on the metapleura.

**Hyposmocoma (Euperissus) caecinervis** Meyrick (figs. 806, pupa; 824, wing venation; 878, moth; 1053, male genitalia; 797, female genitalia).  
*Hyposmocoma caecinervis* Meyrick, 1928c:103.

Endemic. Oahu (type locality: Mt. Kaala).

Hostplant: *Smilax sandwicensis*. The larvae bore in the dead stems.

**Hyposmocoma (Euperissus) catapyrrha** (Meyrick), **new combination** (fig. 880, moth).

*Euperissus catapyrrha* Meyrick, 1935a:64.

Endemic. Maui (type locality: Olinda).

Hostplant: *Rubus hawaiiensis*.

The only known specimen of this moth was reared from a larva found by Dr. Swezey in the pith of a dead stem. It has, most unfortunately, lost its abdomen.

**Hyposmocoma (Euperissus) centralis** Walsingham (figs. 787, palpus, 881, moth; 1055, male genitalia).

*Hyposmocoma centralis* Walsingham, 1907b:636, pl. 24, fig. 15.

Endemic. Kauai (type locality: behind Lihue, 4,000 feet).

Hostplant: unknown.

Only the male holotype is known. Walsingham noted that the right hindwing has a branch on vein 4; the hindwing thus has an abnormal nine veins.

**Hyposmocoma (Euperissus) centronoma** Meyrick (figs. 881, moth; 794, female genitalia).

*Hyposmocoma centronoma* Meyrick, 1935a:66.

Endemic. Oahu (type locality: Kawaihapai).

Hostplant: *Metrosideros*.

This moth is known from one female which was bred from a larva found by Dr. Swezey feeding on the bark of the hostplant.

**Hyposmocoma (Euperissus) chilonella chilonella** Walsingham (figs. 806, pupa; 807, wing venation; 882, moth; 1055, 1056, male genitalia; 1196, female genitalia).

*Hyposmocoma chilonella* variety *chilonella* Walsingham, 1907b:637, pl. 24, fig. 17.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Maui, Hawaii.

Hostplants: *Acacia koa*, *Aleurites moluccana*, *Cheirodendron gaudichaudii*, *Coprosma foliosa*, *Coprosma* species, *Metrosideros*, *Pipturus*, *Rubus hawaiiensis*, *Smilax sandwicensis*.

Parasites: *Pycnophion fuscipennis* Perkins, *Scleroderma chilonellae* Bridwell, *Sympiesis* ("Ophelinus") *mauiensis* (Ashmead).

The whitish larvae bore in dead wood or pith.

I have not had opportunity to study the supposed forms of this species in sufficient detail. The genitalia I have examined appear to display certain differences in some structures, but I do not have enough evidence to ascertain whether these differences are more than individual. Studies of series of examples from various localities, as well as studies in the field, are now required. Both sexes of this complex have the brush of hairs on the vannal areas of the hindwings strongly developed.

Walsingham called the four forms of this species that he recognized "varieties", and he said (1907b:639):

The descriptions of the varieties of this species show a wide range of difference in intensity and distribution of color. I had originally regarded them as distinct, but the intergradations are numerous and it appears to me to be one of the rare instances in which a species ranging over several of the islands fails to establish for itself any recognisable local form. The size as well as the colour of the specimens is very variable and this difference is to be found in connection with each separate pattern or peculiarity. If anyone had before him the varieties described above without the intermediate gradations he would undoubtedly regard them as distinct species, but in the absence of a knowledge of their life-histories it seems preferable to describe them as varieties rather than species.

These forms may be color varieties, or species, or a mixture of the two categories. They cannot be called subspecies because they do not appear to conform to the current definition of subspecies. They must be considered either forms of a variable species or as separate species. At this preliminary writing, I believe that a complex of species is involved here. It is not impossible that some of the specimens considered by Walsingham to represent connecting intergrades between these forms may really be themselves distinct forms. Thus, a series of distinct species, perhaps sibling species, may be confused in this complex.

The ostium of *chilonella chilonella* differs from that of *venosa*. The bursa copulatrix of *chilonella* is distinctly constricted (figure 1196), whereas that of *venosa* is elongated and not constricted and is thus different from *chilonella*. These differences indicate full species. The ostium and the bursa copulatrix of *triocellata*, however, are like those of *chilonella*. Differences observable in the shapes of the genital flaps, valvae, lobes of the anellus, and left brachia, for example, of the male genitalia are confusing and difficult to evaluate from the few examples examined, but some of these differences may indicate different species. It would appear possible that several species are involved with possibly similar color varieties.

Because I cannot at this time clarify the problems involved here, I shall leave the group as Walsingham left it. Although I realize that names of varieties have, under current nomenclatorial usage, no official standing, elimination of the names given by Walsingham from this list would further

obfuscate the situation and would result in a loss of identity of the information assembled for them. I have, therefore, let them stand as Walsingham used them, and I leave the solution of the problems involved to a future generation or to a time when additional specimens can be assembled for study.

**Hyposmocoma (Euperissus) chilonella percondita** Walsingham (figs. 882, moth; 1056, male genitalia; 1249, female genitalia).

*Hyposmocoma chilonella* variety *percondita* Walsingham, 1907b:638, pl. 24, fig. 19.

Endemic. Kauai, Hawaii (type locality: Kilauea).

Hostplant: unknown, but presumed to be dead wood.

The only places where this form has been reported are at opposite ends of the main island group. I collected at light, at Kokee, Kauai, specimens of what appeared to be this form, but more study of specimens from the two localities is required.

**Hyposmocoma (Euperissus) chilonella triocellata** Walsingham (figs. 787, palpus; 883, moth; 1055, 1057, 1058, male genitalia; 1231, female genitalia).

*Hyposmocoma chilonella* variety *triocellata* Walsingham, 1907b:637, pl. 24, fig. 16.

*Hyposmocoma ocellata*, misspelling by Swezey, 1929:300.

Endemic. Kauai, Oahu, Molokai (type locality: about 4,000 feet), Hawaii.

Hostplants: *Cheirodendron*, *Hibiscus*, *Pipturus*, *Pittosporum*, *Rubus hawaiiensis*, *Wikstroemia*.

Parasite: *Scleroderma* species.

The whitish larvae have been found boring in dead wood.

I am not sure that this form has such an extensive range as recorded. Certain differences are observable in the genitalia of the few examples studied, but I do not know how to evaluate them. See figures 1057 and 1058, for example. Sibling species may be involved in the complex.

**Hyposmocoma (Euperissus) chilonella venosa** Walsingham (figs. 883, moth; 1059, male genitalia; 1231, female genitalia).

*Hyposmocoma chilonella* variety *venosa* Walsingham, 1907b:638, pl. 24, fig. 18.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Molokai, Hawaii.

Hostplant: *Wikstroemia*.

The whitish larvae bore in dead wood.

As figure 1059 demonstrates, there are differences between the male genitalia of the holotype from Kauai and a paratype from Molokai. Are these differences more than individual? Here, again, sibling species may be involved. Detailed studies of long series of specimens from different localities are required before such problems can be solved.

**Hyposmocoma (Euperissus) chloraula** Meyrick (figs. 824, wing venation; 884, moth; 1058, male genitalia).

*Hyposmocoma chloraula* Meyrick, 1928c:103.

Endemic. Kauai (type locality: Summit Camp).



Hostplant: *Astelia*.

The larva is a borer in dead stems. This species, an ally of *fulvida*, is noteworthy because it has a lily as its hostplant.

**Hyposmocoma (Euperissus) cleodorella** (Walsingham), **new combination** (figs. 780, palpus; 810, wing venation; 885, moth; 1005, male genitalia).

*Neelysia cleodorella* Walsingham, 1907b:535, pl. 17, fig. 3.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) columbella** (Walsingham), **new combination** (figs. 818, wing venation; 886, moth; 1017, male genitalia, abdomen).

*Aphthonetus columbella* Walsingham, 1907b:521, pl. 16, fig. 4.

Endemic. Molokai (type locality: above 3,000 to 4,000 feet).

Hostplant: unknown.

The female studied had such a decomposed abdomen that it was impossible to make a preparation worthy of illustration.

**Hyposmocoma (Euperissus) complanella** (Walsingham), **new combination** (figs. 780, palpus; 811, wing venation; 887, moth; 1006, male genitalia).

*Neelysia complanella* Walsingham, 1907b:546, pl. 17, fig. 25.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Two males only are known.

**Hyposmocoma (Euperissus) confusa** (Walsingham), **new combination** (figs. 888, moth; 1017, male genitalia, abdomen).

*Aphthonethus confusa* Walsingham, 1907b:523, pl. 16, fig. 8.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

I have only seen the unique male holotype.

**Hyposmocoma (Euperissus) coprosmae** (Swezey), **new combination** (figs. 889, moth; 996, male genitalia; 1198, female genitalia).

*Semnoprepia coprosmae* Swezey, 1920b:382.

Endemic. Oahu (type locality: Malamalama, Mt. Konahuanui).

Hostplant: *Coprosma longifolia*.

Parasite: *Scleroderma semnoprepiae* Bridwell.

The larvae of this genus [*Semnoprepia*] are elongate and whitish and usually feed in dead wood; but the larvae of this species were found in the live wood and were quite abundant in the trees of the locality. The injury by them caused dead places in the tree trunks and branches, and a very rough, gnarled appearance where the growing of the tree had partially overgrown the injuries. Pieces of branches containing larvae were brought in, and the moths issued November 20 to December 14 [the branches had been collected on October 8, 1916]. A series of 18 *Sclerodermus semnoprepia* Bridwell also issued from this material, and cutting up [sic] some of the wood, it was demonstrated that this parasite had bred on the larvae. . . . (Swezey, 1920b:382-383.)

**Hyposmocomma (Euperissus) corticicolor** (Walsingham), **new combination** (figs. 819, wing venation; 890, moth; 1018, male genitalia).  
*Aphthonetus corticicolor* Walsingham, 1907b:519, pl. 15, fig. 27.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Dr. Swezey (1910f:114) reported that he had collected one specimen of this species in the Waianae Mountains of Oahu, but, not having confirmed the determination, I have not accepted his record.

**Hyposmocomma (Euperissus) cristata** (Butler), **new combination** (figs. 760, head, wing venation; 892, moth; 792, 995, male genitalia; 1224, female genitalia).

*Euperissus cristatus* Butler, 1881:402, fig. 1. Walsingham 1907b:643, 735, pl. 24, fig. 26. The type-species of *Euperissus*.

Endemic. Oahu (type locality: mountains near Honolulu; the Blackburn field code number is 81.7 over 72), Molokai, Hawaii.

Hostplant: *Freycinetia* ("ieie").

This species is often abundant. The slender, white larvae bore in the pith of the dead stems, and pupation takes place within the burrows. Its true distribution is unknown.

See the details above under the discussion of the name *Euperissus* where there are notes on some of the characters of this fine species. See also the discussion under the similar species *fulvogrisea* below.

**Hyposmocomma (Euperissus) cryptogamiella** (Walsingham), **new combination** (figs. 770, head and wing venation; 792, 991, 992, male genitalia; 893, moth; 1214, female genitalia).

*Hyperdasys cryptogamiellus* Walsingham, 1907b:642, pl. 24, fig. 25. The type-species of *Hyperdasys*.

*Hyperdasysella cryptogamiella* (Walsingham) Fletcher, 1940:18. The type-species of *Hyperdasysella*, a replacement name for *Hyperdasys*, a homonym.

Endemic. Kauai, Oahu, Molokai, Lanai, Hawaii (type locality: Olaa, holotype male; Kilauea, allotype female).

Hostplants: *Acacia koa*, *Clermontia*, *Lantana*, *Metrosideros*, *Sophora*.

The larvae are naked stem-borers.

I have not confirmed the widespread distribution and hostplant range reported for this species. A comparative study of specimens from various localities remains to be done.

**Hyposmocomma (Euperissus) cuprea** (Walsingham), **new combination** (figs. 780, palpus; 811, wing venation; 893, moth; 1006, male genitalia; 1220, female genitalia).

*Neelysia cuprea* Walsingham, 1907b:532, pl. 16, fig. 27.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) diffusa** (Walsingham), **new combination** (figs. 764, head, wing venation; 894, moth; 1019, male genitalia, abdomen; 1216, female genitalia).

*Aphthonetus diffusa* Walsingham, 1907b:527, pl. 16, fig. 19. The type-species of *Aphthonetus*.

Endemic. Kauai, Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Walsingham described this species from a series of 25 specimens: one from Maui and 24 from Kauai. I do not know what led him to select the single Maui example as the holotype and to designate the long series of Kauai specimens as paratypes instead of selecting a holotype and an allotype from Kauai. He did not designate a female type. Walsingham's action was unfortunate, because *diffusa* is the type-species of *Aphthonetus*. It would appear logical to have firmly established the type-species on the good series of Kauai specimens. I believe that there may be reason to doubt that the Kauai specimens are exactly the same as the Maui holotype. There appear to be some slight differences in the male genitalia, and the basal parts of the processes on the seventh tergite differ. This problem must be given attention in the future.

**Hypsmocoma (Euperissus) digressa** (Walsingham), **new combination** (figs. 819, wing venation; 894, moth; 1018, male genitalia, abdomen).

*Neelysia digressa* Walsingham, 1907b:522, pl. 16, fig. 6.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

I have not seen a female.

**Hypsmocoma (Euperissus) discolor** Walsingham (figs. 781, palpus; 895, moth; 1234, female genitalia).

*Hypsmocoma discolor* Walsingham, 1907b:633, pl. 24, fig. 9.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the female holotype is known.

**Hypsmocoma (Euperissus) divergens** (Walsingham), **new combination** (figs. 785, palpus; 895, moth; 1018, male genitalia).

*Aphthonetus divergens* Walsingham, 1907b:520, pl. 16, fig. 2.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

This moth is known only from the male holotype. Walsingham considered it to be "nearly allied to *corticicolor*". This is not true; the species belong to different species groups.

**Hypsmocoma (Euperissus) dorsella** Walsingham (figs. 783, palpus; 897, moth; 1069, male genitalia).

*Hypsmocoma dorsella* Walsingham, 1907b:605, 734, pl. 22, fig. 7.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Hostplant: unknown.

Dr. Swezey (1913:236) recorded this species from a single specimen taken at light at Kilauea, Hawaii in August, 1911. Although I have not studied the specimen, I have deleted Hawaii from the distribution of this species because it is probable that an error in identification was made. The moth was described from one male from the Mt. Kaala region of Oahu, and Walsingham (1907:734) later recorded it from the northwest Koolau Mountains of Oahu.

**Hyposmocoma (Euperissus) ekaha** Swezey (figs. 772, head, wing venation; 778, palpus; 897, moth; 1030, male genitalia; 1212, female genitalia).

*Hyposmocoma ekaha* Swezey, 1910*d*:105, pl. 3, figs. 3, 4.

*Euhyposmocoma ekaha* (Swezey) Swezey, 1913*f*:277. Type-species of *Euhyposmocoma*.

*Euhyposmocoma akaha* Swezey, 1915*d*:67, misspelling.

*Euhyposmocoma asplenii* (Meyrick manuscript) T. B. Fletcher, 1929:89.

Endemic. Oahu (type locality: Halawa Valley).

Hostplant: *Asplenium nidus* ("ekaha", bird's nest fern).

Parasite: *Coccygomimus punicipes* (Cresson) [= *Ephialtes hawaiiensis* (Cameron)].

"This moth occurs wherever the fern is found in the mountain valleys of Oahu." (Swezey, 1954:86) The larvae "feed on the under surface of the frond, leaving the upper epidermis intact, which dries and gives the frond the appearance of having numerous dead patches. The older larvae also bore into the rachis, and each has a tunnel of silk and frass extending out onto the frond to its feeding place. It apparently hides in the bored rachis except when out feeding." (Swezey, 1910*d*:105.)

Dr. Swezey described the larva and pupa as follows (1910*d*:106):

The full-grown larva is pale yellowish; head pale yellowish brown, eyes black; cervical shield pale yellow; tubercles brownish, "ii" [D2] a little farther apart dorsally than "i" [D1], "iii" [SD1] above spiracle, "iv + v" [L1-L2] below spiracle; setae pale brown; spiracles concolorous.

Pupae were found in the rachis, also in a pendant portion of the silken tunnel which was on surface of frond. The pupa is 8 mm.; medium brown; antenna-, wing- and leg-cases extend to about middle of 6th abdominal segment, attached throughout; spiracles a little elevated by the segments being slightly bulging conically at the sides; a cluster of hooked bristles at cremaster fastened into silk of cocoon.

Although Dr. Swezey stated clearly in his description of *Euhyposmocoma* that this species, *ekaha*, is the type-species of the genus, T. B. Fletcher, in his well-known list of the generic names of the Microlepidoptera (1929:89), gives *asplenii* Meyrick as the type-species of *Euhyposmocoma*. I called Fletcher's attention to this in 1941, and he replied that he had obtained the name *asplenii* from a manuscript of Meyrick, and he said that "Meyrick would have considered the vernacular name 'ekaha' as barbarous and non-classical and renamed the species *asplenii*, which was an unpublished ms. name, until, most unfortunately, I published it in my list (where it was, of course, merely a *nomen nudum*)." It was the common practice of Meyrick to rename species when he did not consider that the names given were classically correct.

The only other species included in Swezey's *Euhypsmocoma* was *trivitella*. The vestiture of the labial palpi of these two species is unusually expanded, as illustrated, and these species are thus easily identified. They form a species group but not a separate genus.

**Hypsmocoma (Euperissus) elegans** (Walsingham), **new combination** (figs. 816, wing venation; 897, moth; 1020, male genitalia, abdomen).  
*Aphthonetus elegans* Walsingham, 1907b:530, pl. 16, fig. 23.

Endemic. Maui (type locality: Olinda, Haleakala, 4,000 feet).

Hostplant: unknown.

The female is unknown.

**Hypsmocoma (Euperissus) eleuthera** (Walsingham), **new combination** (figs. 785, palpus; 817, wing venation; 898, moth; 1216, female genitalia).

*Aphthonetus eleuthera* Walsingham, 1907b:522, pl. 16, fig. 7.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only two females are known.

**Hypsmocoma (Euperissus) emendata** Walsingham (figs. 833, wing venation; 898, moth; 1069, male genitalia; 1234, female genitalia).  
*Hypsmocoma emendata* Walsingham, 1907b:587, pl. 20, fig. 28.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) empetra** (Meyrick), **new combination** (figs. 785, palpus; 817, wing venation; 899, moth, 1020, male genitalia; 1199, female genitalia).

*Aphthonetus empetra* Meyrick, 1915a:399.

Endemic. Oahu (type locality: Koolau Mountains)

Hostplant: unknown.

**Hypsmocoma (Euperissus) enixa** Walsingham (figs. 833, wing venation; 900, moth; 1071, male genitalia).

*Hypsmocoma enixa* Walsingham, 1907b:586, pl. 20, fig. 24.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

The female is unknown. Walsingham correctly associated the species with *adolescents*, but it is not allied to *fulvida* with which he also compared it.

**Hypsmocoma (Euperissus) ensifer** Walsingham (figs. 834, wing venation; 900, moth; 1069, male genitalia).

*Hypsmocoma ensifer* Walsingham, 1907b:588, pl. 21, fig. 1.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only males have been seen.

**Hyposmocoma (Euperissus) epicharis** Walsingham (figs. 787, palpus; 900, moth).

*Hyposmocoma epicharis* Walsingham, 1907*b*:639, pl. 24, fig. 20.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

This large, beautifully yellow moth is known only from the female holotype, the abdomen of which has been lost.

**Hyposmocoma (Euperissus) erebogramma** (Meyrick), **new combination** (fig. 901, moth).

*Neelysia erebogramma* Meyrick, 1935*a*:64.

Endemic. Oahu (type locality: Kahuku).

Hostplant: *Hesperomannia*.

The unique male holotype, now in the Bishop Museum, has lost its abdomen. Meyrick said that the head is dark fuscous, but he failed to note that the face is white—only the dorsum of the head is dark. The white penultimate segment of the labial palpus contrasts sharply with the dark terminal segment.

**Hyposmocoma (Euperissus) erismatias** Meyrick (figs. 901, moth; 1072, male genitalia; 1235, female genitalia).

*Hyposmocoma erismatias* Meyrick, 1928*c*:102.

Endemic. Oahu (type locality: Nuuanu).

Hostplant: *Euphorbia*.

The larvae are stem borers. The holotype is now in the Bishop Museum.

**Hyposmocoma (Euperissus) exaltata** (Walsingham), **new combination** (figs. 780, palpus; 811, wing venation; 902, moth; 1007, male genitalia; 1220, female genitalia).

*Neelysia exaltata* Walsingham, 1907*b*:542, pl. 17, fig. 17.

Endemic. Maui (type locality: Haleakala, probably in the Olinda Forest region).

Hostplant: unknown.

Walsingham originally labeled this species as a *Hyposmocoma*, but he described it in *Neelysia*.

See the discussion of the metapleural brushes under *mactella* below.

**Hyposmocoma (Euperissus) exornata** Walsingham (figs. 834, wing venation; 902, moth; 1073, male genitalia; 1235, female genitalia; col. pl. 5:6).

*Hyposmocoma exornata exornata* Walsingham, 1907*b*:550, pl. 18, fig. 4.

Endemic. Hawaii (type locality: Kona, 4,000 feet, male holotype; Kilauea, female allotype).

Hostplant: unknown.

See the comments under *flavicosta* below; the latter may represent a form of *exornata*.

**Hyposmocoma (Euperissus) exsul** (Walsingham), **new combination** (figs. 785, palpus; 819, wing venation; 903, moth; 1021, male genitalia; 1216, female genitalia).

*Aphthonetus exsul* Walsingham, 1907b:526, pl. 16, fig. 16.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

One would conclude from the original description that the type series contained only females, because only the female is mentioned by Walsingham. Both sexes are, however, represented.

Walsingham wrongly supposed this species to be allied to *subocellata*, but the species belong to different subgenera. Walsingham also stated that it was allied to *Aphthonetus* "*suffusa*", but there was no *Aphthonetus* "*suffusa*" described. This was a *lapsus calami* for some other species name.

**Hyposmocoma (Euperissus) falsimella** Walsingham (figs. 903, moth; 1074, male genitalia).

*Hyposmocoma falsimella* Walsingham, 1907b:606, pl. 22, fig. 9.

Endemic. Maui (type locality: Haleakala, above 5,000 feet).

Hostplant: unknown.

This moth is known only from the male holotype. Walsingham wrongly considered this species and *fallacella* to be close associates, but *falsimella* belongs to *Euperissus* and *fallacella* belongs to *Hyposmocoma sensu stricto*. The species are thus far removed from one another in relationship. Walsingham said that *falsimella* "is closely allied to *fallacella*, from which it differs essentially in lacking the subcostal hair-pencil and in its darker palpi." He could not, of course, have arrived at such a conclusion had he studied the genitalia or understood the significance of the different vestiture on the vannus of the hindwing.

**Hyposmocoma (Euperissus) ferruginea** (Swezey), **new combination** (figs. 904, moth; 997, male genitalia).

*Semnoprepia ferruginea* Swezey, 1915e:94.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Cheirodendron*.

This moth is a large, beautiful, orange-brown species whose palpi are very long and slender and may be curved up over the head to reach the tegulae. The unique male holotype is in the Bishop Museum.

Dr. Swezey found the whitish larvae boring in dead twigs and branches. He described the pupa as follows (1915e:94): "12 mm.; pale reddish brown; antenna-sheaths, wing-sheaths and posterior leg-sheaths extend to near the apex of 5th abdominal segment; segments 4, 5 and 6 movable; cremaster blunt, with 6 or 8 hooked bristles."

**Hyposmocoma (Euperissus) flavicosta** (Walsingham), **new status** (figs. 902, moth; 1073, male genitalia).

*Hyposmocoma exornata* variety *flavicosta* Walsingham, 1907b:551, pl. 18, fig. 5.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

This form may represent only a color variety of *exornata* as Walsingham originally described it. There are, however, differences in the male genitalia that indicate that it may be a distinct species. Only one male of each form has been examined, and, pending further study of additional specimens, I have tentatively chosen to consider it a species instead of a synonym.

**Hyposmocoma (Euperissus) fluctuosa** (Walsingham), **new combination** (figs. 784, palpus; 820, wing venation; 906, moth; 1021, male genitalia; col. pl. 6:4).

*Aphthonetus fluctuosa* Walsingham, 1907b:519, pl. 15, fig. 28.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The female is unknown.

**Hyposmocoma (Euperissus) fractivittella** Walsingham (figs. 907, moth; 1236, female genitalia).

*Hyposmocoma* (?) *fractivittella* Walsingham, 1907b:593, pl. 21, fig. 11.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham noted that in the forewings of the unique female holotype veins 4 and 5 are stalked, and he considered that this species "probably belongs to a new genus" for that reason. He also said, "It would be unwise to found a new genus in this group on a single [female] which may be merely of abnormal structure." This species, of course, does not represent a distinct genus.

**Hyposmocoma (Euperissus) fugitiva** (Walsingham), **new combination** (figs. 820, wing venation; 907, moth; 1015, abdomen; 1022, male genitalia, abdomen).

*Aphthonetus fugitiva* Walsingham, 1907b:518, pl. 15, fig. 25.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

The female is unrecorded.

**Hyposmocoma (Euperissus) fulvida** Walsingham (figs. 781, palpus; 835, wing venation; 908, moth; 1078, 1079, male genitalia; 1207, 1237, female genitalia).

*Hyposmocoma fulvida* Walsingham, 1907b:608, pl. 22, fig. 14.

Endemic. Kauai, Molokai (type locality: between 3,000 and 4,000 feet).

Hostplant: unknown.

This moth is an ally of *chloraula*. Also, see the notes under *ochreovittella*. It is not an ally of *ocellata* as Walsingham thought. It is possible that it is rather widely distributed, although now we know it only from the two islands. It belongs to the group that has the strongly sclerotized ductus ejaculatorius (see figure 1079). It has a modest cluster of very long hair on the metapleuron beneath the posterior axis of the hindwing.



**Hyposmocoma (Euperissus) fulvocervina** Walsingham (figs. 783, palpus; 836, wing venation; 908, moth; 1080, male genitalia; 1237, female genitalia).

*Hyposmocoma fulvocervina* Walsingham, 1907b:610, pl. 22, fig. 19.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) fulvogrisea** (Walsingham), **new combination** (figs. 771, head and wing venation; 793, 996 male genitalia; 908, moth; 1198, female genitalia).

*Semnoprepia fulvogrisea* Walsingham, 1907b:644, pl. 24, fig. 27. Type-species of *Semnoprepia*.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

I have deleted the records for this species from Oahu because I am not sure that the Oahu specimens belong to the same species as the Kauai holotype. Dr. Swezey recorded it from Oahu where he found what he considered to be larvae of this species boring in the dead flower stalk of *Pritchardia*, in dead leaf sheaths of bamboo, and in dead *Pelea*.

There appear to be only slight differences between the male genitalia of this species and those of *cristata*, and it is extraordinarily similar to *cristata* in color pattern. However, the hindwing of the male *fulvogrisea* does not have the dense fringe of hairs and long scales along the posterior margin of the cell from the base to vein 2 on the dorsal surface but this structure is strongly developed on *cristata*. Also, whereas the mass of hair on the hindwing between veins 1a and 1c is comparatively short on *fulvogrisea*, it is conspicuously long and extends across vein 2 on *cristata*.

**Hyposmocoma (Euperissus) fuscudentata** (Walsingham), **new combination** (figs. 780, palpus; 812, wing venation; 909, moth).

*Neelysia fuscudentata* Walsingham, 1907b:534, pl. 17, fig. 2.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only two females of this species are known.

**Hyposmocoma (Euperissus) fuscifusa** (Walsingham), **new combination** (figs. 780, palpus; 812, wing venation; 909, moth; 1006, male genitalia; 1220, female genitalia).

*Neelysia fuscifusa* Walsingham, 1907b:538, pl. 17, fig. 9.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) fuscopurpurata** Zimmerman, **new name, new combination** (figs. 909, moth; 998, male genitalia).

*Semnoprepia fuscopurpurea* Swezey, 1915e:94.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: unknown.

The merging of *Semnoprepia* and *Hyposmocoma* makes necessary the replacement of Swezey's name *fuscopurpurea*, which is preoccupied in *Hyposmocoma* by the *fuscopurpurea* of Walsingham.

The male holotype is now in Bishop Museum.

**Hyposmocoma (Euperissus) hirsuta** (Walsingham), **new combination** (figs. 785, palpus; 820, wing venation; 912, moth; 1216, female genitalia).  
*Aphthonetus hirsuta* Walsingham, 1907b:528, pl. 16, fig. 19.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only two females are known.

**Hyposmocoma (Euperissus) homopyrrha** (Meyrick), **new combination** (figs. 866, wing venation; 912, moth; 1198, female genitalia).  
*Phthoraula homopyrrha* Meyrick, 1935a:65. Type-species of *Phthoraula*.

Endemic. Oahu (type locality: Nuuanu).

Hostplant: *Metrosideros*.

The unique type specimen was bred by Dr. Swezey from a larva found in dead wood. It is now in the Bishop Museum.

The labial palpi are very long and slender and curve up far above the top of the head. Measured along their greatest chords (on the female holotype), segment two equals five units, and segment three (terminal) equal 6.5 units compared with the height of the eye which is 2.1 units. The terminal segment is almost needlelike.

Meyrick erected the generic name *Phthoraula* for this species principally because of the loss of vein 8 (7?) in the forewings of the unique holotype. Although this character is unusual, it is not of generic importance in this instance. As we now know, the wing venation is subject to great variation and instability in *Hyposmocoma*. Additional information concerning this species is given above under *Phthoraula* in the discussion of the generic synonyms of *Hyposmocoma*.

**Hyposmocoma (Euperissus) humerella** (Walsingham), **new combination** (figs. 785, palpus; 821, wing venation; 913, moth; 1022, male genitalia; 1217, female genitalia).  
*Aphthonetus humerella* Walsingham, 1907b:528, pl. 16, fig. 20.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) incongrua** (Walsingham), **new combination** (figs. 780, palpus; 817, wing venation; 915, moth; 1008, male genitalia).

*Neelysia incongrua* Walsingham, 1907b:546, pl. 17, fig. 27.

Endemic. Maui (type locality: Haleakala, 5,000 to 6,000 feet).

Hostplant: unknown.

The abdomen of the allotype female was so decomposed that it was impossible to make a usable slide preparation of the genitalia (BM slide 7725).

**Hyposmocoma (Euperissus) inflexa** Walsingham (figs. 779, palpus; 915, moth; 1087, male genitalia).

*Hyposmocoma inflexa* Walsingham, 1907*b*:632, pl. 24, fig. 7.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only the male holotype is known. It has a long, heavy brush on each metapleuron beneath the posterior axis of each hindwing and a small cluster of long hair on the anterior margin.

**Hyposmocoma (Euperissus) insinuatix** Meyrick (figs. 838, wing venation; 916, moth; 1091, male genitalia).

*Hyposmocoma insinuatix* Meyrick, 1928*c*:103.

Endemic. Molokai (type locality: Kainalu, 2,000 to 3,000 feet).

Hostplant: *Smilax sandwicensis*.

The larvae bore in the dead wood; no case is made. The species was described from two males. The holotype is in the Bishop Museum.

**Hyposmocoma (Euperissus) jugifera** Meyrick (figs. 917, moth; 1091, male genitalia).

*Hyposmocoma jugifera* Meyrick, 1928*c*:102.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplants: *Acacia koa*, *Pelea*.

The larvae bore in dead wood; no case is formed.

The male holotype is now in the Bishop Museum, and there are only fragments of one example in the Meyrick collection in the British Museum.

**Hyposmocoma (Euperissus) kauaiensis** (Walsingham), **new combination** (figs. 785, palpus; 821, wing venation; 918, moth; 1023, male genitalia; 1217, female genitalia).

*Aphthonetus kauaiensis* Walsingham, 1907*b*:518, pl. 15, fig. 26.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

Walsingham considered this species to be allied to *mediocris*, but the moths belong to different species groups.

Dr. Swezey recorded this species from Oahu and Maui, but his data are based upon misidentifications. His Oahu material may be designated as new species 14.

**Hyposmocoma (Euperissus) new species 14** (fig. 1023, male genitalia).

*Aphthonetus* species misidentified as *kauaiensis* by Swezey, 1910*e*:139; 1954:6.

Endemic. Oahu (and Maui?).

Hostplant: *Acacia koa*.

Dr. Swezey said that he found the species on Oahu and Maui. I have not studied specimens from Maui and cannot confirm that the species ranges to Maui.

Dr. Swezey first mentioned the larval habit of this species in 1910*e*:139

(there listed as *kauaiensis*), and in 1954:6 he said, "This tiny moth has been reared from the phyllodes of koa. The larvae feed at the tips of new phyllodes where they are folded by webbing to produce a hiding place for the larvae, which occur singly. . . . The rearing records are from koa on Oahu and Maui."

**Hyposmocoma (Euperissus) latiflua** Meyrick (figs. 11–A, *d*, antenna; 781, palpus; 804, 806, pupa; 838, wing venation; 919, moth; 1094, male genitalia; 1202, female genitalia).

*Hyposmocoma latiflua* Meyrick, 1915a:344. Swezey, 1932:201, pl. 13, fig. 6.

Endemic. Oahu (type locality: Koolau Mountains, above Honolulu).

Hostplant: *Pittosporum cauliflorum*.

Dr. Swezey (1932:201) said:

This species was described from a single specimen collected by Perkins in the Koolau Mts., about 1900 or 1901. [this is an error; the holotype male was collected in 1908]. It was not rediscovered until 26 specimens were reared from larvae found by the writer feeding on leaves of *Pittosporum cauliflorum* on the ridge leading up to Puu Kalena, Waianae Mts., Oahu, December 29, 1929. The larvae were feeding singly on the under surface of the leaves beneath a frass-covered web. The upper surface of the epidermis was left intact and showed as a dead spot in the leaf. Pupation took place in a cocoon in the same place where larva fed. The pupa is brown, about 5 mm. long; the wing and antenna sheaths extend to apex of 7th abdominal segment; cremaster rounded obtuse, with 8 erect hooked bristles on dorsal part.

The female has two signa in the bursa copulatrix. The male has a long brush of hair from the posterior margin of each metapleuron beneath the posterior axis of the wing and a small cluster of hair on each metapleuron beneath the anterior axis of the hindwing. Compare *fulvida* and associates which have the ductus ejaculatorius heavily sclerotized.

**Hyposmocoma (Euperissus) lichenalis** (Walsingham), **new combination** (figs. 785, palpus; 816, wing venation; 920, moth; 1203, female genitalia).

*Aphthonetus lichenalis* Walsingham, 1907b:522, pl. 16, fig. 5.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

The female holotype has lost its abdomen. Only two females are known.

**Hyposmocoma (Euperissus) lignicolor** (Walsingham), **new combination** (figs. 767, head and wing venation; 793, male genitalia; 921, moth; 1008, male genitalia; 1221, female genitalia).

*Neelysia lignicolor* Walsingham, 1907b:533, pl. 17, fig. 1. The type-species of *Neelysia*.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

The extensive type series requires detailed study; it is possible that more than one species is involved.

**Hyposmocoma (Euperissus) limata** Walsingham (figs. 922, moth; 1096, male genitalia).

*Hyposmocoma limata* Walsingham, 1907b:568, pl. 19, fig. 12.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Euperissus) longitudinalis** Walsingham (figs. 786, palpus; 924, moth; 1208, 1242, female genitalia; 1354, wing venation; col. pl. 5:8).

*Hyposmocoma longitudinalis* Walsingham, 1907b:636, pl. 24, fig. 14.

Endemic. Hawaii (type locality: allotype male, Kona, 4,000 feet; holotype female, Kaawaloa, Kona, 2,000 feet).

Hostplant: unknown.

This species was originally described as occurring on Oahu (two specimens), Molokai (one specimen), and Hawaii (four specimens), but from the material I have seen, I now restrict it to the type island of Hawaii. Unfortunately, the male allotype has lost its abdomen, and I have not seen the male genitalia. An examination of the male genitalia of the two paratypes from Oahu reveals a distinct species (BM slide 5437) which has long spurs on the valvae and a strong pseuduncus. A male paratype from Molokai (BM slide 5436) represents a third species; it lacks genital valvae spurs and the pseuduncus. One of these species is designated as new species 20 in *Hyposmocoma sensu stricto*, and the other placed in *Euperissus* as new species 21.

The three species, *longitudinalis* and new species 20 and 21, have a distinctive color pattern (which is also shared by some other species), and at first sight it would appear that they are all the same species, as Walsingham and Durrant considered them. When one examines the color patterns carefully, however, subtle differences are revealed, but with such a small series of specimens (seven) now available for study it is almost impossible to determine from an examination of the color patterns alone whether the external differences observable are individual or specific. Astonishingly, although the series of specimens from the different islands were all considered to belong to one species, not only are there at least three species involved, but the type series includes species representing both subgenera as I have divided the genus *Hyposmocoma*. The true *longitudinalis* from the island of Hawaii belongs to *Euperissus* as does the Molokai new species 21, but the Oahu new species 20 is a well-developed member of *Hyposmocoma sensu stricto*.

**Hyposmocoma (Euperissus) new species 21** (figs. 789, 1106, male genitalia).

*Hyposmocoma* species confused with the paratypes of *longitudinalis* by Walsingham, 1907b:636 (BM slide 5436, male genitalia).

Endemic. Molokai (above 3,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) lugens** Walsingham (figs. 925, moth; 1094, male genitalia; 1242, female genitalia).

*Hyposmocoma lugens* Walsingham, 1907b:586, pl. 20, fig. 25.

Endemic. Maui (type locality: 5,000 feet).

Hostplant: unknown.

This is, as the male genitalia demonstrate, a member of the typical *Neelysia* subgroup although it was originally placed incorrectly by Walsingham. There is a cluster of long hairs on each metapleuron, but they do not form long brushes.

**Hyposmocoma (Euperissus) lunifer** Walsingham (figs. 925, moth; 1243, female genitalia).

*Hyposmocoma lunifer* Walsingham, 1907b:584, pl. 20, fig. 20.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only the female is known.

**Hyposmocoma (Euperissus) mactella** (Walsingham), **new combination** (figs. 780, palpus; 812, wing venation; 927, moth; 1009, male genitalia; 1221, female genitalia).

*Neelysia mactella* Walsingham, 1907b:545, pl. 17, fig. 23.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Molokai.

Hostplant: unknown.

The male has a strongly developed brush on each metapleuron just beneath the base of the wing. These brushes cross over the middle of the dorsum of the abdomen to end between a large mass of greatly enlarged abdominal scales which arise from each side of the abdomen and overlap the middle of the abdomen. It may appear at times that the hairs of the brushes end in huge scalelike lobes. The same structures are found in other species that were originally described in *Neelysia*, such as *exaltata*, *argyresthiella*, and probably also on *poeciloceros* and *tischeriella* which have the thoracic brushes. I have seen none of these with intact abdomens, and, although they probably do, I cannot be positive that the enlarged abdominal scales occur on the two latter species. A rather similar development occurs on *Euperissus brevistrigata*, but the abdominal scales are not so enlarged. See also *Euperissus ochreovittella*. The metapleural brushes and the enlarged abdominal scales do not occur on the following species which were also described in *Neelysia*: *agnetella*, *anthinella*, *cleodorella*, *cuprea*, *lignicolor*, *paltodorella*, and *tigrina*.

The male genital tegumen has a dorsal thickening of the sclerotization which suggests a tendency toward the development of a dorsal flange such as that found on *subaurata*, but it is different from the uncuslike process of *subaurata*.

The above-mentioned characters appear to be correlated with differences in the male genitalia and wing shape. For example, *mactella* has a narrowly pointed hindwing and vein 2 is missing from the forewing (other species also have the same characters). However, *agnetella* and associated species have hindwings that are more broadly rounded apically, and vein 2 is partly present in the forewings. *Euperissus brevistrigata* has sharply pointed hindwings, but vein 2 in the forewing is fully developed. These features require detailed study, and no doubt they will be of use in developing a key to the species of this huge assemblage.

The spermatophore (BM slide 7723) is long and wirelike and about twice the length of the corpus bursae.

**Hyposmocoma (Euperissus) maestella** Walsingham (figs. 786, palpus; 843, wing venation; 927, moth; 1117, male genitalia; 1243, female genitalia).

*Hyposmocoma maestella* Walsingham, 1907b:610, pl. 22, fig. 18.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) malacopa** Meyrick (figs. 781, palpus; 838, wing venation; 928, moth; 1118, male genitalia).

*Hyposmocoma malacopa* Meyrick, 1915a:343.

Endemic. Oahu (type locality: Koolau Mts.)

Hostplant: unknown.

I have seen, in the British Museum, only the two male specimens originally described by Meyrick. The metapleura appear to lack brushes.

**Hyposmocoma (Euperissus) margella** (Walsingham), **new combination** (figs. 784, palpus; 929, moth; 999, male genitalia).

*Semnoprepia margella* Walsingham, 1907b:645, pl. 25, fig. 1.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Euperissus) mediocris** (Walsingham), **new combination** (figs. 821, wing venation; 930, moth; 1015, 1024, abdomen; 1024, male genitalia; 1217, female genitalia).

*Aphthonetus mediocris* Walsingham, 1907b:517, pl. 15, fig. 24.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) mormopica** (Meyrick), **new combination** (fig. 934, moth).

*Neelysia mormopica* Meyrick, 1935a:64.

Endemic. Oahu (type locality: Punaluu).

Hostplant: unknown.

The unique female holotype, now in the Bishop Museum, has lost its abdomen.

**Hyposmocoma (Euperissus) municeps** (Walsingham), **new combination** (figs. 780, palpus; 934, moth; 1221, female genitalia).

*Neelysia municeps* Walsingham, 1907b:537, pl. 17, fig. 7.

Endemic. Kauai, Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

This moth has been recorded thus far only from the widely separated islands of Kauai and Maui. I presume that it occurs on other islands, unless a group of similar-appearing sibling species is involved. The male is evidently not represented in collections. Until males from the several islands are studied little more can be said regarding the populations.

**Hyposmocoma (Euperissus) mystodoxa** Meyrick (figs. 776, wing venation; 781, palpus; 935, moth; 1125, male genitalia).

*Hyposmocoma mystodoxa* Meyrick, 1915a:344.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

This moth was described from two males (now in the British Museum).

**Hyposmocoma (Euperissus) nipholoncha** Meyrick (figs. 939, moth; 1204, female genitalia).

*Hyposmocoma nipholoncha* Meyrick, 1935a:66.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: *Euphorbia*.

The naked larvae are stem-borers.

Only two specimens of this species are known: the female holotype, now in the Bishop Museum, and a paratype which has lost its abdomen.

Meyrick said that the head is snow-white. He failed to note that this applies only to the dorsal aspect. Laterally, in front of the eyes, and on the lower part of the face the squamae are golden brown in sharp contrast to the dorsal white scaling. Meyrick said that the tegulae are dark brownish fuscous, but I would call them brown.

**Hyposmocoma (Euperissus) niveiceps** Walsingham (figs. 939, moth; 1139, male genitalia; col. pl. 6:1).

*Hyposmocoma niveiceps* Walsingham, 1907b:583, pl. 20, fig. 18.

Endemic. Molokai, Lanai (type locality: 2,000 to 3,000 feet).

Hostplant: unknown.

I have only seen males.

**Hyposmocoma (Euperissus) obliterated** Walsingham (figs. 779, palpus; 941, moth; 1142, male genitalia; 1247, female genitalia).

*Hyposmocoma obliterated* Walsingham, 1907b:601, pl. 21, fig. 27.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The male has a long, dark-tipped brush from the anterior corner of each metapleuron.

**Hyposmocoma (Euperissus) obscura** Walsingham (figs. 849, wing venation; 941, moth; 1142, male genitalia; 1247, female genitalia).

*Hyposmocoma obscura* Walsingham, 1907b:609, pl. 22, fig. 16.

Endemic. Maui (type locality: Olinda, Haleakala, 4,000 feet).

Hostplant: unknown.

The male does not have a long brush on the metapleuron.

**Hyposmocoma (Euperissus) ocellata** Walsingham (figs. 849, wing venation; 941, moth; 1143, male genitalia; 1248, female genitalia).

*Hyposmocoma ocellata* Walsingham, 1907b:586, pl. 20, fig. 26.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Walsingham wrongly allied this species to *fulvida*, to which it cannot be closely associated. It belongs with *adolescens* and associates.

**Hyposmocoma (Euperissus) ochreovittella** Walsingham (figs. 781, palpus; 850, wing venation; 943, moth; 1144, male genitalia).

*Hyposmocoma ochreovittella* Walsingham, 1907b:606, pl. 22, fig. 10. (In *Fauna Hawaiiensis*, a misprint refers to pl. 12 instead of 22.)



I have not seen the female. The ventral surface of the male forewing bears a heretofore overlooked, remarkable, thornlike process developed from vein 3 (see figure 776). I assume this to be a character confined to the males. The thorn is a less developed form of the even more astonishing structure found on the singular *Euperissus sordidella*. See the expanded discussion under that species.

**Hyposmocoma (Euperissus) nemo** (Walsingham), **new combination** (figs. 785, palpus; 936, moth; 1025, male genitalia).

*Aphthonetus nemo* Walsingham, 1907b:526, pl. 16, fig. 15.

Endemic. Maui (type locality: 5,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Euperissus) nemoricola** (Walsingham), **new combination** (figs. 781, palpus; 936, moth; 1009, male genitalia; 1221, female genitalia).

*Neelysia nemoricola* Walsingham, 1907b:544, pl. 17, fig. 21.

Endemic. Molokai (type locality: forest above Pelekunu).

Hostplant: unknown.

The type pair bear labels that indicate that Walsingham originally considered this moth to be a *Hyposmocoma*, although he described it in *Neelysia*.

**Hyposmocoma (Euperissus) nigrodentata** Walsingham (figs. 848, wing venation; 938, moth; 1140, male genitalia; 1247, female genitalia).

*Hyposmocoma nigrodentata* Walsingham, 1907b:600, pl. 21, fig. 26.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The metapleura of the males examined are abraded, but they appear to lack brushes.

**Hyposmocoma (Euperissus) ningorella** (Walsingham), **new combination** (figs. 782, palpus; 938, moth; 1010, male genitalia; 1222, female genitalia; 1354, wing venation).

*Neelysia ningorella* Walsingham, 1907b:543, pl. 17, fig. 20.

Endemic. Maui (type locality: Haleakala, 5,000 feet or above).

Hostplant: unknown.

The holotype male has a brush of long hairs on the thorax beneath each hindwing. It bears a "*Hyposmocoma*" label, thus indicating that Walsingham changed his mind regarding its generic assignment in his final arrangement of the group.

**Hyposmocoma (Euperissus) ningorifera** (Walsingham), **new combination** (figs. 813, wing venation; 939, moth; 1010, male genitalia).

*Neelysia ningorifera* Walsingham, 1907b:540, pl. 17, fig. 14.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

The abdomen of the female allotype is lost.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

The male has a long, strong, conspicuous, yellow brush which arises from the metathorax at the posterior axil of each hindwing. This brush extends to the fifth abdominal segment. There is also a cluster of long scales on the anterior margin of the metapleuron. The female has a shorter tuft which extends hardly beyond the apex of the coxa. These structures show plainly in figure 943. There are no enlarged squamae on the abdomen (see the discussion under *mactella* above). Walsingham said, "The limbal hair-pencil arises on the upper side of the wing but is sometimes folded underneath; this structure does not occur in *fulvida*, *quadripunctata* and *vicina*, three allied species, which it is difficult otherwise to distinguish from *ochreovittella*." It would appear that Walsingham mistakenly thought that the yellow metapleural brushes belonged to the hairy area on the dorsal vannal surface of the hindwing. See the discussion under *mactella* above.

I have not seen the female genitalia. The female allotype has lost its abdomen. The paratypes are all males.

**Hyposmocoma (Euperissus) oculifera** Walsingham (figs. 850, wing venation; 943, moth; 1145, male genitalia).

*Hyposmocoma oculifera* Walsingham, 1907b:551, pl. 18, fig. 6.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only males have been seen.

**Hyposmocoma (Euperissus) ossea** Walsingham (figs. 851, wing venation; 943, moth; 1145, male genitalia).

*Hyposmocoma ossea* Walsingham, 1907b:595, pl. 21, fig. 16.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Two males only are known.

**Hyposmocoma (Euperissus) pallidipalpis** Walsingham (fig. 944, moth).

*Hyposmocoma pallidipalpis* Walsingham, 1907b:591, pl. 21, fig. 8.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

The unique male holotype has lost its abdomen.

**Hyposmocoma (Euperissus) palmifera** (Meyrick), **new combination** (figs. 944, moth; 1011, male genitalia; 1222, female genitalia; 1354, wing venation).

*Neelysia palmifera* Meyrick, 1935a:63.

Endemic. Oahu (type locality: Pauoa Flats), Hawaii?

Hostplants: *Acacia koa* (in branches affected with rust galls), *Pteralyxia* (in dead twigs), *Sophora tomentosa* (in old pods), *Wikstroemia* (holotype from dead wood).

The Hawaii records are from *Acacia* and *Sophora* as determined by Dr. Swezey. He also reared what he determined to be this moth from *Pteralyxia* in Haleauau Valley, Waianae Mountains, Oahu. I have not examined this material.

The holotype is now in the Bishop Museum.

**Hypsmocoma (Euperissus) palmivora** Meyrick (figs. 863, wing venation; 924, moth; 1248, female genitalia).

*Hypsmocoma palmivora* Meyrick, 1928c:104.

Endemic. Kauai (type locality: Kumuwela, 4,000 feet).

Hostplant: *Pritchardia eriophora*.

The naked larvae were found by Dr. Swezey "feeding amongst the abundant yellowish cottony tomentum on undersides of leaves. . . ." (Meyrick, 1928:104.)

A female paratype (Busck slide 136) has 13 veins in the forewing—veins 3 and 4 are connate and 5 and 5' are connate. The moth was described from a series of eight females; I have not seen the male. The holotype is now in the Bishop Museum.

**Hypsmocoma (Euperissus) paltodorella** (Walsingham), **new combination** (figs. 813, wing venation; 945, moth; 1011, male genitalia; 1222, female genitalia).

*Neelysia paltodorella* Walsingham, 1907b:537, pl. 17, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) passerella** (Walsingham), **new combination** (figs. 785, palpus; 947, moth; 1025, male genitalia).

*Aphthonetus passerella* Walsingham, 1907b:520, pl. 16, fig. 1.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the holotype male was found.

**Hypsmocoma (Euperissus) petalifera** (Walsingham), **new combination** (figs. 813, wing venation; 948, moth; 1011, male genitalia; 1205, female genitalia).

*Neelysia petalifera* Walsingham, 1907b:541, pl. 17, fig. 8.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) petroptilota** (Walsingham), **new combination** (figs. 786, palpus; 807, wing venation; 949, moth; 1000, 1001, male genitalia).

*Semnoprepia petroptilota* Walsingham, 1907b:645, pl. 24, fig. 28.

Endemic. Kauai, Oahu, Maui, Hawaii (type locality: Kilauea).

Hostplants: dead wood of *Metrosideros* and *Pelea*.

The type series includes only males. I have not studied specimens from all

of the islands from which this moth has been recorded, and I am not sure that only one species is involved in the records. It was described from Hawaii and Maui, and Dr. Swezey reported it from Oahu and Kauai. The hostplant records may also be subject to question, because they apply to material collected on islands other than the type island of Hawaii. The species may, however, be widely distributed over the islands.

Dr. Swezey (1910e:141) found the naked white larvae of "*Semnoprepia*" *fulvogrisea*, *petroptilota*, "*Euperissus*" *cristatus*, and "*Hyposmocoma*" *chilonella*, all of which feed in dead wood, to be "quite similar".

***Hyposmocoma (Euperissus) phantasmatella*** Walsingham (figs. 950, moth; 1250, female genitalia; 1353, wing venation).

*Hyposmocoma phantasmatella* Walsingham, 1907b:595, pl. 21, fig. 15.

Endemic. Kauai (type locality: holotype male, 3,000 to 4,000 feet; allotype, Kaholuamano, 4,000 feet).

Hostplant: unknown.

The male holotype has lost its abdomen, and I did not have another male to illustrate the all-important male genitalia.

***Hyposmocoma (Euperissus) philocharis*** (Meyrick), **new combination** (figs. 783, palpus; 951, moth; 993, male genitalia).

*Hyperdasys philocharis* Meyrick, 1915a:344.

*Hyperdasyyella philocharis* (Meyrick) T. B. Fletcher, 1940:18.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

Meyrick (1915a:344) said, "Neither in this species nor in typical *cryptogamiellus* do I see any 'limbal hairpencil' as described. I may add that the 'limbus' as defined and employed by Walsingham and Durrant is in my view merely the dorsum, neither more nor less; the great variation in form of the hindwings sometimes obscures the original triangular form, which is essentially identical with that of the forewings." Meyrick did not fully understand the structure Walsingham referred to, and his criticism displays this lack of understanding. Walsingham's "limbal" area is the anal or vannal area (see the discussion of *Euperissus* above where the synonymy of the old generic names in this group is considered).

I have seen only the unique male holotype which is in the British Museum.

***Hyposmocoma (Euperissus) pittospori*** (Swezey), **new combination** (figs. 952, moth; 999, male genitalia).

*Semnoprepia pittospori* Swezey, 1920b:382.

*Diplosara pittospori* (Swezey) Swezey, 1954:169.

Endemic. Oahu (type locality: Kuliouou).

Hostplant: *Pittosporum*.

Parasite: *Scleroderma semnoprepiae* Bridwell.

I do not know why Dr. Swezey used *Diplosara* for this species in his 1954 report. He said, "This species has been collected only as larvae in dead wood of *Pittosporum* at Kuliouou Valley, Oahu; adults were reared."

**Hypsmocoma (Euperissus) plumbifer** (Walsingham), **new combination** (figs. 785, palpus; 952, moth; 1025, male genitalia).

*Aphthonetus plumbifer* Walsingham, 1907b:524, pl. 16, fig. 10.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

This moth was described from a unique male—I have seen no other specimens.

**Hypsmocoma (Euperissus) pluviella** (Walsingham), **new combination** (figs. 780, palpus; 814, wing venation; 952, moth; 1223, female genitalia).

*Neelysia pluviella* Walsingham, 1907b:540, pl. 17, fig. 13.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

This moth is known from only two females.

**Hypsmocoma (Euperissus) poeciloceras** (Walsingham), **new combination** (figs. 784, palpus; 814, wing venation; 953, moth; 1011, male genitalia; 1223, female genitalia).

*Neelysia poeciloceras* Walsingham, 1907b:542, pl. 17, fig. 18.

Endemic. Maui (type locality: Haleakala, 4,000 feet, allotype male; 5,000 feet, holotype female).

Hostplant: unknown.

Walsingham originally labeled this species as a *Hypsmocoma*, but he described it as a *Neelysia*.

**Hypsmocoma (Euperissus) polia** (Walsingham), **new combination** (figs. 785, palpus; 821, wing venation; 953, moth; 1026, male genitalia, abdomen; 1199, female genitalia).

*Aphthonetus polia* Walsingham, 1907b:525, pl. 16, fig. 13.

Endemic. Kauai (type locality: holotype male, 3,000 to 4,000 feet; allotype female, Halemanu, 4,000 feet).

Hostplant: unknown.

The detached abdomen supposedly of the female allotype was found in a gelatin capsule. In such an instance there is always the possibility that an error in association has been made so that caution is advised.

**Hypsmocoma (Euperissus) prae fracta** (Meyrick), **new combination** (figs. 822, wing venation; 953, moth; 1217, female genitalia).

*Aphthonetus prae fracta* Meyrick, 1935a:63.

Endemic. Kauai (type locality: Kumuwela).

Hostplant: unknown.

I have not seen the male genitalia of this species. The holotype (now in the Bishop Museum) and the two paratypes in Honolulu are females. The one specimen in the Meyrick collection in the British Museum has lost its abdomen.

**Hyposmocoma (Euperissus) pritchardiae** (Swezey), **new combination** (figs. 954, moth; 1002, male genitalia; 1213, female genitalia).

*Bubaloceras pritchardiae* Swezey, 1933b:303.

Endemic. Kauai (type locality: Kumuwela).

Hostplant: *Pritchardia eriophora*.

Swezey observed the larvae "feeding in the abundant fulvous cottony tomentum, with which the spathe and other parts of inflorescence . . . is clothed. The moths are about the color of this cottony substance." The holotype is now in the Bishop Museum.

**Hyposmocoma (Euperissus) psaroderma** (Walsingham), **new combination** (figs. 780, palpus; 955, moth).

*Neelysia psaroderma* Walsingham, 1907b:536, pl. 17, fig. 6.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Hostplant: unknown.

The unique male holotype has lost its abdomen.

**Hyposmocoma (Euperissus) pucciniella** Walsingham (figs. 853, wing venation; 956, moth; 1156, male genitalia; 1250, female genitalia).

*Hyposmocoma pucciniella* Walsingham, 1907b:589, pl. 21, fig. 4.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

**Hyposmocoma (Euperissus) puncticiliata** (Walsingham), **new combination** (figs. 785, palpus; 816, wing venation; 956, moth; 1026, male genitalia, abdomen; 1218, female genitalia).

*Aphthonetus puncticiliata* Walsingham, 1907b:529, pl. 16, fig. 21.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) punctifumella** Walsingham (figs. 956, moth; 1156, male genitalia).

*Hyposmocoma punctifumella* Walsingham, 1907b:584, pl. 20, fig. 19.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

This is a strikingly marked species. Only the male holotype is known.

**Hyposmocoma (Euperissus) quadripunctata** Walsingham (figs. 957, moth; 1251, female genitalia; 1353, wing venation).

*Hyposmocoma quadripunctata* Walsingham, 1907b:607, pl. 22, fig. 11.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The male holotype has lost its abdomen.

**Hyposmocoma (Euperissus) quadristriata** Walsingham (fig. 958, moth).  
*Hyposmocoma quadristriata* Walsingham, 1907b:581, pl. 20, fig. 11.

Endemic. Molokai (type locality: about 4,500 feet).

Hostplant: unknown.

The unique male holotype has lost its abdomen.

**Hyposmocoma (Euperissus) radiatella** Walsingham (figs. 854, wing venation; 959, moth; 1156, 1158, male genitalia; 1209, 1251, female genitalia).

*Hyposmocoma radiatella* Walsingham, 1907b:634, 735; pl. 24, fig. 11.

Endemic. Kauai, Oahu, Molokai, Hawaii (type locality: Kona, 4,000 feet, allotype male; 3,000 feet, holotype female).

Hostplant: unknown.

There may be a complex of similar forms included under this name. My study of the few available specimens has been inconclusive, and further investigations of series of specimens from the various islands are required.

**Hyposmocoma (Euperissus) rediviva** (Walsingham), **new combination** (figs. 814, wing venation; 959, moth; 1012, male genitalia; 1223, female genitalia).

*Neelysia rediviva* Walsingham, 1907b:543, pl. 17, fig. 6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet, holotype male; mountains 3,000 to 4,000 feet, female allotype).

Hostplant: unknown.

Walsingham originally labeled this species as a *Hyposmocoma*, but he described it in *Neelysia*. Note the strong, specialized setae on the costal margins of the male genital valvae which may indicate a trend in the direction of the *Hyposmocoma sensu stricto* developments.

**Hyposmocoma (Euperissus) repandella** (Walsingham), **new combination** (figs. 815, wing venation; 959, moth; 1012, male genitalia; 1223, female genitalia).

*Neelysia repandella* Walsingham, 1907b:536, pl. 17, fig. 5.

Endemic. Molokai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) roseofulva** Walsingham (figs. 784, palpus; 854, wing venation; 960, moth; 1159, male genitalia; 1209, 1252, female genitalia).

*Hyposmocoma roseofulva* Walsingham, 1907b:611, pl. 22, fig. 21.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

This moth has an unusually long, slender, distal labial palpal segment; it is longer than the remainder of the palpus (figure 784). It would appear that Walsingham considered this species to be allied to *carnea*. However, it belongs to *Euperissus*; *carnea* is a member of *Hyposmocoma sensu stricto*.

**Hyposmocoma (Euperissus) rotifer** (Walsingham), **new combination**  
(figs. 780, palpus; 960, moth; 1205, female genitalia).

*Neelysia rotifer* Walsingham, 1907b:539, pl. 17, fig. 11.

Endemic. Molokai (type locality: 3,000 feet).

Hostplant: unknown.

The unique holotype is a female, not a male as stated in the original description.

**Hyposmocoma (Euperissus) rusius** Walsingham (figs. 779, palpus; 961, moth; 1161, male genitalia).

*Hyposmocoma rusius* Walsingham, 1907b:614, pl. 22, fig. 28.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Only the male holotype is known. Although this species was originally placed in *Hyposmocoma*, its male genitalia indicate that it is a member of the typical *Neelysia* group. There is a cluster of long hairs on the anterior dorsal corner of each metapleuron, but they do not form a long brush.

**Hyposmocoma (Euperissus) rutillella** (Walsingham), **new combination**  
(figs. 765, head, wing venation; 962, moth; 1162, male genitalia).

*Rhinomactrum rutilellum* Walsingham, 1907b:531, pl. 16, fig. 25. Type-species of *Rhinomactrum*.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the male holotype is known. It appears not to have any metapleural brushes.

**Hyposmocoma (Euperissus) sagittata** (Walsingham), **new combination**  
(figs. 785, palpus; 822, wing venation; 963, moth; 1027, male genitalia, abdomen; 1218, female genitalia).

*Aphthonetus sagittata* Walsingham, 1907b:530, pl. 16, fig. 24.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) scandens** Walsingham (figs. 856, wing venation; 964, moth; 1169, male genitalia; 1253, female genitalia; col. pl. 6:5).

*Hyposmocoma scandens* Walsingham, 1907b:609, pl. 22, fig. 17.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) scepticella** Walsingham (figs. 781, palpus; 856, wing venation; 965, moth; 1168, male genitalia; 1253, female genitalia).

*Hyposmocoma scepticella* variety *scepticella* Walsingham, 1907b:590, pl. 21, fig. 6.

*Hyposmocoma scepticella* variety *dubia* Walsingham, 1907b:590, pl. 21, fig. 5.

**New synonym.** (Figs. 965, moth; 1168, male genitalia).



Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Walsingham separated three examples with differences in color pattern under the varietal name *dubia*. These specimens came from the same area as the type series of *scepticella*. A separate name does not appear to be required for the color form. When a larger series of specimens is examined, it may be found that the species is more variable than is shown by the few specimens in the type series. Hence, I have reduced the name *dubia* to synonymy.

**Hyposmocoma (Euperissus) sciurella** (Walsingham), **new combination** (figs. 966, moth; 1013, male genitalia).

*Neelysia sciurella* Walsingham, 1907b:546, pl. 17, fig. 26.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Euperissus) semifuscata** Walsingham (figs. 759, 857, head, wing venation; 967, moth; 1168, male genitalia; 1254, female genitalia).

*Hyposmocoma semifuscata* Walsingham, 1907b:589, pl. 21, fig. 3.

Endemic. Hawaii (type locality: Kona, above 2,000 feet to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) semiusta** (Walsingham), **new combination** (figs. 770, wing venation; 786, palpus; 968, moth; 993, male genitalia; 1214, female genitalia).

*Hyperdasys semiustus* Walsingham, 1907b:640, pl. 24, fig. 22.

*Hyperdasyyella semiusta* (Walsingham) Fletcher, 1940:18.

Endemic. Oahu, Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: rotten wood of *Acacia koa*.

This moth was described from Kauai only. The Oahu record and the hostplant record are those of Dr. Swezey.

**Hyposmocoma (Euperissus) sideroxyloni** (Swezey), **new combination** (figs. 822, wing venation; 969, moth; 1027, male genitalia; 1218, female genitalia).

*Aphthonetus sideroxyloni* Swezey, 1932:200, pl. 13, fig. 7.

Endemic. Oahu (type locality: ridge above Puu Peahinaia, Koolau Mountains).

Hostplant: *Pouteria* (*Sideroxylon*) *sandwicensis*.

Dr. Swezey found the larvae feeding "on the under surface of the leaf protected by a frass-covered web."

On a slide preparation of a male paratype (figure 822; Busck slide 153), vein 5 is missing in the hindwing. Thus, the hindwing has only seven veins, and the cell appears open between veins 4 and 7. The forewing has the typical venation of the *Aphthonetus* group, but the abdomen of the male lacks the caudal processes of the *Aphthonetus* group.

The holotype is now in the Bishop Museum.

**Hyposmocoma (Euperissus) sordidella** (Walsingham), **new combination** (figs. 775, head, wing venation; 777, wing process; 971, moth, male genitalia; 972, male genitalia).

*Stigmatophora? sordidella* Walsingham, 1907b:516, pl. 15, fig. 23.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

This extraordinary species displays one of the most singular characters yet to be reported on the wings of Lepidoptera. On the forewing vein 3 has become free from the membrane and has been developed as an astonishing thornlike process which protrudes from the scaling on the underside of the wing (see figures 775 and 777). Most unfortunately, this remarkable species is known only from two male specimens collected by Dr. Perkins in June, 1894. Evidently none have been collected since. Additional specimens of both sexes are required to enable its proper elucidation. At present, we cannot tell whether the thornlike process on the forewing is confined to the male or whether the female has an indication of such a process. I believe that it will be found to be a sexual character confined to the male. Walsingham overlooked the organ, although he called attention to "a small tuft of raised scales at the end of the cell." What is the function of this peculiar structure?

The venation is shown in figure 775. It will be noted that the cell in the forewing is unusually narrow. In the hindwings the discocellulars (the transverse veins closing the distal end of the cell) are obsolescent, and the apex of the cell is thus ill defined (at least in this one specimen). Veins 4 and 5 are evidently fused (or one has been lost), and there are therefore only seven veins in the hindwing. A similar condition is found on (*Aphthonetus*) *sideroxyloni*. These details are probably at least in part confined to the male, and they may be subject to considerable individual variation. The venation is, however, of the basic "*Aphthonetus*" type.

The male genitalia are of the type found in the "*Aphthonetus*" *exsul* or "*Rhinomactrum*" subgroup of *Euperissus* species and demonstrate the close affinity of this noteworthy species to its Hawaiian associates in this subgroup.

It might be considered that *sordidella* represents a distinctive new genus if one were familiar only with existing literature. But when the moth is studied with a knowledge of the astonishing structural radiation in *Hyposmocoma* as a whole, one can only conclude that this species displays one of the extremes of sexual modification in a bewildering species swarm. This conclusion is strengthened when (*Euperissus*) *mystodoxa* is studied. In that species the same vein in the forewing of the male demonstrates a similar but less advanced form of modification (figure 776). The wings of *mystodoxa* are much more generalized than are the more highly modified wings of *sordidella*. Moreover, the male genitalia demonstrate that the two species belong to two species groups of *Euperissus*, and this reveals that the "thorns" on the forewings are independent developments. What other astounding modifications and developments may be revealed when we obtain a more complete knowledge of the magnificent Hawaiian fauna?

It is of interest to compare the different development on the forewings of male *Asymphorodes dimorpha* (figure 745).

**Hypsmocoma (Euperissus) spurcata** (Walsingham), **new combination** (figs. 785, palpus; 970, moth; 1029, male genitalia, abdomen).

*Aphthonetus spurcata* Walsingham, 1907b:523, pl. 16, fig. 9.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Euperissus) stigmatella** Walsingham (figs. 858, wing venation; 973, moth; 1175, male genitalia; 1255, female genitalia).

*Hypsmocoma stigmatella* Walsingham, 1907b:591, pl. 21, fig. 7.

Endemic. Molokai (type locality: above 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) subargentea** Walsingham (figs. 973, moth; 1176, male genitalia).

*Hypsmocoma subargentea* Walsingham, 1907b:596, pl. 21, fig. 18.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Euperissus) subaurata** (Walsingham), **new combination** (figs. 817, wing venation; 974, moth; 1013, male genitalia; 1224, female genitalia).

*Neelysia subaurata* Walsingham, 1907b:541, pl. 17, fig. 16.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

The male genitalia of this species are unusually divergent and appear abnormal for the group. There is an extraordinary reduction of the valvae, and they have become rather similar in form to the long, slender, right lobe of the anellus. On the tegumen there is an unusual, broad, flangelike, sclerotized process extending over the base of the left brachium in the form of a truncated, spatulate uncus. I have not noticed such a process elsewhere in *Hypsmocoma*, but an incipient stage of such a development may be evident on such species as *mactella* (figure 1009), for example. The wings are basically similar to *mactella*—the hindwings are sharply pointed and there is no remnant of vein 2 in the forewings. The aedeagus appears to be unusual. The eighth sternite and the attachment of the genital flaps are atypical as well.

Unfortunately, only one male is known. The slide mount of its genitalia was made before I examined the specimen, and I have been unable to make an adequate study of this strange species. The slide of the female genitalia is unsatisfactory, and I cannot ascertain the structure of various parts. It too, however, appears unusual for this group. Obviously, this divergent species requires much further study.

**Hypsmocoma (Euperissus) subburnea** (Walsingham), **new combination** (figs. 769, head, wing venation; 974, moth; 1002, male genitalia).

*Bubaloceras subburneum* Walsingham, 1907b:549, pl. 18, fig. 3. Type-species of *Bubaloceras*.

Endemic. Molokai (type locality: above 4,000 feet).

Hostplant: unknown.

This moth was described from the unique male holotype. The dilated basal antennal segment with its well-developed pecten led Walsingham to erect a new generic name for it. However, since the development of the first antennal segment and the pecten is subject to much variation in *Hyposmocoma*, this species should not be separated from its obvious allies.

**Hyposmocoma (Euperissus) sublimata** Walsingham (fig. 975, moth).

*Hyposmocoma sublimata* Walsingham, 1907b:568, pl. 19, fig. 13.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Euperissus) subnitida** Walsingham (figs. 787, palpus; 859, wing venation; 946, moth, paratype, color form; 975, moth, holotype; 1178, male genitalia; 1256, female genitalia).

*Hyposmocoma subnitida* Walsingham, 1907b:639, pl. 24, fig. 21.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

**Hyposmocoma (Euperissus) subocellata** (Walsingham), **new combination** (figs. 785, palpus; 822, wing venation; 976, moth; 1028, male genitalia, abdomen).

*Aphthonetus subocellata* Walsingham, 1907b:526, pl. 16, fig. 14.

Endemic. Maui (type locality: Haleakala, 4,000 to 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Euperissus) subsericea** Walsingham (figs. 783, palpus; 976, moth; 1179, male genitalia).

*Hyposmocoma subsericea* Walsingham, 1907b:611, pl. 22, fig. 22.

Endemic. Kauai?, Molokai (type locality: 4,000 feet), Lanai?

Hostplant: unknown.

This moth was originally described from the male holotype from Molokai, one female from Lanai, one female from Kauai, and a male and one other specimen (which I have not examined) from Hawaii. The male paratype from Hawaii represents a distinct species, as my illustration demonstrates, and I have deleted Hawaii from the recorded range. I have also questioned the Kauai and Lanai records. The species from Hawaii confused with *subsericea* is listed tentatively below as new species 29.

**Hyposmocoma (Euperissus) new species 29** (fig. 1180, male genitalia).

*Hyposmocoma* species misidentified as a male paratype of *subsericea* by Walsingham, 1907b:611 (BM slide 7511).

Endemic. Hawaii (Kilauea).

Hostplant: unknown.

**Hypsmocoma (Euperissus) sudorella** Walsingham (figs. 860, wing venation; 977, moth; 1181, male genitalia; col. pl. 6:3).

*Hypsmocoma sudorella* Walsingham, 1907b:607, pl. 22, fig. 12.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

I have not seen the female. The metapleuron of the male has a modest cluster of long hair scales on the anterior margin. The species belongs to the *fulvida* group.

**Hypsmocoma (Euperissus) terminella** (Walsingham), **new combination** (figs. 780, palpus; 979, moth; 1014, male genitalia).

*Neelysia terminella* Walsingham, 1907b:547, pl. 18, fig. 1.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Euperissus) thermoxyla** Meyrick (figs. 783, palpus; 863, wing venation; 980, moth; 1186, male genitalia).

*Hypsmocoma thermoxyla* Meyrick, 1915a:343.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

This moth was described from two males. I have not seen the female genitalia. The male metapleuron has a cluster of long hairs on the anterior margin.

**Hypsmocoma (Euperissus) tigrina** (Butler), **new combination** (figs. 767, wing venation; 780, palpus; 981, moth; 1014, male genitalia).

*Chrysoclista tigrina* Butler, 1881:406.

*Neelysia tigrina* (Butler) Walsingham, 1907b:533, pl. 16, fig. 28.

Endemic. Maui (type locality: Haleakala).

Hostplant: "beaten from 'Koa' trees on Haleakala" (Blackburn's field note).

**Hypsmocoma (Euperissus) tischeriella** (Walsingham), **new combination** (figs. 780, palpus; 815, wing venation; 982, moth; 1014, male genitalia; 1224, female genitalia).

*Neelysia tischeriella* Walsingham, 1907b:545, pl. 17, fig. 24.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Euperissus) trichophora** (Walsingham), **new combination** (figs. 785, palpus; 983, moth; 1029, male genitalia, abdomen).

*Aphthonetus trichophora* Walsingham, 1907b:524, pl. 16, fig. 11.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the male holotype is known. Walsingham said that this species is "closely allied to *plumbifer*, but separable by its more hairy tibiae and the absence of the black and chestnut markings." The species are not allied, however, and they belong to different species groups. This species has the true *Aphthonetus*-type abdominal processes on the male which are lacking on *plumbifer*.

**Hyposmocoma (Euperissus) tricineta** Walsingham (figs. 862, wing venation; 949, moth; 1188, male genitalia; 1258, female genitalia).

*Hyposmocoma tricineta* Walsingham, 1907b:588, pl. 21, fig. 2.

Endemic. Hawaii (type locality: Kona, 2,000 feet).

Hostplant: unknown.

The male allotype has lost its abdomen.

**Hyposmocoma (Euperissus) trilunella** Walsingham (figs. 862, wing venation; 983, moth; 1258, female genitalia).

*Hyposmocoma trilunella* Walsingham, 1907b:583, pl. 20, fig. 17.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Only females of this species are known.

**Hyposmocoma (Euperissus) trivitella** (Swezey), **new combination** (figs. 985, moth; 1030, male genitalia).

*Euhyposmocoma trivitella* Swezey, 1913f:278.

Endemic. Kauai (type locality: near the head of Grove Farm Ditch).

Hostplants: *Elaphoglossum reticulatum*, *Elaphoglossum gorgoneum*.

Parasites: *Echthromorpha agrestoria fuscator* (Fabricius), *Pnigalio externa* (Timberlake).

The larvae bore tunnels in the fern fronds. Dr. Swezey described the larva and pupa as follows (1913f:278):

Full-grown larva 8 mm.; dirty whitish yellow; head very pale brownish, much retracted into segment 2 [= prothorax]; eyes dark brown; cervical shield concolorous; tubercles concolorous, "i" [D1] and "ii" [D2] almost in a longitudinal line, "iii" [SD1] close above spiracle and a little anterior of it, "iv-v" [L1-L2] below spiracles and farther from it than "iii" [SD1] is; setae long, pale; spiracles minute, circular, pale. . .

Pupa 7 mm., light yellowish-brown; eyes black; wing-sheaths and antennae-sheaths extend to apex of seventh abdominal segment; a cluster of bristles at apex of abdomen hooked into silk cocoon. The pupa is formed within the mine in a slight cocoon covered with pellets of frass.

In 1954:86, Dr. Swezey reported that "they have been found only on the east side of the Kauai mountains, behind Lihue and along the summit camp trail."

There are two female specimens on the mount designated as type by Dr. Swezey. I designate the specimen figured herein as the lectotype and the second specimen on the mount as paralectotype.

I am indebted to the late T. Bainbrigge Fletcher who many years ago called my attention to the error in the construction of the specific name. Dr. Swezey meant to refer to the three vittae on the forewings, which he mentioned in his original description, and the name should have been spelled *trivittella*. It was originally spelled *trivitella*, which would refer to "three lives", and the name would have no meaning in this instance. I would prefer to correct the obvious spelling error, but Swezey repeated the misspelling in other publications, and evidently a correction now would not be acceptable under the Code.

The other species formerly associated with *trivitella* in *Euhyposmocoma* is *ekaha* Swezey, and the distinctive palpi (see figures 772 and 778) set these two species apart from other *Hyposmocoma*. It is probable that there are undiscovered species in this complex.

**Hyposmocoma (Euperissus) unicolor** (Walsingham), **new combination** (figs. 987, moth; 994, male genitalia; 1214, female genitalia; 1353, wing venation).

*Hyperdasys unicolor* Walsingham, 1907b:642, pl. 24, fig. 24.

*Hyperdasylella unicolor* (Walsingham) Fletcher, 1940:18.

Endemic. Kauai?, Oahu?, Molokai (type locality: allotype male, above 4,500 feet; holotype female, forest above Pelekunu).

Hostplants: Dr. Swezey found what he considered to be larvae of this species in the dead wood of *Acacia koa*, *Alectryon*, *Bidens*, *Cheirodendron*, *Clermontia*, *Elaeocarpus bifidus*, *Freycinetia*, *Diospyros* (*Maba*), and *Wikstroemia*.

This species was described from one male and one female from Molokai. I have questioned Dr. Swezey's Kauai and Oahu records. I have not examined all of his specimens so that I do not know whether they all represent *unicolor* or whether more than one species is involved. All of the hostplant records are also Dr. Swezey's, and they may include details of more than one species.

**Hyposmocoma (Euperissus) veterella** (Walsingham), **new combination** (figs. 785, palpus; 988, moth; 1218, female genitalia).

*Aphthonetus veterella* Walsingham, 1907b:525, pl. 16, fig. 12.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Euperissus) vicina** Walsingham (figs. 865, wing venation; 989, moth; 1193, male genitalia; 1210, 1259, female genitalia).

*Hyposmocoma vicina* Walsingham, 1907b:607, pl. 22, fig. 13.

Endemic. Oahu (type locality: Waianae Mountains, 1700 feet).

Hostplant: the type series was taken on the trunks of "more or less decayed" *Acacia koa*.

The male has a small yellow brush on the metapleuron beneath the anterior axil of the hindwing.

**Hyposmocoma (Euperissus) new species 35.**

Endemic. Hawaii (Kipuka Ki).

Hostplant: *Sapindus*.

I have seen a series of specimens reared from the bark of the hostplant by C. J. Davis and K. Kawamura which appear to represent a new species in the "*Aphthonetus*" group of *Euperissus*.

Subgenus **HYPOSMOCOMA** Butler, *sensu stricto*

*Hyposmochoma* Butler, 1881:399. Type-species: *Hyposmochoma Blackburnii* Butler, 1881:400, monotypic. Walsingham, 1907b:549.

*Hyposmocoma*: Walsingham, 1907b:549, emendation (see p. 1079). See Zimmerman, 1969, and Melville, 1971, regarding the emendation.

*Diplosara* Meyrick, 1883a:35. Type-species: *Scardia lignivora* Butler, 1879b:273, monotypic. Walsingham, 1907b:646. **New synonym.**

*Agonismus* Walsingham, 1907b:512. Type-species: *Agonismus flavipalpis* Walsing-

ham, 1907b:512, by original designation. **New synonym.**

*Petrochroa* Busck, 1914b:104. Type-species: *Petrochroa swezeyi* Busck, 1914b:105, by original designation. **New synonym.**

For a summary of the characters of this group, see the key to subgenera on p. 1221.

**Hyposmocoma (Hyposmocoma) abjecta** (Butler) (figs. 823, wing venation; 867, moth; 1032 (was this specimen correctly identified?) male genitalia; 1226, female genitalia).

*Laverna abjecta* Butler, 1881:404.

*Hyposmocoma abjecta* (Butler) Walsingham, 1907b:559, 734, pl. 18, fig. 22.

Endemic. Oahu (type locality: none given in the original description. The Blackburn code numbers on the holotype are "77.43", and beneath the card there is what appears to be "L" or "1" over "48"; Butler refers to this in his original description as "No. 48". Could the 48 be an error for 43? Perhaps the "77.43" refers to the 43rd species captured in 1877).

Hostplants: dead *Freyinetia* "and other sticks".

The larva forms "a regular elongate oblong-oval, brown case covered with frass and bits of rotten wood." (Swezey, 1910e:140.)

There may be some confusion regarding this species. It was described from one female whose place of capture remains unknown to me because I lack a key to the Blackburn code numbers. However, one specimen collected by Blackburn bears another code that indicates Oahu, and another Blackburn specimen bears a very small label bearing a ruled "+" mark on the upper and lower surfaces. This could be an early reference to the Waianae Mountains, but it is not the code Blackburn usually used for specimens collected in the Waianae Mountains. Perhaps the small label does not refer to one of Blackburn's collecting areas. See Volume 6 of *Insects of Hawaii* for an explanation of one of the Blackburn codes.

The two specimens mentioned above are labeled "Blackburn 1899". This refers to the date when Meyrick obtained the specimens from Blackburn and not to their date of capture. Blackburn left Hawaii in 1882. Meyrick gave the specimens to Walsingham for inclusion in *Fauna Hawaiiensis*.

Walsingham, in *Fauna Hawaiiensis*, included three specimens taken by Perkins at 2,000 feet in the Waianae Mountains. My figure of the male genitalia is from a specimen collected by Swezey on Pacific Heights in the Koolau Mountains behind Honolulu. I have not compared the moth, from which the genitalia were removed, with the holotype. Dr. Swezey's observations were probably made in the Koolau Mountains. I have compared specimens, including their male genitalia, from the Waianae Mountains and the Koolau Mountains, and they appear to be the same. They all have a short subcostal brush on the hindwing. However, another specimen in the British Museum series, wrongly determined by Durrant as *abjecta*, and collected by Dr. Perkins in the northwest Koolau Mountains, July, 1901, (Walsingham specimen 29138), has a long, heavy, cream-colored, subcostal brush on the hindwing—it represents a different species.



**Hypsmocoma (Hypsmocoma) adjacens** (Walsingham), **new status** (figs. 884, moth; 1196, female genitalia).

*Hypsmocoma cincta* variety *adjacens* Walsingham, 1907b:567, pl. 19, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the female holotype is known. Although this form appears to be closely related to *cincta*, there are differences between the one female of this species and the unique female holotype of *cincta*. This leads me to consider that there are probably two species involved instead of a species and a "variety" as described by Walsingham. Additional specimens, including males, are required to enable a firm decision to be made.

**Hypsmocoma (Hypsmocoma) admirationis** Walsingham (figs. 823, wing venation; 867, moth; 1033, male genitalia).

*Hypsmocoma admirationis* Walsingham, 1907b:580, pl. 20, fig. 10.

Endemic. Molokai (type locality: above 3,000 to 4,000 feet).

Hostplant: unknown.

This belongs to a cluster of species that includes *albonivea*, *alveata*, *carbonenotata*, *hygroscopta*, *irregularis*, probably *oxypetra*, *persimilis*, *propinqua*, *somatodes*, *subscolopax*, *tetraonella*, *torella*, *trimaculata*, and *turdella*. Although *alveata* is typical of this species group within *Hypsmocoma sensu stricto*, it was described by Meyrick as a *Neelysia*, which belongs to subgenus *Euperissus*.

**Hypsmocoma (Hypsmocoma) advena** Walsingham (figs. 868, moth; 1226, female genitalia).

*Hypsmocoma advena* Walsingham, 1907b:569, pl. 19, fig. 14.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hypsmocoma (Hypsmocoma) albifrontella** Walsingham (figs. 869, moth; 1035, male genitalia).

*Hypsmocoma albifrontella* Walsingham, 1907b:565, pl. 19, fig. 5.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Hypsmocoma) albonivea** Walsingham (figs. 825, wing venation; 869, moth; 1015, abdomen; 1036, male genitalia; 1227, female genitalia).

*Hypsmocoma albonivea* Walsingham, 1907b:599, pl. 21, fig. 23.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

This species was described from one female. Dr. Swezey found the male, and it lacks a subcostal brush on the hindwing. I have compared moths collected by Dr. Swezey with the holotype, and they are closely similar. I include a figure of the male genitalia from one of his specimens collected at Punaluu in the Koolau Mountains.

The female genitalia are unusual and are similar to those of *carbonenotata*, for example. The ovipositor is very short, and it has an unusual T-shaped or Y-shaped dorsal sclerite at the apex (such a structure is also found in *alveata*, *carbonenotata*, *hygroscopa*, *persimilis*, and probably other members of the *admirationis* group). See *admirationis* for a list of allied species.

**Hyposmocoma (Hyposmocoma) alliterata** Walsingham (figs. 801, larval case; 826, wing venation; 870, moth; 1037, 1038 male genitalia; 1226, female genitalia; col. pl. 7:7).

*Hyposmocoma alliterata* Walsingham, 1907b:600, 734, pl. 21, fig. 25.

Endemic. Oahu, Molokai (type locality: above 3,000 to 4,000 feet), Maui, Hawaii.

Hostplants: feeds amongst lichens on trees trunks of *Acacia koa*, *Aleurites moluccana*, *Boehmeria*, *Manihot glaziovii* (ceara rubber), *Prosopis*, *Sophora*.

Parasite: *Euderus metallicus* (Ashmead).

This species is thought to range from the lowlands to the highlands, where it is most abundant. Its larvae are at times common on the trunks of living trees. "Larvae in a broad, flat, rounded-oval case coming to a point in front. The case really is not so broad, but has a broad extension on sides and rear made of a single layer of round bits of epidermis from the bark, forming a mosaic of the coloration of the bark of the tree on which it lives, and thus not seen by the casual observer" (Swezey, 1910e:140). Swezey (1954:6) describes the "broad extension" on the case as an "extending flange" and notes that this flange distinguishes the case from that of *empedota*. A cluster of sibling species may be confused here.

**Hyposmocoma (Hyposmocoma) alveata** (Meyrick), **new combination** (figs. 780, palpus; 809, wing venation; 870, moth; 1003, male genitalia; 1219, female genitalia).

*Neelysia alveata* Meyrick, 1915a:339.

Endemic. Oahu [type locality: Koolau Mountains (Mt. Tantalus area?)]

Hostplant: unknown.

Unlike the species placed originally in *Neelysia*, this species has three long spurs near the apices of the valvae. It was erroneously associated with the *Neelysia* group which belong to subgenus *Euperissus*. In the forewings, vein 2 is strong, but vein 6 is weak. This evidently led Meyrick to place the species in *Neelysia*. The male has a subcostal brush on the hindwing, but no member of the *Neelysia* group has a subcostal brush. The male genitalia of *alveata* are closely similar to those of *admirationis* and its associates, but, strangely, *alveata* lacks a pseuduncus. See the notes under *admirationis* for a list of associated species.

**Hyposmocoma (Hyposmocoma) anisoplecta** Meyrick (figs. 871, moth; 1039, male genitalia).

*Hyposmocoma anisoplecta* Meyrick, 1935a:67.

Endemic. Oahu (type locality: Mt. Kaala).

Hostplant: unknown.

Meyrick had before him three specimens from Mt. Kaala, Oahu, and one female from Maui when he described this species. Only fragments of the specimen from Maui remain in Meyrick's collection in the British Museum. It is probable that the Maui female represents a different species, and I have, therefore, deleted Maui from the reported range of this species. The holotype is now in the Bishop Museum.

**Hyposmocoma (Hyposmocoma) arenella** Walsingham (figs. 782, palpus; 826, wing venation; 871, moth; 1040, male genitalia; 1228, female genitalia).

*Hyposmocoma arenella* Walsingham, 1907b:627, pl. 23, fig. 25.

Endemic. Hawaii (type locality: holotype male, Kona, 2,000 feet; allotype female, 3,000 feet).

Hostplant: unknown.

Dr. Swezey (1926b:75) recorded this species from Nihoa Island on the basis of four "poor specimens". His determination was incorrect—the Nihoa specimens represent a different species. See *Hyposmocoma* Leeward Island species 5, above.

**Hyposmocoma (Hyposmocoma) argentifera** (Walsingham), **new combination** (figs. 763, wing venation; 778, palpus; 872, moth; 1215, female genitalia).

*Agonismus argentiferus* Walsingham, 1907b:513, pl. 15, fig. 17.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only two females of *argentifera* are known.

**Hyposmocoma (Hyposmocoma) atrovittella** Walsingham (fig. 874, moth).

*Hyposmocoma atrovittella* Walsingham, 1907b:555, pl. 18, fig. 14.

Endemic. Hawaii (type locality: Olaa).

Hostplant: unknown.

Only the male holotype is known, and it has lost its abdomen.

**Hyposmocoma (Hyposmocoma) auripennis** (Butler) (figs. 827, wing venation; 874, moth; 1041, male genitalia; 1228, female genitalia).

*Gracilaria auripennis* Butler, 1881:404.

*Hyposmocoma auripennis* (Butler) Walsingham, 1907b:571, pl. 19, fig. 18.

Endemic. Maui (type locality: Haleakala. Blackburn's code label on the holotype bears the numbers "81.7 121").

Hostplant: *Acacia koa*.

The male has a small pseuduncus.

**Hyposmocoma (Hyposmocoma) auropurpurea** Walsingham (figs. 779, palpus; 827, wing venation; 875, moth; 1041, male genitalia).

*Hyposmocoma auropurpurea* Walsingham, 1907b:614, pl. 23, fig. 1.

*Hyposmocoma atropurpurea*, misspelling by Swezey, 1913a:198.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

Swezey (1913a:198) recorded it from above Punaluu in the Koolau Mountains.

**Hyposmocoma (Hyposmocoma) bacillella** Walsingham (figs. 800, larval case; 828, wing venation; 875, moth; 1039, male genitalia).

*Hyposmocoma bacillella* Walsingham, 1907b:601, pl. 21, fig. 28.

Endemic. Kauai (type locality: "Halemanu and Kaholuamano", 4,000 feet).

Hostplant: *Metrosideros*.

The larva lives in an elongate conical case, with overlapping lip at the anterior end, the narrower posterior end being obtuse and the whole case having much the appearance of a piece of birch bark, but somewhat darker on the upper than on the under side, the division between the darker and lighter portions being straight and clearly defined. For pupation the case is attached by a short, stiff, thick silken stem from the middle of its underlip to the midrib of the leaf. The case is suspended parallel with the plane of the leaf, two or three fine silk threads attaching its anal extremity to the leaf. (Walsingham, 1907b:602.)

**Hyposmocoma (Hyposmocoma) bella** Walsingham (figs. 876, moth; 1033, male genitalia).

*Hyposmocoma bella* Walsingham, 1907b:614, pl. 22, fig. 27.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Hyposmocoma) belophora** Walsingham (figs. 876, moth; 1043, male genitalia).

*Hyposmocoma belophora* Walsingham, 1907b:631, pl. 24, fig. 4.

Endemic. Oahu (type locality: near the head of Kawailoa Gulch).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Hyposmocoma) bilineata** Walsingham (figs. 828, wing venation; 877, moth; 1229, female genitalia).

*Hyposmocoma bilineata* Walsingham, 1907b:573, pl. 19, fig. 22.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 to 3,000 feet).

Hostplant: unknown.

The holotype is a female, not a male as stated in *Fauna Hawaiiensis*. All specimens seen are females. This species may prove to be a member of the group which includes *thiatma*, but without male specimens no conclusion can be reached.

**Hyposmocoma (Hyposmocoma) blackburnii** Butler (figs. 758, head, wing venation; 800, larval case (does this belong to *blackburnii*?); 877, moth; 1044, male genitalia; 1230, female genitalia).

*Hyposmochoma blackburnii* Butler, 1881:400.

*Hyposmocoma blackburnii* Butler, Walsingham, 1907b:559, 734, pl. 18, fig. 23. The type-species of *Hyposmocoma*.

Endemic. Maui [type locality: "Occurring at about 4000 feet above sea

level on Haleakala, Maui; various localities. I think it is connected with dead wood." (Blackburn, in Butler, 1881:400.) The holotype probably came from near Olinda. It bears the Blackburn field data code 81.7 over 123].

Hostplants: in dead wood of *Acacia koa* (and other trees?).

There is much confusion concerning this species in collections and in literature. It has also been recorded from Kauai and Oahu, and doubtfully from Molokai and Hawaii, but I have deleted those islands from its distribution which I have here restricted to the type island of Maui. My study of the series of specimens under this name in the *Fauna Hawaiiensis* collection has revealed that eight or more species have been mixed under this one name!

There is a series of similar-appearing species distributed throughout the islands. The differences in the male genitalia between these species are remarkable, considering that the specimens were all supposed to be one species. There are collections with several undescribed species in this complex from Oahu and several from Kauai. I have seen others from Molokai and Hawaii. It is probable that all of the main islands have clusters of new species which may outwardly resemble the type of *blackburnii* rather closely, but I have had no opportunity to prepare reports upon them. It will take much detailed fieldwork to elucidate the species of this complex, and I regret deeply that I cannot now contribute further to our knowledge of these moths. They deserve concentrated study in the field and in the laboratory.

Following are listed seven apparently new species of the *blackburnii* species group which I have examined, and the male genitalia of six of these species are illustrated. Comparison of these illustrations of genitalia with the figure of typical *blackburnii* and other species in this complex such as *belophora*, *evanescens*, *haleakalae*, and *lacertella* will reveal immediately the extraordinary range of variation on a common theme in a closely interrelated group of *Hyposmocoma*.

***Hyposmocoma (Hyposmocoma) new species 1*** (fig. 1045, male genitalia).

*Hyposmocoma* species heretofore confused with *blackburnii* (BM male genitalia slide 5512).

Endemic. Kauai (Kaholuamano, 4,000 feet).

Hostplant: unknown.

The thumblike costal process of the left valva is much farther distad on this species than on others of this complex. The pseuduncus is very broad.

***Hyposmocoma (Hyposmocoma) new species 2*** (fig. 1046, male genitalia).

*Hyposmocoma* species heretofore confused with *blackburnii* (BM male genitalia slide 5511).

Endemic. Kauai (Halemanu, 4,000 feet).

Hostplant: unknown.

Note the costal process on the right valva, the broad, apically emarginate process on the left valva, the position of the spur adjacent to its base, and the extraordinary angled second spur.

**Hyposmocoma (Hyposmocoma) new species 3** (fig. 1047, male genitalia).

*Hyposmocoma* species heretofore confused with *blackburnii* (BM male genitalia slide 5505).

Endemic. Kauai (3,000 to 4,000 feet).

Hostplant: unknown.

The left valva approaches the form of typical *blackburnii*, but the costal process is longer than the adjacent costal spurs, whereas it is distinctly shorter than the spurs on *blackburnii*. Note also the major differences at the apex of the right valva.

**Hyposmocoma (Hyposmocoma) new species 4** (fig. 1048, male genitalia).

*Hyposmocoma* species heretofore confused with *blackburnii* (BM male genitalia slide 5506).

Endemic. Oahu (Waianae Mountains, 2,000 feet).

Hostplant: unknown.

The right valva has an angular costal expansion near the basal third; it lacks a long terminal spur. The left valva lacks a long costal process, and the margins of abdominal sternites 4, 5, and 6 are sclerotized. This species may not belong in such close association with *blackburnii* as it is placed here.

**Hyposmocoma (Hyposmocoma) new species 5** (fig. 1049, male genitalia).

*Hyposmocoma* species heretofore confused with *blackburnii* (BM male genitalia slide 5507).

Endemic. Oahu (Waianae Mountains, about 2,000 feet).

Hostplant: unknown.

This moth approaches the species listed below from Kilauea, Hawaii, but the process of the left valva is distinct, the spur nearest it is in a different position, and the spurs are much longer, as illustrated.

**Hyposmocoma (Hyposmocoma) new species 6.**

"*Hyposmocoma* sp.? (? *blackburnii* Btl.)" Walsingham, 1907b:561. Walsingham specimen 26402.

Endemic. Molokai (4,500 feet).

Hostplant: unknown.

This species, represented by one female, appears to be another new species in the *blackburnii* complex, but I cannot be positive of its status until the male is found.

**Hyposmocoma (Hyposmocoma) new species 7** (fig. 1050, male genitalia).

"*Hyposmocoma* sp.? (? *blackburnii* Btl.)" Walsingham, 1907b:561. Walsingham specimen number 27418 (BM male genitalia slide 5513).

Endemic. Hawaii (Kilauea).

Hostplant: unknown.

Although the male genitalia may at first sight appear to be rather similar to new species 5, examination will reveal major differences, as illustrated.

Walsingham (1907b:561) said of this species: "A single specimen, in-

separable in appearance from *blackburnii*, differs in having veins 4 and 5 of the hindwings connate in one wing and short-stalked in the other. The specimen is doubtless abnormal, and being unique it might be rash to name it *blackburnii*, since no similar variation in neuration has been found in the long series from Kauai, Oahu and Maui."

**Hypsmocoma (Hypsmocoma) butalidella** Walsingham (figs. 829, wing venation; 878, moth; 1051, male genitalia; 1230, female genitalia).

*Hypsmocoma butalidella* Walsingham, 1907b:578, pl. 20, fig. 5.

Endemic. Maui (type locality: Haleakala, 7,000 feet).

Hostplant: unknown.

See *malornata* for notes on allies of this species.

**Hypsmocoma (Hypsmocoma) calva** Walsingham (figs. 879, moth; 797, female genitalia).

*Hypsmocoma calva* Walsingham, 1907b:617, pl. 23, fig. 7.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Walsingham described this species from two specimens. Although both sexes are represented, the female is not mentioned in the original description. Unfortunately, the male holotype has lost its abdomen.

**Hypsmocoma (Hypsmocoma) candidella** (Walsingham), **new status** (figs. 926, moth; 1109, male genitalia; 1231, female genitalia).

*Hypsmocoma lupella* variety *candidella* Walsingham, 1907b:564, pl. 19, fig. 2.

Endemic. Hawaii (type locality: Kona, 4,000 feet, holotype male; 3,000 feet, allotype female).

Hostplant: *Acacia koa*?

This moth was considered by Walsingham to be a "variety" of *lupella*, but the differences between the genitalia of the two forms lead me to consider them distinct species. This species has been recorded from Kauai, Molokai, Maui, Lanai, and the type locality of Kona, Hawaii. The genitalia of paratypes from Kauai (wing venation on figure 829), Molokai, and Lanai display differences that indicate that a series of species is involved. No male from Maui has been examined, but I presume that the Maui population is also distinct. I presume, moreover, that an allied form is also represented on Oahu. It is probable that a species swarm is involved here, and I have deleted all locality records except the type locality from the distribution of *candidella*.

Case-making larvae formerly thought to be of this species have been found in or under dead bark of *Acacia koa* on Maui, but these specimens probably belong to an allied species and not to typical *candidella*.

**Hypsmocoma (Hypsmocoma) new species 8** (fig. 1110, male genitalia).

*Hypsmocoma* species confused with *candidella* by Walsingham, 1907b:564.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

This species, represented by a paratype of *candidella* (BM slide 7338), has a very different aedeagus from *candidella*, and the lobes of the anellus and the valvae differ.

**Hyposmocoma (Hyposmocoma) new species 9** (fig. 1111, male genitalia).

*Hyposmocoma* species confused with *candidella* by Walsingham, 1907b:564.

Endemic. Molokai (over 3,000 feet).

Hostplant: unknown.

This species is based on another paratype of *candidella* (BM slide 7337). It has a remarkable, sinuous aedeagus which is strikingly distinct from the aedeagus of any other species I have seen.

**Hyposmocoma (Hyposmocoma) new species 10** (fig. 1112, male genitalia).

*Hyposmocoma* species confused with *candidella* by Walsingham, 1907b:564.

Endemic. Lanai (2,000 feet).

Hostplant: unknown.

The paratype of *candidella* from Lanai (BM slide 7336) represents this species.

**Hyposmocoma (Hyposmocoma) canella** Walsingham (figs. 829, wing venation; 879, moth; 1052, male genitalia; 1207, 1230, female genitalia).

*Hyposmocoma canella* Walsingham, 1907b:602, pl. 22, fig. 1.

*Hyposmocoma tenella*, a misprint and error in determination by Swezey, 1935:94.

Endemic. Kauai, Oahu, Molokai (type locality: 3,000 to over 4,000 feet), Hawaii.

Hostplant: probably lichens.

The larvae are case-makers and have been found on rocks. I have not examined carefully specimens from all of the islands from which this moth has been reported, and I am not sure that it has such a wide distribution.

Although this moth belongs to *Hyposmocoma sensu stricto*, its wing venation shows a strong tendency toward that of the *Aphthonetus* type, although veins 4 and 5 are separate in the forewing. See the legend for figure 1052 for a list of allied forms in this confusing complex. The status of each name requires verification.

**Hyposmocoma (Hyposmocoma) carbonenotata** Walsingham (figs. 830, wing venation; 879, moth; 1053, male genitalia; 1231, female genitalia).

*Hyposmocoma carbonentata* Walsingham, 1907b:599, pl. 21, fig. 24.

Endemic. Kauai type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

See the comments on the female under *albonivea*, and see the notes under *admirationis* for a list of allied species.



**Hyposmocoma (Hyposmocoma) carnea** Walsingham (figs. 783, palpus; 880, moth; 1054, male genitalia).

*Hyposmocoma carnea* Walsingham, 1907*b*:610, pl. 22, fig. 20.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

It would appear from the original description that Walsingham considered this species to be allied to *Hyposmocoma (Euperissus) roseofulva*, but the species belong to different subgenera.

**Hyposmocoma (Hyposmocoma) cincta** Walsingham (figs. 884, moth; 1232, female genitalia).

*Hyposmocoma cincta cincta* Walsingham, 1907*b*:566, pl. 19, fig. 7.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

This moth is known from the female holotype only. The form called *cincta adjacens* by Walsingham is here treated as a species.

**Hyposmocoma (Hyposmocoma) cinereosparsa** Walsingham (figs. 830, wing venation; 885, moth; 1043, male genitalia; 1232, female genitalia).

*Hyposmocoma cinereosparsa* Walsingham, 1907*b*:603, pl. 22, fig. 3.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The ostium of the female genitalia is unusual; see figure 1232.

**Hyposmocoma (Hyposmocoma) commensella** Walsingham (figs. 830, wing venation; 886, moth; 1060, male genitalia; 1232, female genitalia).

*Hyposmocoma commensella* Walsingham, 1907*b*:558, pl. 18, fig. 20.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

The stalking of veins 7 and 8 in the forewings is variable in this species. Walsingham (1907*b*:558) said, "This species is the most generalized of the group [not true], veins 7 and 8 of the forewings, which are normally stalked, being in two specimens (28102-3) separated by a small space (almost connate), while in one specimen (28104) these veins are stalked in one wing and approximated in the other." See figure 830.

**Hyposmocoma (Hyposmocoma) communis** (Swezey), **new combination** (figs. 808, wing venation; 887, moth; 1031, male genitalia).

*Petrochroa communis* Swezey, 1946:627.

Endemic. Kauai, Oahu (type locality: Honolulu).

Hostplant: unknown.

This small moth has been commonly taken at lights in the lowlands of Oahu and supposedly at Kokee, Kauai. There are some apparently minor differences in the male genitalia of the Oahu and Kauai specimens which I have examined, and this may indicate that two forms are involved. This species lacks a pseuduncus. It belongs to the *canella* complex.

**Hyposmocoma (Hyposmocoma) conditella** Walsingham (figs. 782, palpus; 831, wing venation; 888, moth; 1061, male genitalia).

*Hyposmocoma conditella* Walsingham, 1907*b*:620, pl. 23, fig. 12.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

I have only seen male specimens. The male abdomen lacks the extraordinary caudal development of the sixth segment as figured for new species 11 (see below).

**Hyposmocoma new species 11** (figs. 885, moth; 1062, male genitalia, abdomen).

Endemic. Oahu (Waianae Mountains, about 3,000 feet; male genitalia from this locality on BM slide 14317).

Hostplant: unknown.

A specimen of this species was placed near *conditella* by Durrant who correctly observed that it differs from *conditella* because the raised scale tufts on the forewings are lacking on *conditella*. There are also other differences; see the figures of the genitalia and abdomen.

**Hyposmocoma (Hyposmocoma) continuella** Walsingham (figs. 889, moth; 1232, female genitalia).

*Hyposmocoma continuella* Walsingham, 1907*b*:577, pl. 20, fig. 2.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) coruscans** (Walsingham), **new combination** (figs. 763, wing venation; 890, moth; 1016, male genitalia).

*Agonismus coruscans* Walsingham, 1907*b*:513, pl. 15, fig. 16.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Only two males of this small species are recorded.

**Hyposmocoma (Hyposmocoma) corvina** (Butler) (figs. 781, palpus; 831, wing venation; 891, moth; 1063, male genitalia; 1233, female genitalia; col. pl. 7:4).

*Laverna corvina* Butler, 1881:405.

*Hyposmocoma corvina* (Butler) Walsingham, 1907*b*:553, pl. 18, fig. 9.

Endemic. Maui (type locality: Haleakala; the Blackburn code numbers on the type are "81.7 122").

Hostplant: *Acacia koa* (lichens on bark?).

See the notes under *malornata* for a list of allied species. I have deleted the Walsingham records for Molokai because, as my illustrations demonstrate, the Molokai specimens represent an allied but different species. This new species is noted immediately below.

**Hyposmocoma (Hyposmocoma) new species 12** (figs. 1063, 1064, male genitalia).

*Hyposmocoma corvina*, in part, as a misidentification by Walsingham, 1907b: 553 (BM male genitalia slide 2011).

Endemic. Molokai (about 4,000 feet).

Hostplant: unknown.

The type locality of *corvina* is Haleakala, Maui. Those specimens from Molokai that Walsingham determined to be *corvina* represent a different species, as my illustrations reveal.

**Hyposmocoma (Hyposmocoma) costimaculata** Walsingham (figs. 831, wing venation; 891, moth; 1061, male genitalia; 1233, female genitalia).

*Hyposmocoma costimaculata* Walsingham, 1907b: 572, pl. 19, fig. 20.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

It is possible that the allotype female is not the same species as the holotype male.

**Hyposmocoma (Hyposmocoma) crossotis** Meyrick (fig. 892, moth).

*Hyposmocoma crossotis* Meyrick, 1915a: 342.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

The unique female holotype, now in the British Museum, has lost its abdomen.

**Hyposmocoma (Hyposmocoma) cupreomaculata** Walsingham (figs. 893, moth; 1233, female genitalia).

*Hyposmocoma cupreomaculata* Walsingham, 1907b: 561, pl. 18, fig. 24.

Endemic. Molokai (type locality: 3,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) discella** Walsingham (figs. 799, larval case; 832, wing venation; 894, moth; 1066, male genitalia; 1233, female genitalia).

*Hyposmocoma discella* Walsingham, 1907b: 553, pl. 18, fig. 10.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplants: lichens? on the bark of *Cheirodendron* and *Metrosideros*.

The larva makes an "irregular case of silk and frass encrusted with miscellaneous fragments (some of them apparently insect remains)." (Walsingham, 1907b: 554.)

This is a member of the *malornata* group, which see.

**Hyposmocoma (Hyposmocoma) divisa** Walsingham (figs. 783, palpus; 832, wing venation; 896, moth; 1065, male genitalia; 1197, female genitalia).

*Hyposmocoma divisa* Walsingham, 1907b: 554, pl. 18, fig. 11.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) domicolens** (Butler) (figs. 832, wing venation; 896, moth; 1066, 1067, 1068, male genitalia; 1197, female genitalia).

*Laverna domicolens* Butler, 1881:405.

*Hyposmocoma domicolens domicolens* (Butler) Walsingham, 1907b:562, pl. 18, fig. 26.

Endemic. Molokai?, Maui (type locality: Makawao, about 2,000 feet, "in a house"; the Blackburn code numbers on the holotype are "81.7 124"), Lanai?, Hawaii?

Hostplant: unknown.

I have questioned all locality records except that of the type—Maui. I have not made a study of many specimens from a series of localities. However, I have found that one of Walsingham's specimens under this name from Kona, Hawaii (Walsingham specimen 25370, Busck slide 40 in the Bishop Museum) represents a distinct species, and my figures demonstrate differences in the male genitalia of specimens from Hawaii and Lanai. It is probable that a species "swarm" is involved here.

Walsingham included *suffusa* as a variety of this species, but, as my illustrations demonstrate, *domicolens* and *suffusa* are widely distinct species. The holotype is a female, not a male as stated by Walsingham.

The anterior margins of abdominal sternites three to seven are peculiarly thickened (see figure 1066).

**Hyposmocoma (Hyposmocoma) elegantula** (Swezey), **new combination** (figs. 808, wing venation; 898, moth; 1070, male genitalia).

*Petrochroa elegantula* Swezey, 1934:524.

Endemic. Oahu (type locality: Koko Head).

Hostplant: unknown. Dr. Swezey collected adults at flowers of *Lipochaeta integrifolia*, but the larvae and the hostplant remain unknown.

The species was originally assigned incorrectly to the "Cygnodiidae" (Cynodiidae). The male genitalia show close similarity to those of *neckerensis*, but the species have quite distinct color patterns. Both are very small moths for the genus. The metallic-colored scales in the dark apical area of the forewing of *elegantula* look like shining jewels. The yellow macula which joins the base of the dark apical area is conspicuous.

There were three specimens on the single mount that Dr. Swezey labeled type. The specimen figured here (now in the Bishop Museum), is designated lectotype and the other specimens in the type series are now designated paralectotypes.

**Hyposmocoma (Hyposmocoma) empedota** Meyrick (figs. 781, palpus; 833, wing venation; 899, moth; 1071, male genitalia; 1234, female genitalia).

*Hyposmocoma empedota* Meyrick, 1915a:341.

Endemic. Oahu (type locality: Koolau Mountains behind Honolulu, but labeled "Honolulu").

Hostplants: apparently lichenivorous on the bark of *Acacia koa*, *Manihot glaziovii* (ceara rubber), *Prosopis*, and no doubt other trees.

Parasites: *Euderus* ("Omphale", "Secodella") *metallicus* (Ashmead), *Gelis tenellus* (Say), *Lepideupelmus setiger* (Perkins).

The larva is a case-maker. Dr. Swezey (1954:6) has reported that the case does not have the wide flange that the case of *alliterata* has.

The development of the pseuduncuslike organs on the male abdomen is extraordinary. There is a large one on the right side of the seventh segment, a similar long one from the left side of the sixth segment, and much smaller ones on the left side of the seventh segment and the right side of the sixth segment; see figure 1071.

**Hyposmocoma (Hyposmocoma) endryas** Meyrick (figs. 782, palpus; 899, moth).

*Hyposmocoma endryas* Meyrick, 1915a:343.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

The unique male holotype, now in the British Museum, has lost its abdomen.

**Hyposmocoma (Hyposmocoma) evanescens** Walsingham (figs. 781, palpus; 834, wing venation; 901, moth; 1072, male genitalia; 1235, female genitalia).

*Hyposmocoma evanescens* Walsingham, 1907b:574, pl. 19, fig. 25.

Endemic. Maui (type locality: Haleakala, above 5,000 feet).

Hostplant: unknown.

The male genitalia are closely similar to those of *lacertella*. Yet, the moths are so distinctive in appearance that Walsingham separated them rather widely as species 181 and 200 in his list.

**Hyposmocoma (Hyposmocoma) fallacella** Walsingham (figs. 903, moth; 1074, male genitalia).

*Hyposmocoma fallacella* Walsingham, 1907b:605, pl. 22, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Only the male holotype is known. See the commentary under (*Euperissus falsimella* above).

**Hyposmocoma (Hyposmocoma) ferricolor** Walsingham (figs. 904, moth; 1235, female genitalia).

*Hyposmocoma ferricolor* Walsingham, 1907b:575, pl. 19, fig. 26.

Endemic. Hawaii (type locality: Hualalai, 5,000 feet).

Hostplant: unknown.

Walsingham thought it possible that this is a form of *domicolens*, but the genitalia demonstrate that the species are fully distinct. Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) fervida** Walsingham (figs. 782, palpus; 905, moth; 1236, female genitalia).

*Hyposmocoma fervida* Walsingham, 1907b:626, pl. 23, fig. 23.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) filicivora** Meyrick (fig. 905, moth, larval case).

*Hyposmocoma filicivora* Meyrick, 1935a:68.

Endemic. Oahu (type locality: Konahuanui).

Hostplant: *Cibotium chamissoi*.

The larva makes a flat case. It lives in the hollows of dead treefern fronds.

The holotype and one paratype, both of which lack abdomens, are now in the Bishop Museum and the Hawaii State Department of Agriculture collections, respectively.

**Hyposmocoma (Hyposmocoma) flavipalpis** (Walsingham), **new combination** (figs. 762, head, wing venation; 906, moth; 1211, female genitalia).

*Agonismus flavipalpis* Walsingham, 1907b:512, pl. 15, fig. 15. The type-species of *Agonismus*.

Endemic. Maui (type locality: Haleakala, 4,000 feet).

Hostplant: unknown.

This moth is known only from the female.

**Hyposmocoma (Hyposmocoma) fractinubella** Walsingham (figs. 835, 1351, male and female wing venation, respectively; 906, moth; 1075, male genitalia; 1236, female genitalia).

*Hyposmocoma fractinubella* Walsingham, 1907b:592, pl. 21, fig. 10.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) fractistriata** Walsingham (figs. 748, palpus; 835, wing venation; 907, moth; 1076, male genitalia; 1236, female genitalia).

*Hyposmocoma fractistriata* Walsingham, 1907b:635, pl. 24, fig. 13.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

There is an unusual comb of spines on the fourth abdominal tergite of the male in addition to a strong pseuduncus on the seventh tergite. In the male there is a subbasal cluster of slanting, erect, elongate squamae and a few erect hairs on the hindwing vannus, but these are not similar to the *Euperissus* development—they are entirely subbasal and none reaches the wing margin. This cluster of modified vestiture may be obscure and give the appearance that it has been roughened by partial abrasion. This species is definitely a member of subgenus *Hyposmocoma*, and the nature of this modified hindwing

vestiture is so different from that of *Euperissus* that one should not be confused by it.

Walsingham included two specimens from Lanai in his paratype series, but they represent a new species. I have deleted Lanai from the range of this species, and the Lanai species may be designated as new species 13 (see below).

**Hyposmocoma (Hyposmocoma) new species 13** (fig. 1077, male genitalia).

*Hyposmocoma* misidentified as *fractistriata*, paratype, by Walsingham, 1907b:635 (BM male genitalia slide 7599).

Endemic. Lanai.

Hostplant: unknown.

Although this species resembles *fractistriata*, the male genitalia are distinct. It lacks the comb of abdominal spines and a pseuduncus, which features are conspicuously developed on *fractistriata*.

**Hyposmocoma (Hyposmocoma) fuscopurpurea** Walsingham (figs. 836, wing venation; 910, moth; 1081, male genitalia; 1237, female genitalia).

*Hyposmocoma fuscopurpurea* Walsingham, 1907b:582, pl. 20, fig. 14.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) fuscotogata** Walsingham (figs. 910, moth; 1237, female genitalia).

*Hyposmocoma fuscotogata* Walsingham, 1907b:634, pl. 24, fig. 10.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) geminella** Walsingham (figs. 782, palpus; 836, wing venation; 910, moth; 1081, male genitalia; 1238, female genitalia).

*Hyposmocoma geminella* Walsingham, 1907b:594, pl. 21, fig. 13.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) genitalis** Walsingham (figs. 911, moth; 1082, male genitalia; 1200, 1238, female genitalia; 1351, wing venation).

*Hyposmocoma genitalis* Walsingham, 1907b:592, pl. 21, fig. 9.

Endemic. Maui (type locality: 4,000 feet).

Hostplant: unknown.

The seventh abdominal segment of the female is unusual; see figure 1238.

**Hyposmocoma (Hyposmocoma) haleakalae** (Butler) (figs. 837, wing venation; 911, moth; 1083, male genitalia; 1238, female genitalia).

*Chrysoclista? haleakalae* Butler, 1881:407.

*Hyposmocoma haleakalae* (Butler) Walsingham, 1907b:573, pl. 19, fig. 23.

Endemic. Maui (type locality: Haleakala, about 4,000 feet; Blackburn's code on the type label is "81.7 126").

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) hemicasis** Meyrick (figs. 911, moth; 1084, male genitalia; 795, female genitalia).

*Hypsmocoma hemicasis* Meyrick, 1935a:68.

Endemic. Oahu (type locality: Mt. Kaala).

Hostplant: unknown.

The holotype is now in the Bishop Museum.

**Hypsmocoma (Hypsmocoma) humerovittella** Walsingham (figs. 913, moth; 1084, male genitalia).

*Hypsmocoma humerovittella* Walsingham, 1907b:566, pl. 19, fig. 6.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Hypsmocoma) hygroscopa** Meyrick (figs. 913, moth; 1085, male genitalia; 1201, female genitalia; col. pl. 7:6).

*Hypsmocoma hygroscopa* Meyrick, 1935a:66.

Endemic. Kauai (type locality: Halemanu).

Hostplants: lichens? on *Eucalyptus* and *Pandanus* (and no doubt other trees).

The larva builds a case. Larvae have been found on bark and on a *Pandanus* leaf.

There is one female in the Meyrick collection in the British Museum, although Meyrick stated that he had only males. The male holotype (now in the Bishop Museum) and two paratypes in Honolulu are in fragments. They were damaged, together with specimens of other species, during shipment from Meyrick to Honolulu.

See *admirationis* for a list of allied species and see the notes under *oxypetra*.

**Hypsmocoma (Hypsmocoma) illuminata** Walsingham (figs. 837, wing venation; 914, moth; 1080, 1086, male genitalia; 1238, female genitalia).

*Hypsmocoma illuminata* Walsingham, 1907b:570, pl. 19, fig. 17.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

See the comments in the legend to figure 1080.

**Hypsmocoma (Hypsmocoma) impunctata** Walsingham (figs. 914, moth; 1087, male genitalia).

*Hypsmocoma impunctata* Walsingham, 1907b:575, pl. 19, fig. 27.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the male holotype is known.



**Hypsmocoma (Hypsmocoma) indicella** Walsingham (figs. 837, wing venation; 915, moth; 1080, 1088, male genitalia; 1208, 1239, female genitalia).

*Hypsmocoma indicella* Walsingham, 1907b:577, pl. 20, fig. 3.

Endemic. Maui (type locality: Haleakala, 5,000 feet and above).

Hostplant: unknown.

See the comments in the legend for figure 1080.

**Hypsmocoma (Hypsmocoma) intermixta** Walsingham (figs. 916, moth; 1239, female genitalia).

*Hypsmocoma intermixta* Walsingham, 1907b:593, pl. 21, fig. 12.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

I have seen only the unique female holotype.

**Hypsmocoma (Hypsmocoma) inversella** Walsingham (figs. 779, palpus; 916, moth; 1239, female genitalia).

*Hypsmocoma inversella* Walsingham, 1907b:615, pl. 23, fig. 2.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 feet).

Hostplant: unknown.

Only the female is known.

**Hypsmocoma (Hypsmocoma) iodes** Walsingham (figs. 782, palpus; 839, wing venation; 917, moth; 1089, male genitalia; 1239, female genitalia).

*Hypsmocoma iodes* Walsingham, 1907b:621, pl. 23, fig. 14.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) irregularis** Walsingham (figs. 782, palpus; 917, moth; 1090, male genitalia).

*Hypsmocoma irregularis* Walsingham, 1907b:626, pl. 23, fig. 22.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

See the notes under *admirationis* for a list of allied species. Only one male has been collected.

**Hypsmocoma (Hypsmocoma) lacertella** Walsingham (figs. 839, wing venation; 918, moth; 1092, male genitalia; 1240, female genitalia).

*Hypsmocoma lacertella* Walsingham, 1907b:582, pl. 20, fig. 16.

Endemic. Maui (type locality: holotype male, Haleakala, 5,000 feet; allotype female, Olinda, Haleakala, 4,000 feet).

Hostplant: unknown.

The male genitalia are similar to those of *evanescens*, but the moths are conspicuously different in external appearance.

**Hyposmocoma (Hyposmocoma) lactea** Walsingham (figs. 839, wing venation; 918, moth; 1093, male genitalia; 1240, female genitalia).  
*Hyposmocoma lactea* Walsingham, 1907*b*:597, pl. 21, fig. 19.

Endemic. Kauai (type locality: holotype male, Halemanu, 4,000 feet; allotype female, mountains 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) lacticretella** Walsingham (figs. 919, moth; 1240, female genitalia).

*Hyposmocoma lacticretella* Walsingham, 1907*b*:597, pl. 21, fig. 20.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) lebetella** Walsingham (figs. 840, wing venation; 920, moth; 1095, male genitalia; 1240, female genitalia).

*Hyposmocoma lebetella* Walsingham, 1907*b*:557, pl. 18, fig. 18.

Endemic. Maui (type locality: Olinda, Haleakala, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) leporella** Walsingham (figs. 840, wing venation; 920, moth; 1096, male genitalia; 1241, female genitalia).

*Hyposmocoma leporella* Walsingham, 1907*b*:558, pl. 18, fig. 21.

Endemic. Kauai (type locality: holotype male, mountains 3,000 to 4,000 feet; allotype female, Lihue, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) lignivora** (Butler), **new combination** (figs. 761, head, wing venation; 778, palpus; 803, larval case; 805, pupa; 921, moth; 1097, male genitalia, abdomen, larval case; 1098, 1099, male genitalia; 1225, female genitalia).

*Scardia lignivora* Butler, 1879*b*:273.

*Diplosara lignivora* (Butler) Meyrick, 1883*a*:35. Sharp, 1899:429, fig. 207, lateral aspect of moth. Walsingham, 1907*b*:647, pl. 25, fig. 2. Clarke, 1965*a*:498, pl. 245, illustrates wings, venation, head, and male genitalia. Type-species of *Diplosara*.

Endemic. Oahu (type locality: "Bred from larvae feeding on very rotten wood, in mountain forest; Oahu"—Blackburn's field note. Blackburn's original label on the holotype reads, "Sandw. Isl. 79.8 No. 56), Molokai.

Hostplants: the larvae are common in rotten wood and under dead bark of various trees, native and introduced, including *Pisonia*, *Tetraplasandra*, and *Wikstroemia*.

True *lignivora* appears to occur on Oahu and Molokai, but associated distinct forms evidently also occur on Molokai and perhaps on Oahu. It has also been recorded or determined by other workers from Kauai, Lanai, Maui, and Hawaii. I have found, however, that a series of undescribed forms is

involved under this name. A special study of this interesting and divergent complex is required.

This is a common and widely distributed moth on Oahu, and it is attracted frequently to light in the damp areas of the lowlands. The larvae live in large brown cases which are familiar to many collectors, although they may not know to what moth the cases belong. The cases are often found in large numbers beneath the bark of dead trees.

This moth and its associates, although somber colored, are among the most distinctive of *Hypsmocoma*. It is the type of Meyrick's family Diplosaridae, 1915a:339. The wing venation is subject to great variation, and the venation of opposite sides of the same individual may be conspicuously different. For example, veins 4 and 5 in the hindwings may be separate, connate, or variably stalked. This may cause considerable confusion to workers, unfamiliar with the variability, who may be accustomed to consider such differences as generic. The forewings have conspicuous tufts of raised scales on the dorsal surfaces.

On the seventh abdominal tergite of the male there is a broad, transverse, caudal band or comb of numerous, modified, persistent, spinelike squamae unlike anything found on this abdominal segment on any other species of this great genus (see figure 1097). The third segment of the labial palpus is expanded on the upper side with hairs and scales in a most distinctive way (see figures 761, 778). This feature, when not abraded, serves as an easily observable diagnostic feature for this species group. No other *Hypsmocoma* has such vestiture on the palpi.

There is in the British Museum a female of an allied species from Hilo, Hawaii, 2,000 feet, from whose ovipositor protrudes a "chain" of eggs. These eggs, the only ones I have examined in *Hypsmocoma*, are very coarsely reticulated.

The *lignivora* species group has what may be called strongly *Hypsmocoma* type male genitalia with protuberances on the costal margins of the valvae and large spurs and typical subgenus *Hypsmocoma* female genitalia, and thus by genital characters it falls obviously into *Hypsmocoma sensu stricto*. However, much to my astonishment, it has conspicuous vannal hair tufts on the hindwings similar to strongly typical *Euperissus* species. Thus, it is a confusing "rule breaker". I have not yet found any other species group that combines so clearly the characters of the two subgenera of *Hypsmocoma*.

The vannal hair tuft definitely consists of long, fine, sharply pointed hairs. The tuft occurs on the vannus of the hindwings of both sexes of *lignivora*, and on the several new species closely allied to it. These fine hairs overlap the cilia (fringe) just as they do in typical *Euperissus*. It is not similar to the mat of elongate, mostly hairlike scales found on the males (only) of *marginenotata* and *vermiculata*, the discussion of which unusual developments is to be found under the *marginenotata* heading below. Because of the typical subgenus *Hypsmocoma* characters of the male and female genitalia and the fact that the larvae make cases, I now place this species group in *Hypsmocoma sensu stricto*. However, these divergent moths might be considered to belong to a subgenus called *Diplosara* when a more definitive classification of *Hypsmocoma* is prepared.

This was the first endemic species of Hawaiian Microlepidoptera to be described (Butler, 1879b).

**Hyposmocoma (Hyposmocoma) new species 15.**

*Hyposmocoma* species confused with *lignivora* by Walsingham, 1907b:647 (Walsingham specimen 27837; BM male genitalia slide 5518).

Endemic. Kauai (Kaholuamano, 4,000 feet).

Hostplant: unknown.

The costae of the valvae lack the wide dorsal expansions of *lignivora*, and the spurs are narrower and do not have expanded apices as do those of *lignivora*. The caudal band of stiffer, persistent, modified, spinelike squamae on the seventh tergite of *lignivora* appears reduced or absent on this species as it is on species 16 and 17. In gross aspect, the genitalia resemble the photograph of the genitalia of species 17 (figure 1099).

**Hyposmocoma (Hyposmocoma) new species 16.**

*Hyposmocoma* species confused with *lignivora* by Walsingham, 1907b:647 (Walsingham specimen 28735; BM male genitalia slide 5520).

Endemic. Hawaii (Kilauea).

Hostplant: unknown.

This form differs from *lignivora* in the same ways as does species 15. It is possible that it is not specifically distinct from 15. The left brachium, the right anellar lobe, and the valvae differ in shape, but the range of variation of such characters remains to be determined.

**Hyposmocoma (Hyposmocoma) new species 17** (fig. 1099, male genitalia).

*Hyposmocoma* species confused with *lignivora* by Walsingham, 1907b:647 (Walsingham specimen 28733; BM male genitalia slide 2004).

Endemic. Hawaii (Kilauea).

Hostplant: unknown.

This form is close to species 15 and 16 and differs as they do from typical *lignivora*. Its valvae differ in shape from species 15 and 16.

Numbers 15, 16, and 17 are closely allied forms. They may represent local forms of one species, or they may represent slightly differentiated sibling species. I regret that I cannot extend my study in an attempt to elucidate the problems involved. Much more material must be collected and detailed field studies made before anyone can begin to understand this subcomplex.

The female genitalia shown on figure 1225 (Busck slide 55) may belong to new species 16 or 17.

**Hyposmocoma (Hyposmocoma) lineata** Walsingham (figs. 840, wing venation; 922, moth; 1100, male genitalia; 1241, female genitalia).

*Hyposmocoma lineata* Walsingham, 1907b:579, pl. 20, fig. 8.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

This species is closely similar to *ludificata*, but it lacks the subcostal brush on the hindwing which is well developed on *ludificata*.

**Hyposmocoma (Hyposmocoma) liturata** Walsingham (figs. 782, palpus; 801, larval case; 841, wing venation; 922, moth; 1101, 1102, 1103, male genitalia; 1241, female genitalia).

*Hyposmocoma liturata* Walsingham, 1907b:622, pl. 23, fig. 15.

Endemic. Oahu, Hawaii (type locality: Kona, 4,000 feet).

Hostplants: lichens? on rocks and on *Pipturus*.

Parasites: *Coccysgomimus punicipes* (Cresson), *Euderus metallicus* (Ashmead), *Gelis tenellus* (Say).

The larvae make lichen-covered cases.

Walsingham included two specimens in his type series from above 4,000 feet on Molokai. He said, "The Molokai specimens, which are slightly paler, can only be regarded as varieties of this species." These Molokai specimens, however, represent a new species. Specimens from Oahu appear to agree with the type, and the species may be widely distributed. The Molokai form in question may be designated temporarily as new species 18.

**Hyposmocoma (Hyposmocoma) new species 18** (fig. 1104, male genitalia).

*Hyposmocoma* species confused with *liturata* by Walsingham, 1907b:622 (BM male genitalia slide 7501).

Endemic. Molokai (above 4,000 feet).

Hostplant: unknown.

The male genital valvae and the lobes of the anellus are differently shaped from those of *liturata*, as may be seen in the illustration.

**Hyposmocoma (Hyposmocoma) lixiviella** Walsingham (figs. 779, palpus; 841, wing venation; 923, moth; 1100, male genitalia; 1208, 1241, female genitalia).

*Hyposmocoma lixiviella* Walsingham, 1907b:623, pl. 23, fig. 18.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The type series consists of a mixture of more than one species. This was clearly demonstrated by an examination of the male genitalia of the holotype (BM slide 4480) and a paratype (BM slide 5473) and slide-mounted preparations of the wings whose venations also differ. See new species 19 below.

**Hyposmocoma (Hyposmocoma) new species 19** (figs. 841, wing venation; 1100, male genitalia).

*Hyposmocoma* species confused as a paratype of *lixiviella* by Walsingham, 1907b:624 (BM slides 5473a, male wings; 5473b, male genitalia).

Endemic. Kauai (3,000 to 4,000 feet).

Hostplant: unknown.

This species is very different from *lixiviella*, and it belongs near *numida* in the *mimema* group, as my illustrations demonstrate. The spurs on the male genital valvae are broad and flat on this species, the left valva bears an unusual process extending from near the base of the dorsal margin, and from the top of the process there extends an unusually long spur. There are two subterminal

spurs on the left valva and three on the right valva, and each spur is broader than its mesal neighbor. Also, this species has a pseuduncus which *lixiviella* lacks.

**Hyposmocoma (Hyposmocoma) longisquamella** (Walsingham), **new combination** (figs. 774, head, wing venation; 923, moth; 1212, female genitalia).

*Elachista longisquamella* Walsingham, 1907b:514, pl. 15, fig. 19.

*Petrochroa nigrella* Swezey, 1940:465. **New synonym.** (Fig. 923, moth).

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

This tiny species has nothing to do with the genus *Elachista* to which it was originally assigned by Walsingham. It was described from two females.

Swezey's *nigrella* (which was described from specimens collected from low vegetation growing among broken lava on the Mauna Loa Trail about five miles from the Volcano House) proves, upon comparing a paratype with the holotype of *longisquamella*, to be a synonym.

**Hyposmocoma (Hyposmocoma) new species 20** (figs. 790, 1105, male genitalia; 842, wing venation).

*Hyposmocoma* species confused with *longitudinalis* by Walsingham, 1907b:636 (BM male genitalia slide 5437; wing slide 8490).

Endemic. Oahu (Waialua Beach and gulch leading into Opaeha at about 2,000 feet).

Hostplant: unknown.

This species was confused as a member of the type series of *longitudinalis*, but that species belongs to subgenus *Euperissus*! See the discussion under (*Euperissus*) *longitudinalis*.

**Hyposmocoma (Hyposmocoma) lucifer** Walsingham (figs. 924, moth; 1242, female genitalia; col. pl. 6:8).

*Hyposmocoma lucifer* Walsingham, 1907b:574, pl. 19, fig. 24.

Endemic. Molokai (type locality: above 4,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) ludificata** Walsingham (figs. 842, wing venation; 924, moth; 1107, male genitalia; 1242, female genitalia).

*Hyposmocoma ludificata* Walsingham, 1907b:579, pl. 20, fig. 7.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

There are some enlarged, specialized, dorsal squamae on the hindwing posterior to the subcostal brush. It is closely similar to *lineata*, but *ludificata* has a strong, yellow, subcostal brush on the hindwing, whereas *lineata* lacks this structure.

**Hyposmocoma (Hyposmocoma) lupella** Walsingham (figs. 782, palpus; 842, wing venation; 926, moth; 1108, male genitalia; 1243, female genitalia).

*Hyposmocoma lupella lupella* Walsingham, 1907b:563, pl. 18, fig. 28.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown, but the larvae are expected to be found on dead wood.

The larvae, although they remain unknown, are presumed to be case-makers.

This moth has been recorded from Molokai by Swezey and Bryan (1929:300) who unfortunately reported it from a single larval case found in *Freycinetia*. I have deleted this record, because I do not believe that it can be proven to apply to this species.

Walsingham described three "varieties" of *Hyposmocoma lupella*, namely *lupella*, *candidella*, and *suffusella*. We may call this group the *Hyposmocoma lupella* complex. A study of the genitalia of a number of specimens, in which I have been ably assisted by my friend J. D. Bradley, reveals differences that indicate that a series of species is involved. I have, therefore, elevated *candidella* and *suffusella* to specific status. Further discussion may be found under those species headings.

**Hyposmocoma (Hyposmocoma) malornata** Walsingham (figs. 843, 845, wing venation; 928, moth; 1119, 1120, 1121, 1122, 1123, 1125, male genitalia; 1244, female genitalia).

*Hyposmocoma malornata* Walsingham, 1907b:619, pl. 23, fig. 10.

*Hyposmocoma metrosiderella*, in part, by misidentification, Walsingham, 1907b:616.

*Hyposmocoma quinquemaculata*, as a misidentification by Swezey, 1926b:76.

Endemic. Necker, Nihoa, Kauai, Oahu, Molokai, Maui (type locality: Olinda, 4,000 feet), Hawaii.

Hostplant: unknown. I believe that the larva is a case-maker, and it may feed on lichens.

This is evidently a widely spread, variable, and confusing species (or a cluster of sibling species?). It has been reported as abundant at lights at Kilauea, Hawaii, and elsewhere. The holotype, illustrated here, is an example of one of the dark forms. Evidently, some specimens, especially from dryer areas, are paler. The Necker and Nihoa Island records are new and are based upon specimens misidentified by Swezey (1926b:76) and on specimens collected at light by J. W. Beardsley in September, 1964.

Walsingham confused specimens of *malornata* in his type series of *metrosiderella*. I have illustrated the male genitalia and wing venation of one of his paratypes of *metrosiderella* (BM slide 7508). It can easily be seen that the paratype is not *metrosiderella*.

The male genitalia of the *malornata* complex are distinctive, as my several illustrations indicate. The dorsal, sclerotized flaplike or flangelike process on the seventh abdominal tergite, the strongly developed pseuduncus, and the strongly lobed lateral margin of the left genital valva are noteworthy.

Other members of what may be called the *malornata* complex are *corvina*, *discella*, *divisa*, *nivadorsella*, *partita*, *similis*, and possibly some others, including

some undescribed species. This is a confusing cluster of forms, and I have not determined whether some of them represent only varieties or synonyms, or whether they are fully distinct species. It would appear that a number of sibling species is also involved. Long study will be required to resolve the many associated problems.

Dissection of one of the members of the type series of *malornata* from Kauai reveals a distinct species that may be temporarily referred to as new species 22.

**Hypsmocoma (Hypsmocoma) new species 22** (fig. 1124, male genitalia).

*Hypsmocoma* misidentified as *malornata* "homotype" by Walsingham, 1907b:619 (BM male genitalia slide 7503).

Endemic. Kauai (3,000 to 4,000 feet).

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) marginenotata** Walsingham (figs. 843, wing venation; 929, moth; 1118, male genitalia; 1244, female genitalia).

*Hypsmocoma marginenotata* Walsingham, 1907b:585, pl. 20, fig. 22.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The male genitalia of the holotype of this species and those of the holotype of *vermiculata* are confusingly similar; it would appear at first sight that they represent only one species. Surprisingly, however, the male of *marginenotata* has a well-developed subcostal brush on the hindwing whereas the male of *vermiculata* lacks a brush. Walsingham described the brush as "greyish", but I consider it mostly pale yellowish.

This species and its associate *vermiculata* are highly unusual and confusing. Although the hindwings of the female are normal for *Hypsmocoma sensu stricto*—the vannus is clothed only with imbricated, prostrate squamae and there is no long fine hair along vein 1b—the male of each species has a large, conspicuous area or mat of very elongate, slender, flattened, expanded-tip squamae (*not* fine, sharp-pointed true hairs). This might easily cause one to conclude that the males of the species belong to subgenus *Euperissus* if one examined only the hindwings of the male and failed to distinguish between the fine, sharp-pointed true hairs of *Euperissus* and the elongated, flattened, blunt-tipped squamae of *marginenotata* and *vermiculata*. The male genitalia are of the subgenus *Hypsmocoma* type with long, well-developed spurs on the valvae, but the pseuduncus is not developed. See also the discussion in the key to the subgenera of *Hypsmocoma*.

**Hypsmocoma (Hypsmocoma) mediella** Walsingham (figs. 844, wing venation; 930, moth; 1126, male genitalia; 1244, female genitalia).

*Hypsmocoma mediella* Walsingham, 1907b:565, 734, pl. 19, fig. 3.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

This moth evidently occurs on both mountain ranges of Oahu.



**Hypsmocoma (Hypsmocoma) mediospurcata** Walsingham (figs. 844, wing venation; 931, moth; 1227, male genitalia; 1244, female genitalia).  
*Hypsmocoma mediospurcata* Walsingham, 1907b:567, pl. 19, fig. 9.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) mesorectis** Meyrick (figs. 779, palpus; 931, moth; 1128, male genitalia).

*Hypsmocoma mesorectis* Meyrick, 1915a:342.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

Only the male holotype is known.

**Hypsmocoma (Hypsmocoma) metallica** Walsingham (figs. 779, palpus; 844, wing venation; 932, moth; 1127, male genitalia; 1245, female genitalia).

*Hypsmocoma metallica* Walsingham, 1907b:576, pl. 20, fig. 1.

Endemic. Hawaii (type locality: holotype male, about 5,000 feet; allotype female, Kilauea).

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) metrosiderella** Walsingham (figs. 784, palpus; 802, larval case; 932, moth; 1129, male genitalia; 1245, female genitalia; 1351, wing venation).

*Hypsmocoma metrosiderella* Walsingham, 1907b:616, pl. 23, fig. 5.

Endemic. Kauai (type locality: "Halemanu and Kaholuamano", 4,000 feet).

Hostplant: *Metrosideros*.

The larva makes "a rough case of frass with a loose lip. The case is somewhat flattened, pouch-shaped, with a short obtuse curved attenuation posteriorly, the middle is widened and the whole case is of a dull dark brownish and fuscous colour." (Walsingham, 1907:616.)

This moth was described from a series of specimens from Kauai, Oahu, and Maui, but the type series is a mixture of species. At least one of the male paratypes from Oahu belongs to, or very near, *malornata* (see figures 1123, 845). I have, therefore, deleted Oahu and Maui from the recorded distribution of the species.

**Hypsmocoma (Hypsmocoma) mimema** Walsingham (figs. 779, palpus; 845, wing venation; 933, moth; 1130, male genitalia).

*Hypsmocoma mimema* Walsingham, 1907b:613, pl. 22, fig. 26.

Endemic. Maui (type locality: Haleakala, below 4,000 to 5,000 feet).

Hostplant: unknown.

Only two males have been seen. It is not allied to *syrrhaptus* as Walsingham appears to have suggested, but compare *numida*, *pseudolita*, *swezeyi*, *triptila*, and new species 23.

**Hyposmocoma (Hyposmocoma) new species 23** (fig. 1131, male genitalia).

Endemic. Nihoa Island.

Hostplant: unknown.

This is a small white and fuscous species with a forewing length of about 3.4 mm. Several specimens were captured at light in September, 1964, by J. W. Beardsley. This species belongs in association with the *mimema* group which includes such species as *numida*, *pseudolita*, *swezeyi*, and *triptila*, although it is strongly differentiated from each of those species.

The hindwing of the male bears a pale subcostal brush. As will be noted from the illustration, the left genital valva of the male bears most extraordinary, broad, enlarged spurs. Two of the spurs are subapical, and the third, even larger, spur arises from a strong process near the middle of the costal margin of the valva. It is noteworthy that the right lobe of the anellus is longer than the left, although some other species have a similar development. The very slender right brachium should also be noted.

**Hyposmocoma (Hyposmocoma) mimica** Walsingham (figs. 845, wing venation; 933, moth; 1132, male genitalia; 1208, 1245, female genitalia).

*Hyposmocoma mimica* Walsingham, 1907b:622, pl. 23, fig. 16.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

Dr. Swezey (1926b:76) recorded this species from Necker Island from "36 poor specimens", but he made an error in identification. The Necker Island specimens represent another species which is allied to *saccophora* and is discussed under that species heading.

Walsingham (1907b:623) said, "It approaches so nearly in appearance to *Hyposmocoma liturata*, in a parallel series of variations, that the separation of the species would be almost impossible without the character found only in the males." The character he referred to is the presence of a subcostal brush on the hindwing of the male of *liturata* and its absence on *mimica*. However, the male genitalia demonstrate that the species are not closely allied.

**Hyposmocoma (Hyposmocoma) modesta** Walsingham (figs. 846, wing venation; 933, moth; 1132, male genitalia; 1245, female genitalia).

*Hyposmocoma modesta* Walsingham, 1907b:604, pl. 22, fig. 5.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) montivolans** (Butler) (figs. 779, palpus; 802, larval case; 805, pupa; 846, wing venation; 934, moth; 1133, male genitalia).

*Laverna parda*? Butler, variety *montivolans* Butler, 1882:44.

*Hyposmocoma montivolans* (Butler) Walsingham, 1907b:620, pl. 23, fig. 13.

Endemic. Oahu (type locality: mountains near Honolulu; Blackburn's field label numbers are 82.9 162").

Hostplant: lichens?

"The larva feeds on lichens on rocks, living in a silk-lined accumulation of frass, [the case] is slightly pointed toward its anal extremity, the opening at the anterior end being large and straight." (Walsingham, 1907*b*:621.)

I have not seen the female.

**Hyposmocoma (Hyposmocoma) nebulifera** Walsingham (figs. 784, palpus; 846, wing venation; 935, moth; 1134, male genitalia).

*Hyposmocoma nebulifera* Walsingham, 1907*b*:555, 734, pl. 18, fig. 15.

Endemic. Oahu (type locality: mountains near Honolulu, 2,000 feet).

Hostplant: unknown.

I have only seen the male.

**Hyposmocoma (Hyposmocoma) neckerensis** (Swezey), **new combination** (figs. 808, wing venation; 935, moth; 1135, male genitalia).

*Petrochroa neckerensis* Swezey, 1926*b*:78.

Endemic. Necker (type locality), Gardner Island.

Hostplant: unknown.

The male genitalia of *neckerensis* show close similarity to those of *elegantula*, and the species appear to be closely allied. The moths of the type series have been abraded, and the material available for study is poor. See the discussion under *elegantula* above.

The holotype is now in the Bishop Museum.

**Hyposmocoma (Hyposmocoma) nephelodes** Walsingham (figs. 782, palpus; 847, wing venation; 937, moth; 1136, 1137, male genitalia; 1246, female genitalia).

*Hyposmocoma nebulifera* Walsingham, 1907*b*:628, 735, pl. 23, fig. 26; homonym, not of Walsingham, 1907*b*:555.

*Hyposmocoma nephelodes* Walsingham, 1908*b*:109; replacement name.

Endemic. Oahu (type locality: Waianae Mountains, holotype female, allotype male), Maui?

Hostplant: unknown ("beaten from dead boughs").

"When combining tentative MS. genera, abandoned through the occurrence of intermediate forms, the idionym *nebulifera* was inadvertently included *twice* in the genus *Hyposmocoma*. The dionym *Hyposmocoma nebulifera* must be employed to designate no. 147, while, for no. 293, which requires a new name, **nephelodes** nn. is suggested." (Walsingham, 1908*b*:109.)

As my illustrations of the male genitalia demonstrate, there are considerable differences in the shapes of the male genital valvae of the holotype from Oahu and a paratype from Maui. I have not determined whether this is individual variation or whether it indicates that different species are represented.

**Hyposmocoma (Hyposmocoma) niger** Walsingham (figs. 937, moth; 1137, male genitalia).

*Hyposmocoma niger* Walsingham, 1907*b*:582, pl. 20, fig. 15.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

This moth is known only from the male holotype.

**Hyposmocoma (Hyposmocoma) nigralbida** Walsingham (figs. 847, wing venation; 937, moth; 1138, male genitalia; 1246, female genitalia).

*Hyposmocoma nigralbida* Walsingham, 1907*b*:551, pl. 18, fig. 7.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The sclerotized processes of the sixth and seventh segments of the male abdomen are extraordinary, as the illustration demonstrates. The valvae are rather similar to those of *liturata*, but that species has no processes on the sixth abdominal segment (see figures 1101, 1103, 1138).

**Hyposmocoma (Hyposmocoma) nigrescens** Walsingham (figs. 847, wing venation; 938, moth; 1139, male genitalia).

*Hyposmocoma nigrescens* Walsingham, 1907*b*:581, pl. 20, fig. 13.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

I have seen only male specimens.

**Hyposmocoma (Hyposmocoma) nividorsella** Walsingham (figs. 848, wing venation; 940, moth; 1140, male genitalia; 1246, female genitalia).

*Hyposmocoma nividorsella* Walsingham, 1907*b*:552, pl. 18, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) notabilis** Walsingham (figs. 786, palpus; 848, wing venation; 940, moth; 1141, male genitalia; 1247, female genitalia).

*Hyposmocoma notabilis* Walsingham, 1907*b*:556, pl. 18, fig. 17.

Endemic. Molokai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

This species has been known from one pair collected by Dr. Perkins on Molokai, but Dr. Swezey told me that he found the species on Mt. Tantalus, Oahu, in 1909. He also reported (1910*e*:140): "Larva in a nearly smooth subcylindrical case bulged in the middle. Among fibrous matter at base of palm leaves." I presume that the palm was *Pritchardia* and that the material referred to was that collected in 1909. Without study of the specimens in question, I do not wish to accept these data as applying to *notabilis* and have removed the Oahu data from the records of this species.

Fullaway (1914*b*:19–20) recorded this species from Laysan Island on the basis of "larval case only, and it had emergence hole of a parasite." I consider this an unfortunate, erroneous, and careless record.

**Hyposmocoma (Hyposmocoma) numida** Walsingham (figs. 940, moth; 1141, male genitalia).

*Hyposmocoma numida* Walsingham, 1907*b*:581, pl. 20, fig. 12.

Endemic. Maui (type locality: Haleakala, 4,000 feet).

Hostplant: unknown.

This moth is known only from the male holotype.

**Hyposmocoma (Hyposmocoma) ochreocervina** Walsingham (figs. 779, palpus; 849, wing venation; 942, moth; 1143, male genitalia; 1248, female genitalia).

*Hyposmocoma ochreocervina* Walsingham, 1907*b*:612, pl. 22, fig. 23.

Endemic. Oahu (type locality: Waianae Mountains, about 3,000 feet).  
Hostplant: unknown, but the moths were beaten from *Metrosideros*.

**Hyposmocoma (Hyposmocoma) ochreociliata** Walsingham (figs. 781, palpus; 850, wing venation; 942, moth; 1144, male genitalia; 1248, female genitalia).

*Hyposmocoma ochreociliata* Walsingham, 1907*b*:618, pl. 23, fig. 9.

Endemic. Hawaii (type locality: Kilauea).  
Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) oxypetra** Meyrick (figs. 866, wing venation; 943, moth).

*Hyposmocoma oxypetra* Meyrick, 1935*a*:65.

Endemic. Oahu (type locality: Pacific Heights, Honolulu).  
Hostplant: unknown.

The female holotype, now in the Bishop Museum, has lost its abdomen and right hindwing. Dr. Swezey considered that a deformed specimen he reared from a larval case found on a *Pandanus* leaf on Kauai also belonged to this species, but I have not accepted his records. A male abdomen glued to the Swezey specimen proves to be closely similar to that of *hygroscopa* Meyrick, a Kauai species, with which he may have confused it.

In his original description, Meyrick said, "Head whitish—centrally suffused brownish." This is confusing because the lower part of the face above the proboscis is white and a patch of scales above each eye is white; otherwise, the entire top of the head is clothed with dark scales. The mesotibiae are brown, narrowly edged by white beneath and at apex, and they have a diagonal white submedial fascia. The hind legs are lost from the female holotype. The larval case is somewhat similar to that of *trimaculata*? as on figure 799 (middle of bottom figure).

**Hyposmocoma (Hyposmocoma) paradoxa** Walsingham (figs. 779, palpus; 1351, wing venation; 945, moth; 1146, male genitalia; 1249, female genitalia).

*Hyposmocoma paradoxa* Walsingham, 1907*b*:613, pl. 22, fig. 25.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).  
Hostplant: unknown.

Originally, this moth was also reported from Molokai, but Walsingham's type series is mixed, and I have deleted the Molokai record. As figure 1146 demonstrates, the Molokai paratype examined represents a distinct species which may be designated temporarily as new species 24.

**Hyposmocoma (Hyposmocoma) new species 24** (figs. 851, wing venation; 1146, male genitalia).

*Hyposmocoma* confused as a paratype of *paradoxa* from Molokai by Walsingham, 1907b:613; BM male genitalia slide 7502).

Endemic. Molokai (above 3,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) parda** (Butler) (figs. 779, palpus; 946, moth; 1147, male genitalia; 1209, 1249, female genitalia).

*Laverna parda* Butler, 1881:406.

*Hyposmocoma parda* (Butler) Walsingham, 1907b:623, pl. 23, fig. 17.

Endemic. Maui (type locality: Haleakala, about 4,000 feet; Blackburn's field code numbers on the holotype are "81.7 125"), Hawaii.

Hostplant: unknown. Blackburn thought that it was "apparently connected with dead wood." It is a close ally of *saliaris*.

**Hyposmocoma (Hyposmocoma) partita** Walsingham (figs. 947, moth; 1148, male genitalia; col. pl. 7:5).

*Hyposmocoma partita* Walsingham, 1907b:554, pl. 18, fig. 12.

Endemic. Hawaii (type locality: Hilo, 2,000 feet).

Hostplant: unknown.

This is a close ally of *malornata*. The male genitalia of the unique holotype resemble *malornata*, but the moths are differently colored.

Dr. Swezey told me that in 1906 he had reared the species from a dead twig of an unidentified plant on Mt. Tantalus, Oahu, and that no larval case was made. However, I do not believe that Swezey's material was correctly identified. The larva of *partita* is probably a case-maker. Dr. Beardsley told me that the single specimen reared by Dr. Swezey, formerly in the collection of the Hawaiian Sugar Planters' Experiment Station, is now in fragmentary condition and has lost its abdomen. I have, therefore, deleted Oahu from the record of this species.

**Hyposmocoma (Hyposmocoma) patriciella** Walsingham (figs. 947, moth; 1149, male genitalia).

*Hyposmocoma patriciella* Walsingham, 1907b:577, pl. 20, fig. 4.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

Walsingham (1907b:578) stated that there is a "mealy patch on the under side of the forewings", but I cannot see such an area. I believe that he was confused by the strong iridescence in certain lights. What he called purple appears to me to be brown with strong iridescence. Observations made with the aid of a hand lens might have misled Walsingham. Only the male holotype is known.

**Hyposmocoma (Hyposmocoma) persimilis** Walsingham (figs. 798, female genitalia; 851, wing venation; 948, moth; 1149, male genitalia).  
*Hyposmocoma persimilis* Walsingham, 1907*b*:598, pl. 21, fig. 21.

Endemic. Hawaii (type locality: Kona).

Hostplant: unknown.

The holotype is a male. The specimen designated as the female type (allotype) is also a male.

**Hyposmocoma (Hyposmocoma) petroscia** Meyrick (figs. 779, palpus; 852, wing venation; 949, moth; 1148, 1149, male genitalia).  
*Hyposmocoma petroscia* Meyrick, 1915*a*:340.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

Although Meyrick said that he had both sexes when he described the species, the six specimens in the type series are all males. I have not seen the female.

**Hyposmocoma (Hyposmocoma) phalacra** Walsingham (figs. 779, palpus; 852, wing venation; 950, moth; 1151, male genitalia; 1249, female genitalia).  
*Hyposmocoma phalacra* Walsingham, 1907*b*:625, pl. 23, fig. 20.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) pharsotoma** Meyrick (figs. 951, moth; 1147, 1150, male genitalia).  
*Hyposmocoma pharsotoma* Meyrick, 1915*a*:341.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

The male genitalia of this species have a greatly reduced tegumen. The species is known only from the male holotype.

**Hyposmocoma (Hyposmocoma) picticornis** Walsingham (figs. 786, palpus; 951, moth; 1151, 1152, 1153, male genitalia; 1250, female genitalia).  
*Hyposmocoma picticornis* Walsingham, 1907*b*:594, pl. 21, fig. 14.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unknown.

This moth was described from specimens from Molokai and Maui. The specimens from Maui differ somewhat from the Molokai specimens, and they may tentatively be distinguished as the subspecies below.

**Hyposmocoma (Hyposmocoma) new subspecies of picticornis?**  
 (figs. 788, metapleural sense organ; 852, wing venation; 1154, male genitalia).

Endemic. Maui (Olinda, Haleakala, 4,000 feet).

Hostplant: unknown.

The male and female paratypes of *picticornis* from Maui are distinguishable from the typical specimens from Molokai. If the differences observed are not individual, the Maui material represents either a new subspecies or a new species. The Maui specimens are closely similar to the Molokai type. However, the forewings have a different tint, and the fuscous areas on the base of the costa of the forewing extend distinctly farther distad on the Maui form. The costal areas of the right male genital valvae differ in the specimens I have examined, as figures 1151 to 1154 demonstrate.

**Hyposmocoma (Hyposmocoma) progressa** Walsingham (figs. 954, moth; 1250, female genitalia).

*Hyposmocoma progressa* Walsingham, 1907*b*:561, pl. 18, fig. 25.

Endemic. Maui (type locality: Haleakala, below 4,000 feet).

Hostplant: unknown.

Described from only two females.

**Hyposmocoma (Hyposmocoma) prophantis** Meyrick (figs. 781, palpus; 825, wing venation; 954, moth; 1211, female genitalia).

*Hyposmocoma prophantis* Meyrick, 1915*a*:342.

Endemic. Oahu (type locality: Koolau Mountains, near Honolulu).

Hostplant: unknown.

This moth was described from a series of three females. I have not seen the male.

**Hyposmocoma (Hyposmocoma) propinqua** Walsingham (figs. 955, moth; 1155, male genitalia).

*Hyposmocoma propinqua* Walsingham, 1907*b*:580, pl. 20, fig. 9.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.

See the notes under *admirationis* for a list of allied species. This moth is known only from the male holotype.

**Hyposmocoma (Hyposmocoma) pseudolita** Walsingham (figs. 779, palpus; 853, wing venation; 955, moth; 1155, male genitalia).

*Hyposmocoma pseudolita* Walsingham, 1907*b*:625, pl. 23, fig. 21.

Endemic. Oahu (type locality: Waianae Mountains), Molokai?, Hawaii?

Hostplant: unknown.

I am not satisfied with the recorded details regarding the supposed distribution of this species. I have neither seen males from Molokai or Hawaii, nor have I studied an Oahu female.

**Hyposmocoma (Hyposmocoma) punctiplicata** Walsingham (fig. 957, moth).

*Hyposmocoma punctiplicata* Walsingham, 1907*b*:584, pl. 20, fig. 21.

Endemic. Molokai (type locality: above 4,500 feet).

Hostplant: unknown.

Only the female holotype is known, and its abdomen is lost.



**Hyposmocoma (Hyposmocoma) quinquemaculata** Walsingham (figs. 781, palpus; 853, wing venation; 958, moth; 1157, male genitalia; 1251, female genitalia).

*Hyposmocoma quinquemaculata* Walsingham, 1907b:619, pl. 23, fig. 11.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Dr. Swezey (1926b:76) erroneously listed this species from Necker and Nihoa, in the Leeward Hawaiian Islands, on the basis of a number of poor specimens. He misidentified *malornata* as *quinquemaculata*. See the notes under *malornata*.

**Hyposmocoma (Hyposmocoma) rhabdophora** Walsingham (figs. 960, moth; 1251, female genitalia).

*Hyposmocoma rhabdophora* Walsingham, 1907b:571, pl. 19, fig. 19.

Endemic. Molokai (type locality: above 4,000 feet).

Hostplant: unknown.

Only the female holotype is known.

**Hyposmocoma (Hyposmocoma) rubescens** Walsingham (figs. 782, palpus; 854, wing venation; 961, moth; 1160, male genitalia; 1252, female genitalia).

*Hyposmocoma rubescens* Walsingham, 1907b:628, pl. 23, fig. 27.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham included three female specimens from Maui in his type series. I have deleted this Maui record because it is probable that the Maui specimens represent a different species.

**Hyposmocoma (Hyposmocoma) sabulella** Walsingham (figs. 783, palpus; 855, wing venation; 962, moth; 1163, male genitalia; 1252, female genitalia).

*Hyposmocoma sabulella* Walsingham, 1907b:565, pl. 19, fig. 4.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) saccophora** Walsingham (figs. 779, palpus; 799, larval case; 963, moth; 1164, 1165, male genitalia; 1227, female genitalia).

*Hyposmocoma saccophora* Walsingham, 1907b:604, pl. 22, fig. 4.

Endemic. Oahu (type locality: allotype male, Waianae Mountains; holotype female, Mt. Kaala, 3,000 feet).

Hostplant: larva evidently lichenivorous, algivorous, or fungivorous.

This moth was described from a series of seven specimens from Oahu, one male from Molokai, and one female from Kauai. The type series is a mixture of several species. A male from near the head of Kawaiolo Gulch, Oahu, and possibly an associated female whose abdomen has been lost; the specimen from Molokai; and that from Kauai represent three other species

which I have designated below as new species 25, 26, and 27. I have also studied an associated new species from Nihoa and Necker which I have called new species 28.

Of the seven specimens from Oahu, four were collected in the Waianae Mountains and the remaining three were collected near the head of Kawailoa Gulch in the Koolau Mountains. I have examined three of the four former specimens and two of the three latter specimens. The Kawailoa Gulch specimens represent a distinct species which need not be immediately discussed further.

In addition to these specimens, I have studied other Koolau Mountain specimens collected by Dr. Swezey and thought to be *saccophora*. I have illustrated the male genitalia of one of these in figure 1165. This specimen displays certain divergent characters which indicate that it may represent a different form, subspecies, or species. The spurs of the right valva are definitely shorter than those of the allotype and paratype, the genital flaps are differently shaped, and the left spurs and the pseuduncus appear somewhat different. In the male paratype from the Waianae Mountains (Walsingham specimen 25903) the three spurs of the right valva, and the genital flaps, are similar to those of the allotype. The left valva of the paratype has three long spurs, but because one or two of the spurs have been broken off the allotype, they cannot be compared. The pseuduncus of the paratype resembles that of the allotype more than it does the specimen from the Koolau Mountains (BM slide 14300). Without additional specimens, I cannot decide whether or not this Koolau Mountain form is distinct from the Waianae Mountain type.

The larvae, in their long, posteriorly pointed, slender, hornlike, or elongate thornlike portable cases (figure 799), are often abundant on rocks covered with lichens and mosses. I have observed them on steep slopes of consolidated lava cinders and on the near vertical walls of road cuttings and other such steep slopes. They may, of course, occur on level substrates, but they are more easily observed on near vertical areas where there is less debris to conceal them and to confuse the observer.

Perkins collected the larval case, and it was described by Walsingham (1907b:604): "The larval case is in the form of a somewhat stout thorn; whitish, mottled with greyish fuscous, and with a straight opening at the larger extremity which is fitted with a lid, like the operculum of a univalve mollusc." However, it was never revealed how remarkable it is. The case is made by incorporating large numbers of small sand grains in a silk matrix. The cases I measured are between 9.5 and 10.0 mm. long. They are bicolored, pale beneath and dark above, rather like the coloration of a fish. The differences in color are obtained by more completely enclosing the sand grains in pale silk in the paler areas and leaving more of the grains exposed to form the darker dorsum. Thus, the paler sides and venter are sharply set off from the distinctly darker dorsum.

The head end of the larval case is closed by a remarkable operculum. On the underside of the operculum the larva spins a mat of silk. This may be grasped by the mandibles of the larva and pulled down to close the aperture. Astonishingly, the larva attaches stone weights to the top of the operculum, and these would appear to assist in the closing of the operculum.

The larva must enlarge its case several times as it grows to maturity. Each time it extends the case it must remove the stone weights from the top of the operculum, push the operculum upward and incorporate it into the structure of the roof, build a new operculum, and attach a new set of stone weights.

It is interesting to observe that the anterior parts of the body of the larva are more heavily sclerotized and pigmented. The thoracic legs are quite long, and the larva bears great resemblance to the larvae of the Trichoptera.

I cannot suggest what environmental pressure may have led to such a remarkable adaptive divergence in the species group. This species and its associates belong to *Hypsmocoma sensu stricto* in which most, if not all, of the included species are case-makers. There are no ants in the endemic Hawaiian fauna and ants could not have influenced the evolution of the operculum. Endemic *Odynerus* wasps, which formerly were very numerous in Hawaii, are known to prey on the naked larvae of the Xyloryctinae, Carposinidae, and, most especially, the Tortricidae. None is known to prey upon any *Hypsmocoma* larvae. Although our lack of knowledge does not preclude the possibility of their having attacked some species, it appears doubtful that they placed much, if any, pressure on these *Hypsmocoma*. There are various small hymenopterous parasites which are known to parasitize some *Hypsmocoma* larvae, but we know little or nothing about the threat that they may have posed to *Hypsmocoma*. I doubt that it was great.

I do not know of any bird that preyed upon *Hypsmocoma* larvae, and that remarkable observer, Dr. R.C.L. Perkins, never mentioned such predation. Should a bird prey upon these small larvae, I presume that it would either tear open the case and extract the larva or swallow the case and its included larva. An operculum would not, therefore, be a deterrent to bird predation.

The Hawaiian carabid beetle fauna is extensive. It may have been that carabids fed extensively on the larvae, but we have no evidence regarding such predation. Many of the case-makers are found on various surfaces or under bark or in vegetable debris where they could easily be found by Carabidae and their larvae. The case-making species are exposed feeders in contrast with the many concealed feeders which are known in the subgenus *Euperissus* and which do not make cases.

I first observed this, or a closely allied species, in March, 1937, when I prepared the following note: "The larvae appear to feed upon algae or fungi growing on damp rocks. The larvae keep building their cases from the head end by sealing their lids to the sides of the cases along the dorso-lateral lines and then building on to the sides and the end of the lid. As they spin their silk for the cases, small grains of sand, etc., are incorporated into the substance to form part of its structure. When full-grown, the larva uses silk to attach the case by the head end to the rock, and it then hangs tail downward to pupate."

***Hypsmocoma* (*Hypsmocoma*) new species 25** (fig. 1252, female genitalia).

*Hypsmocoma* species confused as a female paratype of *saccophora* by Walsingham, 1907b:604 (Walsingham specimen 26917; BM slide 8079).

Endemic. Kauai (3,000 to 4,000 feet).

Hostplant: unknown.

The ostium of this species is very different from that of the female holotype of *saccophora*. The bursa copulatrix is also distinct.

**Hyposmocoma (Hyposmocoma) new species 26** (fig. 855, wing venation).

*Hyposmocoma* species confused as a paratype of *saccophora* by Walsingham, 1907b:604 (Walsingham specimen 25651; B.M. slide 5472).

Endemic. Oahu (near the head of Kawaiiloa Gulch).

Hostplant: unknown.

This species has a small pseuduncus which is obviously unlike the long pseuduncus of true *saccophora*. Unfortunately, the male genital valvae were lost during the slide mounting process before I saw them so that I am unable to supply information on these all-important structures.

**Hyposmocoma (Hyposmocoma) new species 27** (fig. 1166, male genitalia).

*Hyposmocoma* species confused as a male paratype of *saccophora* by Walsingham, 1907b:604 (Walsingham specimen 26141; BM slide 7327).

Endemic. Molokai (above 3,000 feet).

Hostplant: unknown.

The figure of the genitalia of the male paratype demonstrates that this specimen represents a species distinct from *saccophora*. Moreover, it belongs to a different species group—it should be placed in or near the *adelphella* group.

**Hyposmocoma (Hyposmocoma) new species 28** (fig. 1167, male genitalia).

*Hyposmocoma mimica*, as a misidentification by Swezey, 1926b:76.

Endemic. Necker and Nihoa Islands.

Hostplant: unknown.

This is another small, white and fuscous species. Each forewing is about 4.0 mm. long. The hindwings of the male lack subcostal brushes. The male genitalia indicate that this species belongs to the *saccophora* group. This moth may have the thornlike larval cases which have been observed in the Leeward Islands, although there may be more than one species in the *saccophora* group in the Leeward Islands.

**Hyposmocoma (Hyposmocoma) saliaris** Walsingham (figs. 782, palpus; 855, wing venation; 964, moth; 1169, male genitalia; 1209, 1253, female genitalia).

*Hyposmocoma saliaris* Walsingham, 1907b:624, pl. 23, fig. 19.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

This species appears to be a close ally of *parda*.

**Hyposmocoma (Hyposmocoma) scapulella** (Walsingham), **new combination** (figs. 766, head, wing venation; 964, moth).

*Rhinomactrum?* *scapulellum* Walsingham, 1907b:531, pl. 16, fig. 25.

Endemic. Hawaii (type locality: Olaa).

Hostplant: unknown.

Only one female of this moth is known, and its abdomen is lost. It is not allied to *rutilella*, the type-species of Walsingham's genus *Rhinomactrum*, which belongs to subgenus *Euperissus*. The metanotum is clothed with broad squamae with only a few slender squamae laterad.

**Hyposmocoma (Hyposmocoma) schismatica** Walsingham (figs. 779, palpus; 856, wing venation; 965, moth; 1169, male genitalia; 1210, 1253, female genitalia).

*Hyposmocoma schismatica* Walsingham, 1907b:603, pl. 22, fig. 2.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Walsingham compared this species with *modesta* and *metrosiderella*, but the species are really not close allies.

**Hyposmocoma (Hyposmocoma) scolopax** Walsingham (figs. 857, wing venation; 966, moth; 1170, male genitalia; 1254, female genitalia).

*Hyposmocoma scolopax* Walsingham, 1907b:629, pl. 23, fig. 28.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Molokai.

Hostplant: unknown.

I have not seen a male from Molokai, but externally the two Molokai females in the British Museum are closely similar to specimens from Kauai.

**Hyposmocoma (Hyposmocoma) semicolon** (Walsingham), **new combination** (figs. 768, head, wing venation; 967, moth; 1171, male genitalia; 1225, female genitalia).

*Dysphoria semicolon* Walsingham, 1907b:548, pl. 18, fig. 2. The type-species of *Dysphoria*.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Although Perkins collected a long series of this species, I have no record of its having been rediscovered. The wing venation displays considerable individual variation. In the forewings, veins 4 and 5 may be connate or stalked, and in the hindwings, veins 4 and 5 may be approximate, connate, or stalked. The genitalia are what I call "strong" *Hyposmocoma* type. In the male, the pseuduncus is strongly developed, and the spurs on the valvae are heavy. The ostium of the female is strongly developed and snaillike. I can find no reason to separate this species generically from *Hyposmocoma*—it is a normal member of the nominate subgenus.

**Hyposmocoma (Hyposmocoma) semifusa** (Walsingham), **new combination** (figs. 780, palpus; 815, wing venation; 968, moth; 1224, female genitalia).

*Neelysia semifusa* Walsingham, 1907b:547, pl. 17, fig. 28.

Endemic. Molokai (type locality: about 4,000 feet).

Hostplant: unknown.

Although this species was described as a *Neelysia*, the typical members of which group belong to subgenus *Euperissus*, *semifusa* belongs to *Hyposmocoma sensu stricto*. Only two females are known.

**Hyposmocoma (Hyposmocoma) sideritis** Walsingham (figs. 968, moth; 1172, male genitalia; 1254, female genitalia; 1352, wing venation).

*Hyposmocoma sideritis* Walsingham, 1907b:608, pl. 22, fig. 15.

Endemic. Maui (type locality: Olinda, 4,000 feet).

Hostplant: unknown.

Only the type pair of specimens is known.

**Hyposmocoma (Hyposmocoma) similis** Walsingham (figs. 857, wing venation; 969, moth; 1173, male genitalia).

*Hyposmocoma similis* Walsingham, 1907b:617, pl. 23, fig. 6.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: unknown.

Does *similis* represent a fully distinct species, or is it a pale form of *malornata*? See the notes under *malornata* for a discussion of allied forms. I have not examined a female.

**Hyposmocoma (Hyposmocoma) somatodes** Walsingham (figs. 970, moth; 1174, male genitalia; 1254, female genitalia; 1352, wing venation).

*Hyposmocoma somatodes* Walsingham, 1907b:630, pl. 24, fig. 3.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the type pair is known.

**Hyposmocoma (Hyposmocoma) straminella** Walsingham (figs. 858; 973, moth; 1175, male genitalia; 1255, female genitalia).

*Hyposmocoma straminella* Walsingham, 1907b:576, pl. 19, fig. 28.

Endemic. Hawaii (type locality: Kona, 3,500 to 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) subcitrella** Walsingham (figs. 801, larval case; 858, wing venation; 974, moth; 1177, male genitalia; 1255, female genitalia).

*Hyposmocoma subcitrella* Walsingham, 1907b:632, pl. 24, fig. 6.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplants: lichens? on bark of *Cheirodendron* and *Metrosideros*.

Walsingham (1907b:632) said: "The larval case, which is coated with frass, is streaked with black, especially along its lower edge; it bulges in the middle and is attenuate to either end, the ends obtuse."

**Hyposmocoma (Hyposmocoma) subflavidella** Walsingham (figs. 779, palpus; 859, wing venation; 975, moth; 1178, male genitalia; 1210, 1255, female genitalia).

*Hyposmocoma subflavidella* Walsingham, 1907b:569, pl. 19, fig. 15.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) subscolopax** Walsingham (figs. 784, palpus; 859, wing venation; 976, moth; 1181, male genitalia; 1256, female genitalia).

*Hyposmocoma subscolopax* Walsingham, 1907b:629, pl. 24, fig. 1.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

This species has a subcostal brush on the hindwing. Although its genitalia are only slightly different from those of *tetraonella*, that species lacks the subcostal brush. Moreover, this species has only a very small, incipient pseuduncus whereas *tetraonella* has a strong, fully developed pseuduncus.

**Hyposmocoma (Hyposmocoma) suffusa** (Walsingham), **new status** (figs. 860, wing venation; 896, moth; 1182, male genitalia; 1234, female genitalia).

*Hyposmocoma domicolens* variety *suffusa* Walsingham, 1907b:563, pl. 18, fig. 27.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

This moth was recorded originally from Kauai as well as the type locality of Hawaii. I have deleted the Kauai record which was based on a single female that appears to represent a different species.

Walsingham was in error when he designated this as a variety of *domicolens*. It is a fully distinct species, as an examination of the genitalia will demonstrate.

**Hyposmocoma (Hyposmocoma) suffusella** (Walsingham), **new status** (figs. 860, wing venation; 926, moth; 1113, 1114, male genitalia; 1256, female genitalia).

*Hyposmocoma lupella* variety *suffusella* Walsingham, 1907b:564, pl. 19, fig. 1.

Endemic. Molokai (type locality: above 3,000 feet), Maui.

Hostplant: *Pipturus*.

The larva is known to be a case-maker. The male genitalia of a paratype from Maui are near those of the Molokai holotype. However, the male genitalia of specimens from Kauai and Oahu display distinct differences which indicate that a series of species has been confused under the name *suffusella*. This condition is similar to that found in *candidella*. I consider *suffusella* specifically distinct from *lupella* to which it was attached as a "variety" by Walsingham. It is allied to *lupella* as well as to *candidella*. The so-called paratypes from Kauai and Oahu may be tentatively listed as the two undescribed species 30 and 31.

**Hyposmocoma (Hyposmocoma) new species 30** (fig. 1115, male genitalia).

*Hyposmocoma* species confused with *suffusella* by Walsingham, 1907b:564 (BM male genitalia slide 7335).

Endemic. Kauai (Kaholuamano, 4,000 feet).

Hostplant: unknown.

This species is represented by a paratype of *suffusella* whose male genital valvae differ from those of true *suffusella*.

**Hyposmocoma (Hyposmocoma) new species 31** (fig. 1116, male genitalia).

*Hyposmocoma* species confused with *suffusella* by Walsingham, 1907b:564 (BM male genitalia slide 7334).

Endemic. Oahu (Waianae Mountains, about 2,000 feet).

Hostplant: unknown.

This species is represented by another "paratype" of *suffusella* whose male genitalia differ from true *suffusella*, as illustrated.

In supplementary remarks, 1907b:734, Walsingham mentions specimens from the northwest Koolau Mountains which may also belong here.

**Hyposmocoma (Hyposmocoma) swezeyi** (Busck), **new combination** (figs. 977, moth, larval case; 1031, male genitalia; 1213, female genitalia).

*Petrochroa swezeyi* Busck, 1914b:105.

Endemic. Oahu (type locality: Kaimuki, Honolulu).

Hostplant: larva lichenivorous?

The larvae make small, oval, flattened cases covered with particles of soil. They have been found on rocks. See the notes under the following species heading.

The holotype is in the U.S. National Museum.

**Hyposmocoma (Hyposmocoma) new species 32** (fig. 773, head, wing venation).

*Petrochroa* species confused with *swezeyi* in collections (BM slide 5212).

Endemic. Oahu (Kaimuki, Honolulu).

Hostplant: larva lichenivorous?

This form appears closely allied to *swezeyi*, but its male genitalia display differences which indicate that a species complex is involved here. When Busck described *swezeyi*, he noted that the cell in the hindwing is closed. On the specimen of this species whose wings I figure, the cell is open. Further study of this complex is obviously required.

**Hyposmocoma (Hyposmocoma) syrrhaptēs** Walsingham (figs. 779, palpus; 861, wing venation; 978, moth; 1183, male genitalia; 1256, female genitalia).

*Hyposmocoma syrrhaptēs* Walsingham, 1907b:612, pl. 22, fig. 24.

Endemic. Kauai (type locality: holotype male 3,000 to 4,000 feet; allotype female, Halemanu, 4,000 feet).



Hostplant: unknown.

This moth belongs to the *iodes* complex and is not allied to *mimema* as Walsingham appeared to suggest.

**Hyposmocoma (Hyposmocoma) tarsimaculata** Walsingham (figs. 784, palpus; 861, wing venation; 978, moth; 1184, male genitalia).

*Hyposmocoma tarsimaculata* Walsingham, 1907b:618, 734, pl. 23, fig. 8.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham included one female from Oahu (from near the head of Kawaiiloa Gulch) in his type series. I have deleted the Oahu record from the distribution of this species because I consider the determination of the specimen doubtful. Walsingham also recorded the species from the northwest Koolau Mountains of Oahu in his supplementary remarks on page 734 of *Fauna Hawaiiensis*, but I have not been able to locate such material in the British Museum. Perhaps the specimens are in Honolulu.

**Hyposmocoma (Hyposmocoma) tenuipalpis** Walsingham (figs. 861, wing venation; 979, moth; 1185, male genitalia; 1257, female genitalia).

*Hyposmocoma tenuipalpis* Walsingham, 1907b:557, pl. 18, fig. 19.

Endemic. Molokai (type locality: forest above Pelekunu).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) tetraonella** Walsingham (figs. 784, palpus; 791, 1186, male genitalia; 862, wing venation; 980, moth; 1257, female genitalia).

*Hyposmocoma tetraonella* Walsingham, 1907b:630, pl. 24, fig. 2.

*Hyposmocoma tetraonis* Walsingham, 1907b:632, misspelling (applies to this species?).

Endemic. Hawaii (type locality: Kona, holotype male 4,000 feet; allotype female, 3,500 feet).

Hostplant: unknown.

The male genitalia are similar to those of *subscolopax*, with rather minor differences, but this species lacks a subcostal brush which is developed on the hindwing of *subscolopax*.

**Hyposmocoma (Hyposmocoma) thiatma** Meyrick (fig. 980, moth).

*Hyposmocoma thiatma* Meyrick, 1935a:67.

Endemic. Maui (type locality: Olinda).

Hostplant: unknown.

A state of confusion surrounds the treatment of this species. Meyrick had four examples before him when he described the species (plus another specimen which he considered probably to be this species), but, strangely, it appears that he did not retain any specimens. Moreover, there is not even a name label for the species in his collection. He described *thiatma* from four specimens which he considered to be females. At least one of these four specimens is a male, however. The holotype (now in the Bishop Museum) is a female whose abdomen has been lost. I have not seen the other two specimens and cannot

comment upon them.

Meyrick wrote (1935a:67): "Maui: Olinda, May 13, 1926 (O. H. Swezey); 4 examples. Taken with these on the same day is a single male, which, I think, is probably the other sex of the same species; it is similar, but has the subdorsal streak white, not extending into cilia, and also has a suffused white elongate costal spot about middle and a shorter one at about  $\frac{3}{4}$ ."

At this writing, I have before me the holotype female, one male paratype (considered by Meyrick to be a female), and the other male discussed by Meyrick in the foregoing quotation. The two males are obviously different species, and each of them belongs to a different species group. The male mentioned by Meyrick has a strong, broad pseuduncus, but the male paratype lacks the pseuduncus. The armature of the valvae is conspicuously different in the two species. The male paratype belongs to the group including *auripennis*, *illuminata*, and others, whereas the male discussed by Meyrick may belong to, or near, the *anisoplecta*-like species group. Hence, there are three species represented by these three similar-appearing specimens.

In the holotype female the longitudinal pale vitta of the forewing is more yellow or cream-colored. This color extends through the fringes, and the tegulae and sides of the mesonotum are yellow. In the male paratype the vitta is more white, it does not extend through the cilia, and the tegulae and sides of the mesonotum are not yellow. The same applies to the second male specimen, but its mesonotum is abraded so that I cannot ascertain its normal coloration. This specimen has a submedial and a preterminal white costal macula as noted by Meyrick.

I regret that I have not had all of Meyrick's series before me so that I could make a more detailed report on this complex. It is composed of species which occur together and are externally so closely similar that the renowned expert Meyrick was led to consider them all one species, yet when their male genitalia are studied they are revealed as conspicuously distinct species. There are many such confusing groups of species in *Hypsmocoma*. It is necessary to dissect almost every specimen studied to be sure of the identity of the material.

**Hypsmocoma (Hypsmocoma) new species 33** (fig. 1352, wing venation).

*Hypsmocoma* species confused as a paratype of *thiatma* by Meyrick, 1935a:67, and there stated to be a female whereas it is a male.

Endemic. Maui (Olinda).

Hostplant: unknown.

**Hypsmocoma (Hypsmocoma) new species 34.**

*Hypsmocoma* species thought probably to represent the male of *thiatma* by Meyrick, 1935a:67.

Endemic. Maui (Olinda).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) thoracella** Walsingham (figs. 782, palpus; 981, moth; 1257, female genitalia; 1352, wing venation).

*Hyposmocoma thoracella* Walsingham, 1907*b*:568, pl. 19, fig. 11.

Endemic. Lanai (type locality: above 2,000 feet).

Hostplant: unknown.

The male holotype bears the British Museum male genitalia slide number 4104. However, no photograph of it was prepared when the *Hyposmocoma* genitalia were being illustrated, and I have been unable to locate such a slide in the collection. This is most unfortunate because only the one male is known.

**Hyposmocoma (Hyposmocoma) tomentosa** Walsingham (figs. 982, moth; 1257, female genitalia).

*Hyposmocoma tomentosa* Walsingham, 1907*b*:605, pl. 22, fig. 6.

Endemic. Hawaii (type locality: Kona, 3,000 feet).

Hostplant: unknown.

This moth was described from two females, and I have not seen the male.

**Hyposmocoma (Hyposmocoma) torella** Walsingham (figs. 784, palpus; 982, moth; 1187, male genitalia).

*Hyposmocoma torella* Walsingham, 1907*b*:627, pl. 23, fig. 24.

Endemic. Molokai (type locality: not definitely known because the type bears no specific locality data for Molokai. However, it was collected by Perkins on June 12, 1893, and on that date Perkins collected at least some insects which he designated as lot 176 from the mountains at 3,000 feet).

Hostplant: unknown.

Only the male holotype is known.

**Hyposmocoma (Hyposmocoma) torquata** Walsingham (figs. 925, moth; 1258, female genitalia).

*Hyposmocoma torquata* Walsingham, 1907*b*:556, pl. 18, fig. 16.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham, in his original description, said that the holotype is a male, but it is a female. The paratype is also a female. Walsingham's statement that the male lacks a subcostal brush on the hindwing is meaningless—he had not seen a male.

**Hyposmocoma (Hyposmocoma) trifasciata** (Swezey), **new combination** (fig. 983, moth).

*Petrochroa trifasciata* Swezey, 1915*e*:97.

Endemic. Hawaii (type locality: Laupahoehoe).

Hostplant: larva lichenivorous?

The color pattern of this moth is unusual; see figure 983. Unfortunately, the unique female holotype in the Bishop Museum has lost its abdomen. It was reared from a larval case found by Dr. Swezey "on rocks at the top of the sea-cliff." He said that the larval case was "3 mm. long, oval, of white silk covered with minute particles of sand and dirt."

**Hyposmocoma (Hyposmocoma) trimaculata** Walsingham (figs. 779, palpus; 799, larval case of this species?; 864, wing venation; 984, moth; 1189, male genitalia; 1258, female genitalia).

*Hyposmocoma trimaculata* Walsingham, 1907*b*:598, pl. 21, fig. 22.

Endemic. Oahu (type locality: Waianae Mountains).

Hostplants: lichens? on and beneath the bark of *Acacia koa* and *Aleurites moluccana*.

Parasites: *Atrometus tarsatus* Ashmead, *Lepideupelmus setiger* (Perkins).

The larva forms "a short subcylindrical case, constricted near each end, covered with minute bits of lichen. . . ." (Swezey, 1910*e*:140). I have not verified the determination of the Swezey material.

See the notes under *admiratonis* for a list of allied species.

**Hyposmocoma (Hyposmocoma) trimelanota** Meyrick (fig. 984, moth).

*Hyposmocoma trimelanota* Meyrick, 1935*a*:66.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Only the male holotype, now in the Bishop Museum, is known, and it has lost its abdomen and right forewing.

**Hyposmocoma (Hyposmocoma) tripartita** Walsingham (figs. 984, moth; 1189, male genitalia; col. pl. 6:7).

*Hyposmocoma tripartita* Walsingham, 1907*b*:567, pl. 19, fig. 10.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.

The female is not known.

**Hyposmocoma (Hyposmocoma) triptila** Meyrick (figs. 779, palpus; 825, wing venation; 985, moth; 1190, male genitalia).

*Hyposmocoma triptila* Meyrick, 1915*a*:340.

Endemic. Oahu (type locality: Koolau Mountains, collected by Perkins in 1908, no further locality given).

Hostplant: unknown.

On the left male genital valva is a most unusual, enormous, trowellike modified seta. It is a most singular development and one of the most extreme forms of genital spur that I have yet seen in this remarkable genus. I have only seen the two males originally described by Meyrick.

**Hyposmocoma (Hyposmocoma) trossulella** Walsingham (figs. 986, moth; 1191, male genitalia).

*Hyposmocoma trossulella* Walsingham, 1907*b*:554, 734, pl. 18, fig. 13.

Endemic. Oahu (type locality: Waianae Mountains, about 2,000 feet).

Hostplant: unknown.

This moth is also supposed to occur in the Koolau Mountains, but I have only seen the male holotype from the Waianae Mountains.

**Hyposmocoma (Hyposmocoma) turdella** Walsingham (figs. 781, palpus; 864, wing venation; 986, moth; 1192, male genitalia; 1259, female genitalia).

*Hyposmocoma turdella* Walsingham, 1907*b*:631, pl. 24, fig. 5.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) unistriata** Walsingham (figs. 864, wing venation; 987, moth; 1190, male genitalia; 1259, female genitalia; col. pl. 6:6).

*Hyposmocoma unistriata* Walsingham, 1907*b*:578, pl. 20, fig. 6.

Endemic. Molokai (type locality: holotype male, forest above Pelekunu; allotype female, 4,000 feet).

Hostplant: unknown.

**Hyposmocoma (Hyposmocoma) vermiculata** Walsingham (figs. 865, wing venation; 988, moth; 1193, male genitalia).

*Hyposmocoma vermiculata* Walsingham, 1907*b*:585, pl. 20, fig. 23.

Endemic. Molokai?, Hawaii (type locality: Kilauea).

Hostplant: unknown.

Walsingham included two female examples from Molokai in his original series. Pending study of males from Molokai, I prefer to question the locality record. I have not examined a female from the island of Hawaii.

This species appears quite similar to *marginenotata*. See the comments under that species name above, and note the unusual vestiture of the vannus of the hindwing.

**Hyposmocoma (Hyposmocoma) vinicolor** Walsingham (figs. 782, palpus; 865, wing venation; 989, moth; 1259, female genitalia).

*Hyposmocoma vinicolor* Walsingham, 1907*b*:615, pl. 23, fig. 3.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Hostplant: unknown.

This moth was described from two females. I have not seen the male.

**Hyposmocoma (Hyposmocoma) virgata** Walsingham (figs. 866, wing venation; 989, moth; 1194, male, female genitalia; col. pl. 7:1).

*Hyposmocoma virgata* Walsingham, 1907*b*:572, pl. 19, fig. 21.

Endemic. Molokai (type locality: about 4,000 feet), Maui.

Hostplant: unknown.

(Text continued on page 1701.)

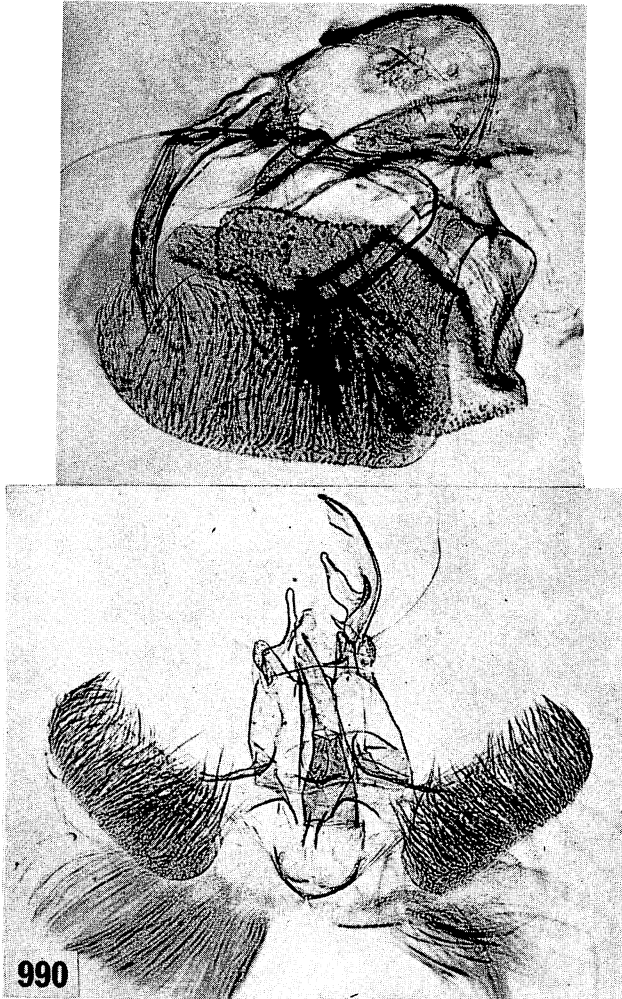


Figure 990—Male genitalia of *Hyposmocoma* (*E.*) *arundinicolor* (Walsingham) (“*Hyperdasyella*”). Top, the holotype (BM slide 4424); Kauai, 3,000 to 4,000 feet. Bottom, a paratype from the same locality (BM slide 2006). There may be differences between these forms; the genitalia of the holotype should be remounted and restudied.

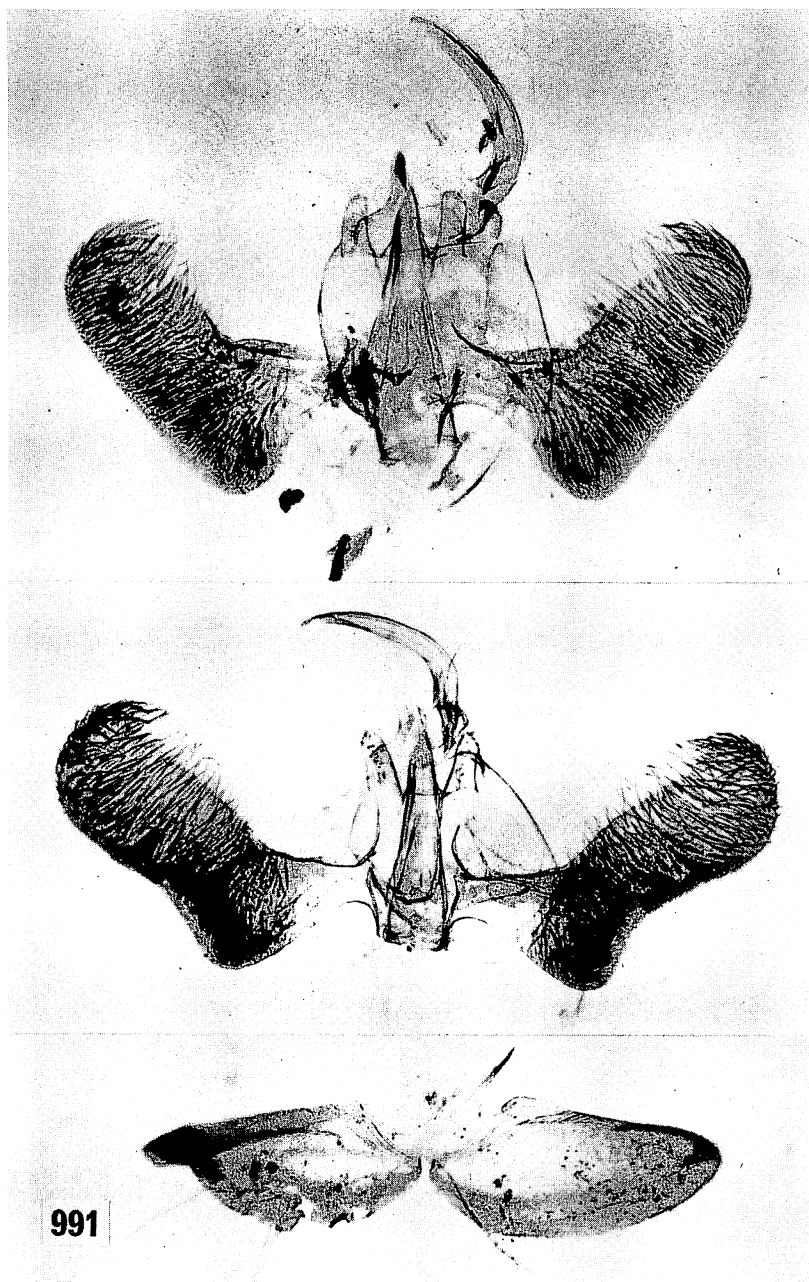


Figure 991—Male genitalia of *Hyposmocoma* (*E.*) *cryptogamiella* (Walsingham) ("*Hyperdasyella*"). Top, a paratype (BM slide 7521) from about 4,000 feet on Molokai. Bottom, a paratype from Kauai, 3,000 to 4,000 feet (BM slide 7519). These may represent different forms. This is the type-species of *Hyperdasyella*. Compare figure 992 of the holotype.

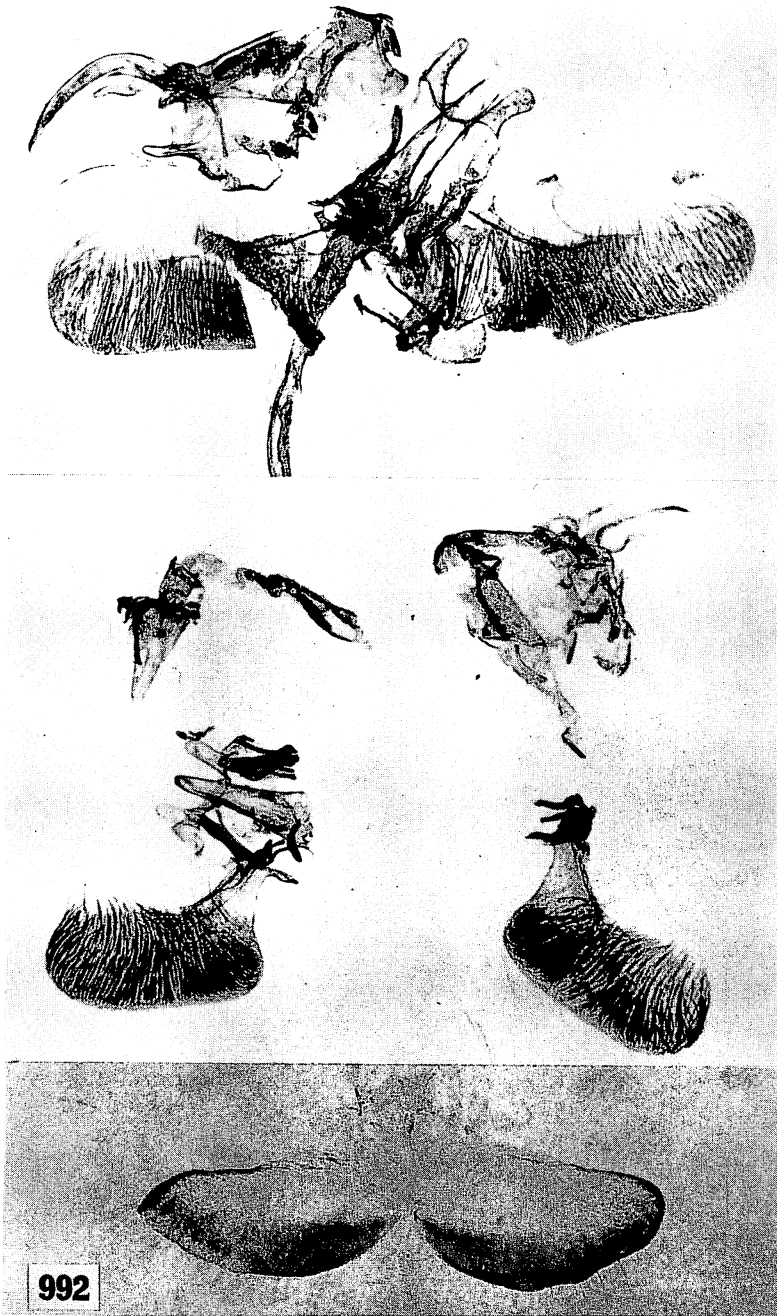


Figure 992 —Male genitalia of *Hypsmocoma* (E.) *cryptogamiella* (Walsingham) ("*Hyperdasylella*"). Top the holotype (BM slide 4428*b*); Olaa, Hawaii. Bottom, a paratype from the Waianae Mts., 3,000 feet, Oahu (BM slide 7520). These dissections were damaged during remounting from older, unsatisfactory mounts.



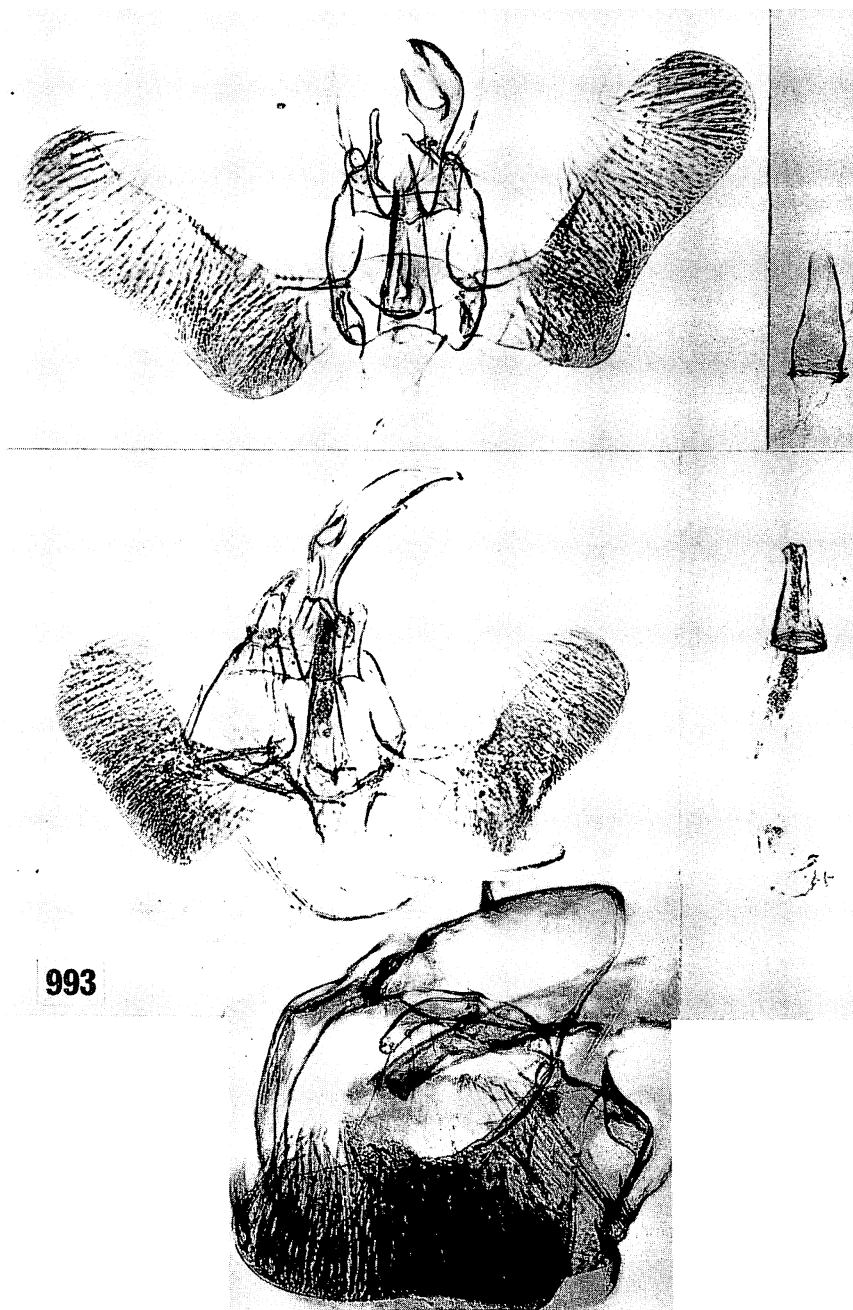


Figure 993—Male genitalia of *Hypsomoema* (*Euperissus*). Top, *philocharis* (Meyrick) ("*Hyperdasylella*"), holotype, (BM slide 9578 Clarke); Honolulu. Middle and bottom, *semiusta* (Walsingham) ("*Hyperdasylella*"), holotype (BM slide 4426); Kauai, 3,000 to 4,000 feet. The middle figure is of the present mount; the bottom figure is as it was previously mounted. At the right of the two top figures are the ejaculatory ducts pulled out of the aedeagus.

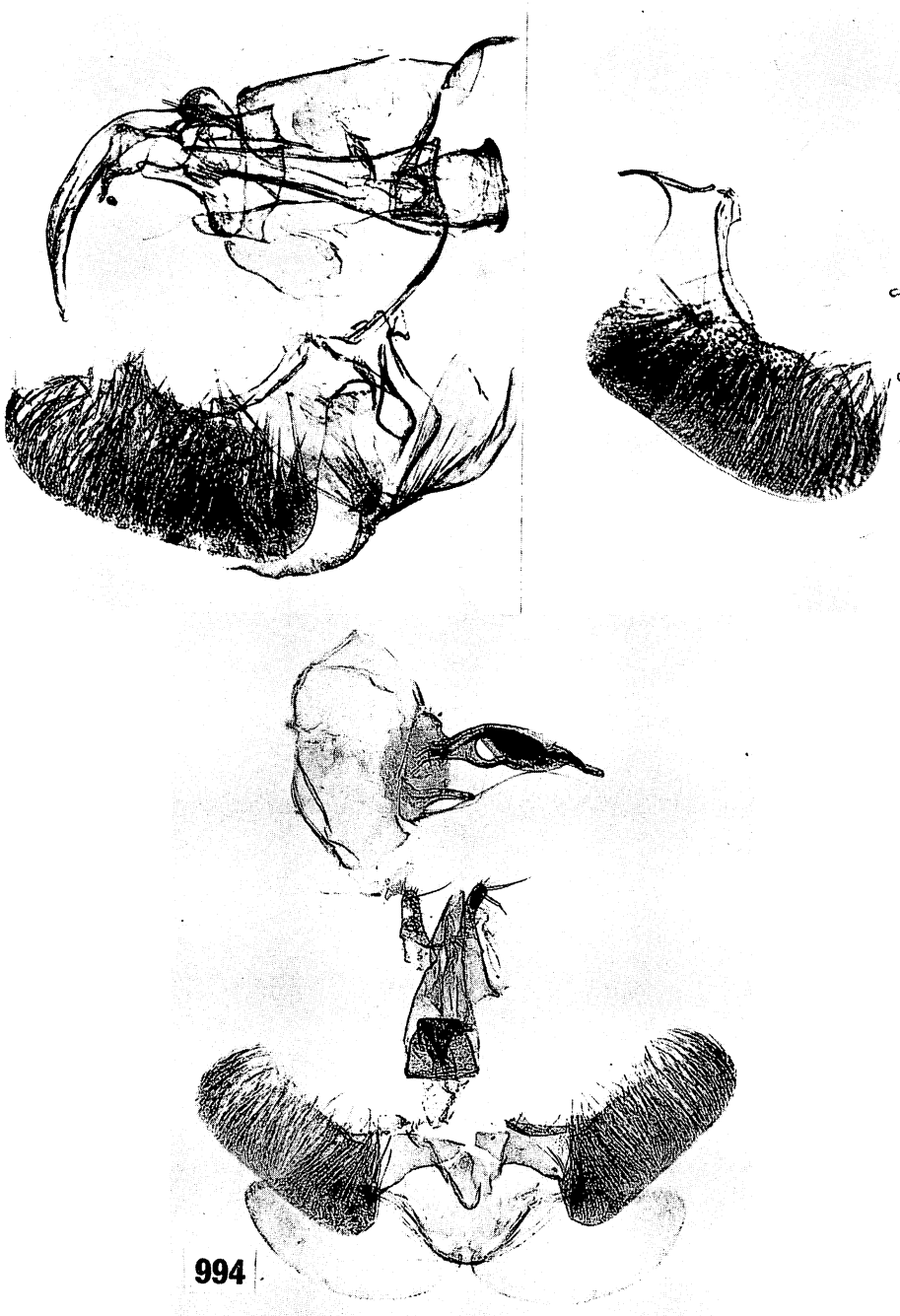
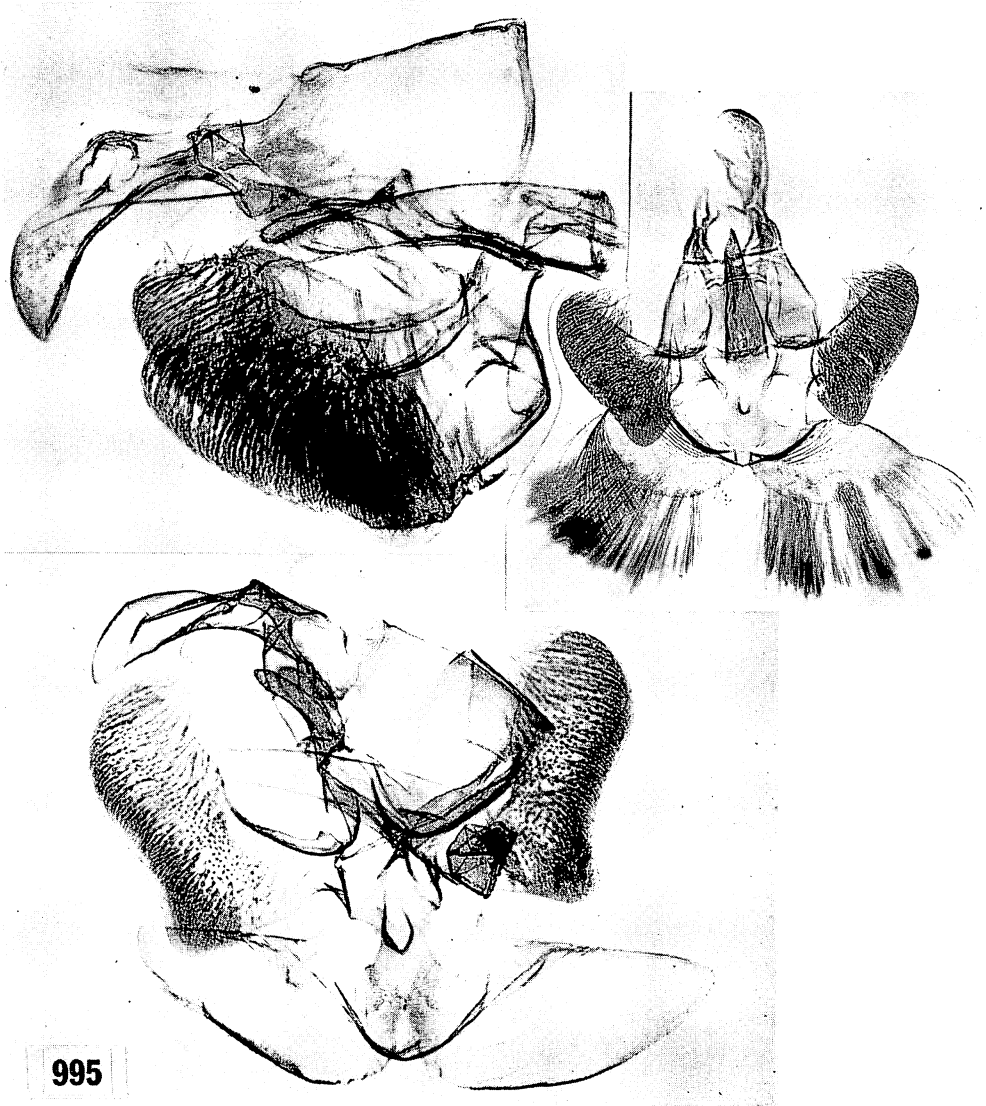


Figure 994—Male genitalia of *Hypsoscocoma* (*E.*) *unicolor* (Walsingham) ("*Hyperdasylella*"). Top, allotype (BM slide 4425); Molokai, above 4,500 feet. Bottom, supposedly the same species, determined by Swezey; ex dead *Eleocharis* wood from Kahauiki, Oahu (slide Z-IV-6-61-2).



995

Figure 995—Male genitalia of *Hypsocoma* (*E.*) *cristata* (Walsingham) ("*Euperissus*"). Top left, the holotype (BM slide 4390); Koolau Mts., near Honolulu. Top right, paratype (BM slide 2001); Northwest Koolau Mts., Oahu. Bottom, paratype (Walsingham specimen 28048) from Hawaii (Busck slide 59). This species has longer anellar lobes than does *cryptogamiella*, for example. Note the variation in the genitalia illustrated; it is possible that more than one form is involved. This is the type-species of *Euperissus*.

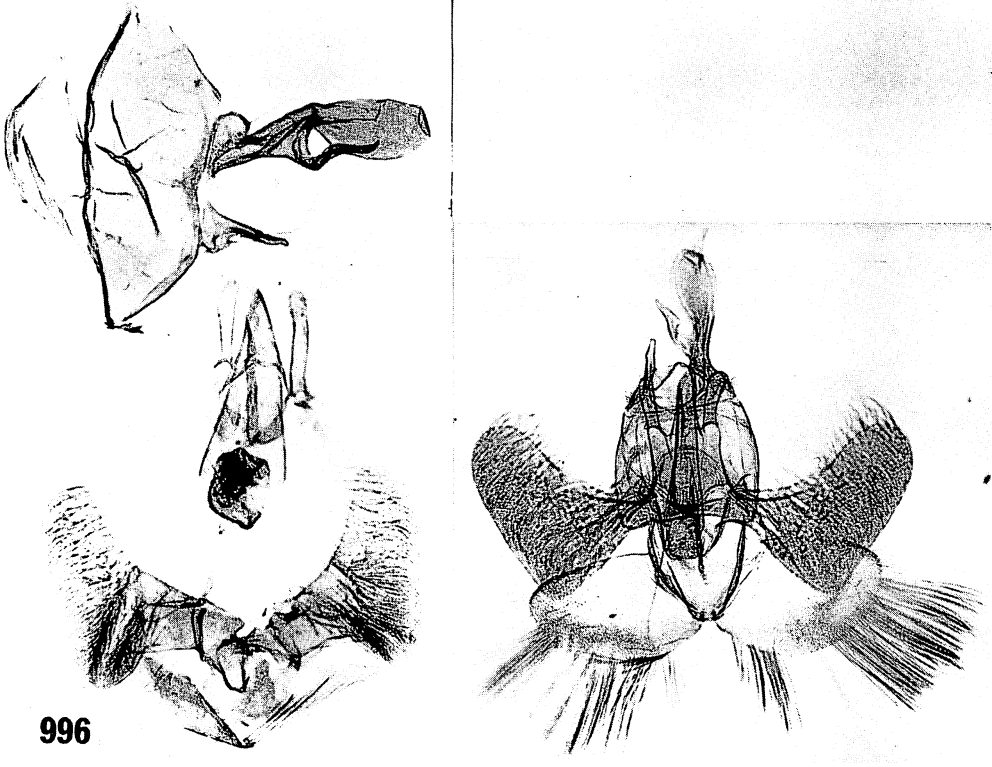
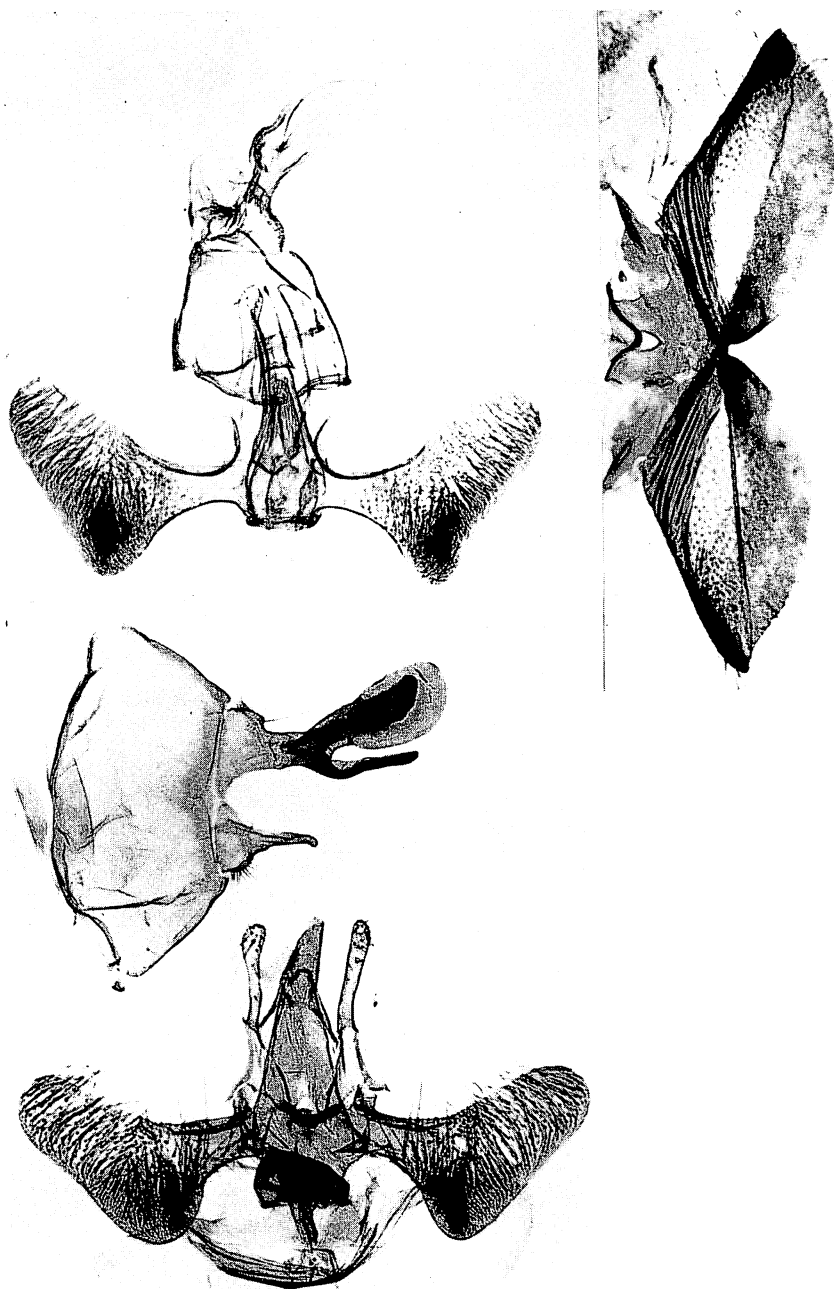


Figure 996—Male genitalia of *Hypsoscoma* (*Euperissus*). Left, *coprosmae* (Swezey) ("*Semnoprepia*"), holotype (slide Z-I-22-61-6); Malamalama, Mt. Konahuanui, Oahu. Right, *fulvogrisea* (Walsingham) ("*Semnoprepia*"), paratype (BM slide 2002); Kauai, 3,000 to 4,000 feet. This is the type-species of *Semnoprepia*.



997

Figure 997—Male genitalia of *Hypsoscocoma (Euperissus) ferruginea* (Swezey) ("*Semnoprepia*"). Top, holotype (slide Z-IX-3-61-2); Mt. Olympus, Oahu (the genital flaps are shown in a greater enlargement, and, because of their angled position in the balsam mount, there is partial optical distortion). Bottom, a specimen from Mt. Kaala, Oahu (slide Z-I-22-61-5). It is possible that two forms are represented here—there appear to be differences in the genital flaps and some other parts of the genitalia. Study of additional material is required.

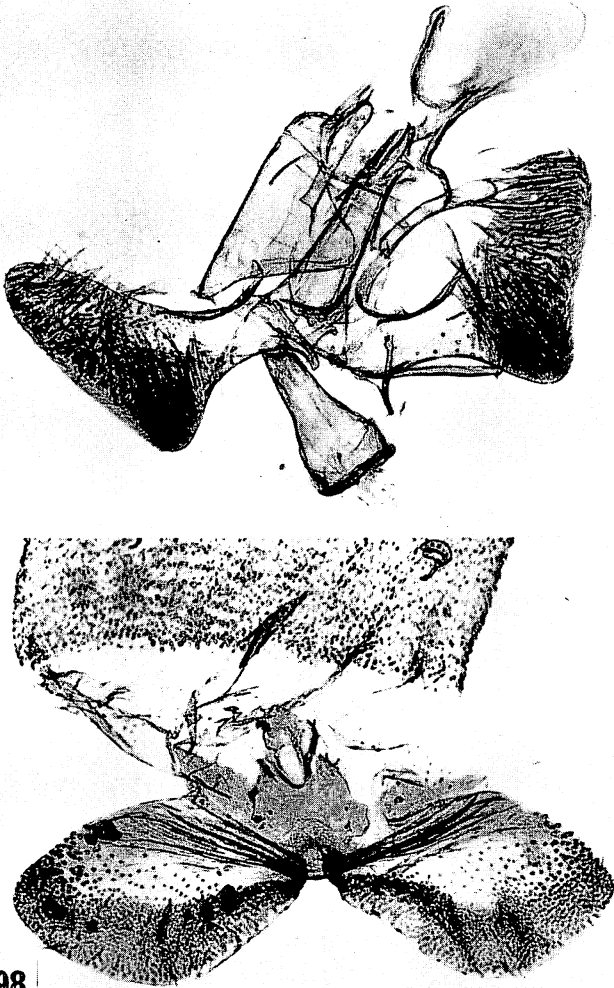
**998**

Figure 998—Male genitalia of the holotype of *Hyposmocoma* (*E.*) *fuscopurpurata* Zimmerman (formerly "*Semnoprepia*" *fuscopurpurea* Swezey); Mt. Olympus, Oahu (slide Z-IX-3-61-3).

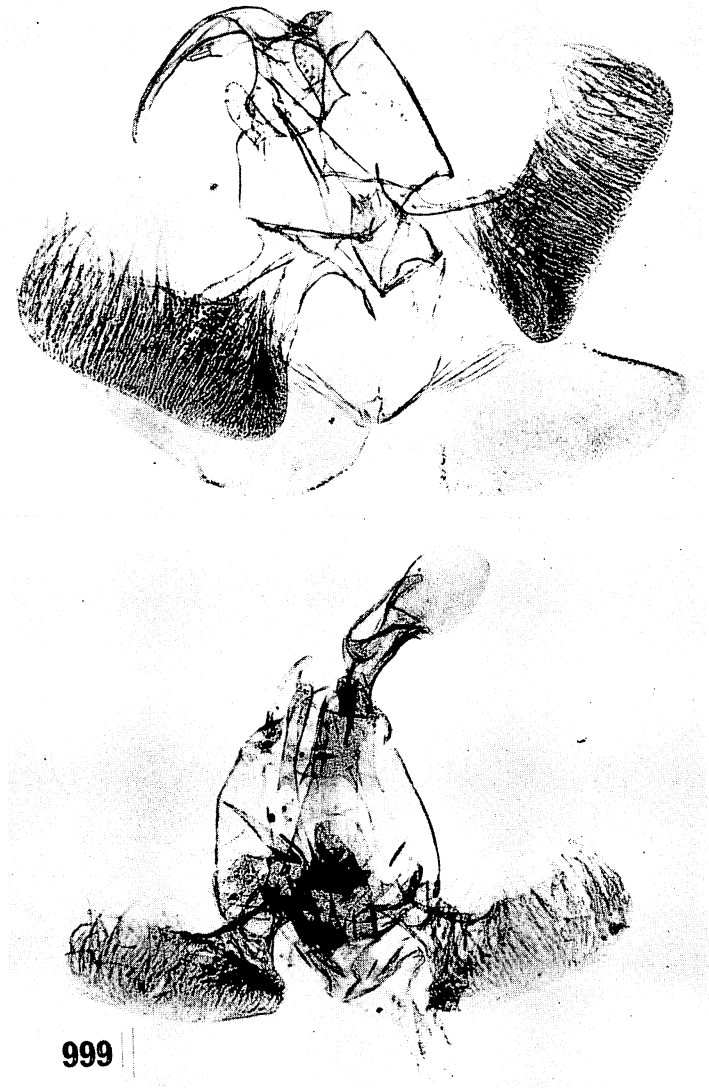


Figure 999—Male genitalia of *Hypsoscoma* (*Euperissus*). Top, *margella* (Walsingham) (“*Semnobrepia*”), holotype (BM slide 4430); Kilauea, Hawaii. Bottom, *pitlopori* (Swezey) (“*Semnobrepia*”), paratype (Busck slide 152); Kuliouou, Oahu. In the top figure the right brachium is viewed from the edge, whereas it is viewed from beneath in the lower figure. Note the differences in the lengths of the anellar lobes and the breadths of the “arms” of the valvae.

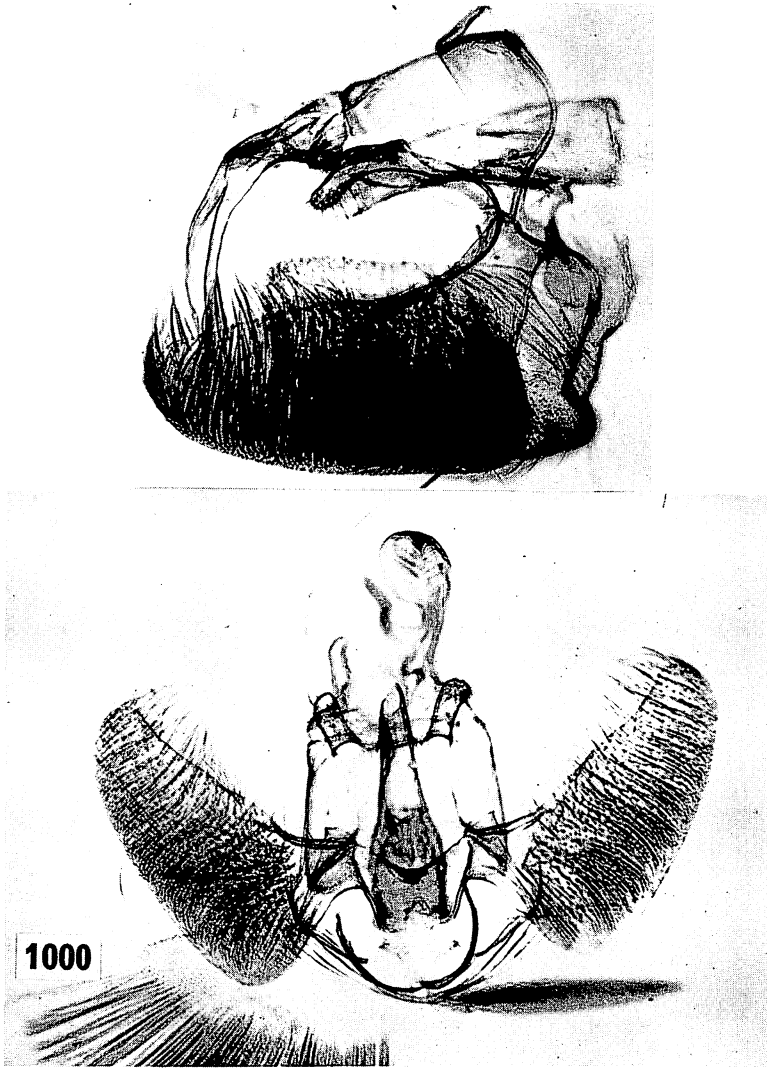


Figure 1000—Male genitalia of *Hypsmocoma* (*E.*) *petroptilota* (Walsingham) ("*Semnoprepia*"). Top, holotype (BM slide 4431); Kilauea, Hawaii. Bottom, paratype (BM slide 2003); Olinda, 4,000 feet, Maui. These may represent different forms. Compare figure 1001.



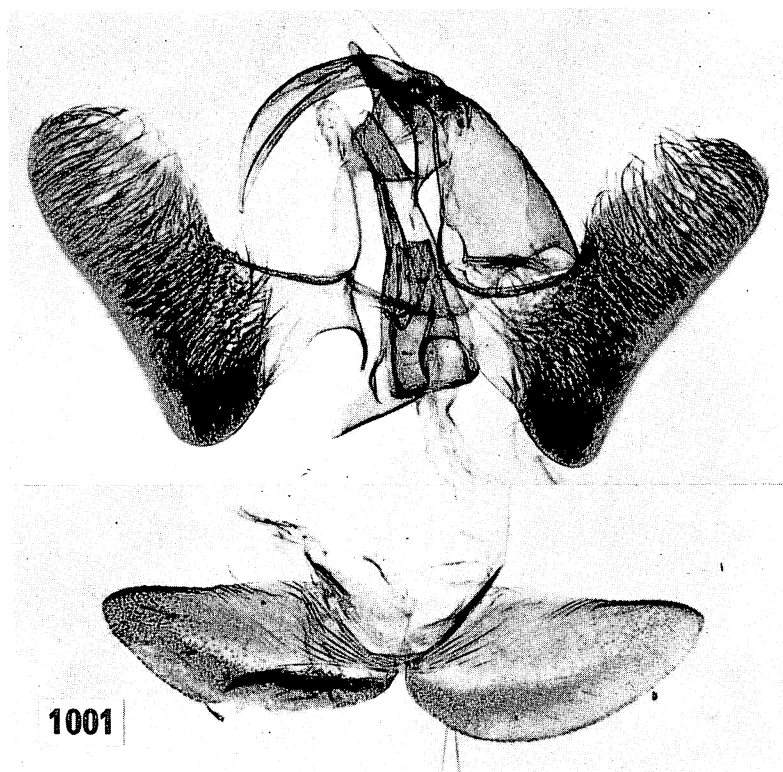


Figure 1001—Male genitalia of *Hypsoscoma (E.) petroptilota* (Walsingham) ("*Semnoprepia*") paratype (BM slide 7512); Kilauea, Hawaii. Compare figure 1000 of the holotype.



1002

Figure 1002—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Bubaloceras"). Top left, *pritchardiae* (Swezey), holotype (slide Z-1-18-61-2); Kumuwela, Kauai. Right and bottom, *subburnea* (Walsingham), the type-species of *Bubaloceras*; holotype (BM slide 4394); Molokai, above 4,000 feet. The figure on the right shows the unspread genitalia; the bottom shows the specimen after being remounted. The genitalia of these two species are closely similar, but the moths are distinctively colored.



1003

Figure 1003—Male genitalia of *Hyposmocoma* formerly placed in "*Neelysia*". Top, (*E.*) *agnatella* (Walsingham), holotype (BM slide 4432); Olinda, 4,000 feet, Maui. The distal part of the right valva is broken off. Middle, (*H.*) *alveata* (Meyrick), lectotype (BM slide 9580 Clarke); Koolau Mts., Oahu. This species obviously does not belong to the *Neelysia* complex; note the long spurs on the valvae that are characteristic of true *Hyposmocoma*. It lacks a pseuduncus; compare *admirationis*. Bottom, (*E.*) *anthinella* (Walsingham), holotype (BM slide 4436); Lanai, 2,000 feet; see also the unspread view of this in figure 1004.

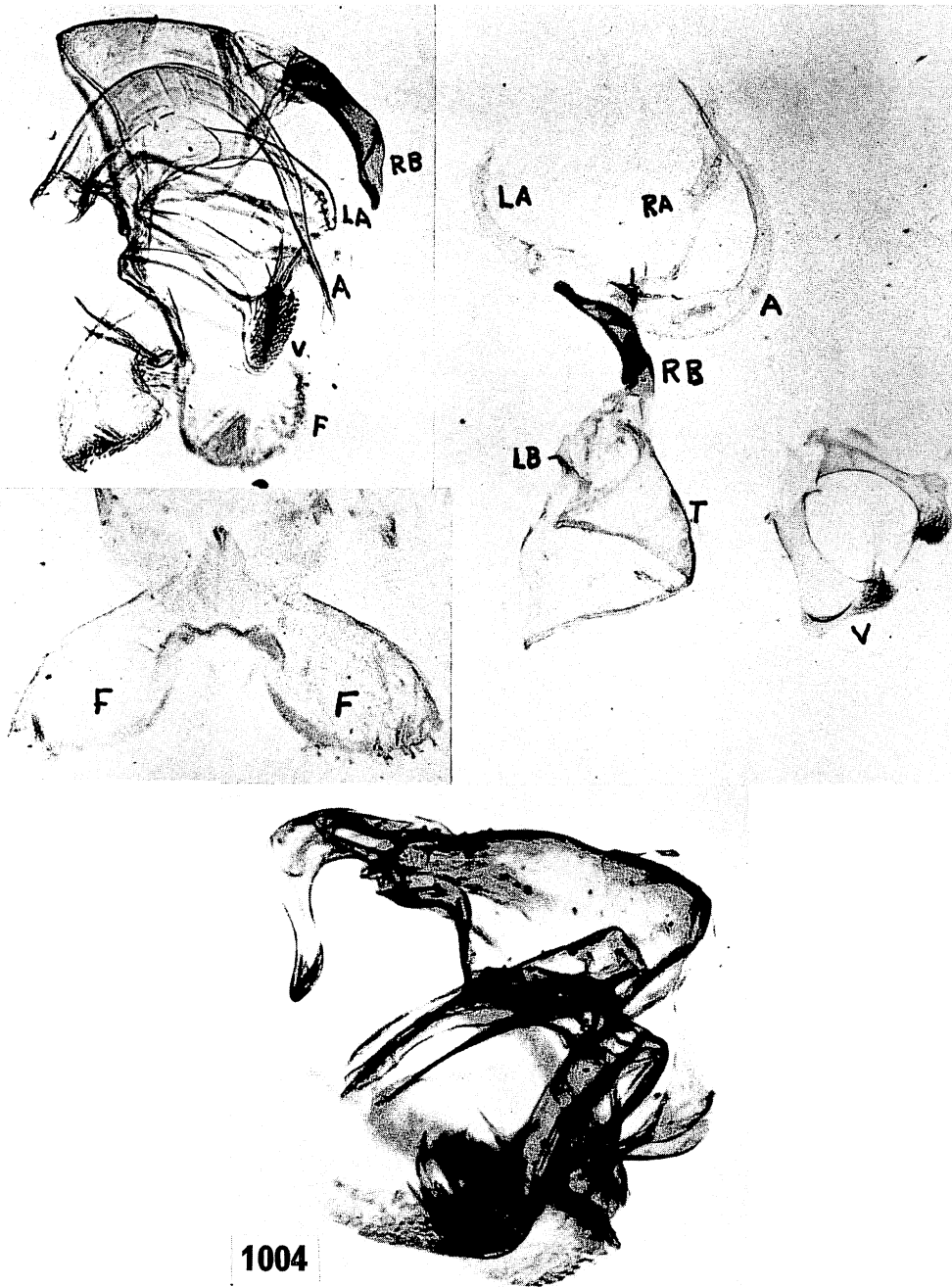


Figure 1004—Male genitalia of *Hyposmocoma* (*Euperissus*) originally described in "*Neelysia*". Top left, *argyresithiella* (Walsingham), paratype (Walsingham specimen 27944, BM slide 2009); Kauai, 4,000 feet. Top right, same species with genital flaps at middle left, paratype (BM slide 7517); Waianae Mts., Oahu; note the long, slender, sickle-shaped aedeagus. Bottom, *anthinella* (Walsingham), holotype (BM slide 4436); Lanai, 2,000 feet; see figure 1003 for this specimen after being remounted. *A*, aedeagus; *F*, genital flaps; *LA*, left anellar lobe; *LB*, left brachium; *RA*, right anellar lobe; *RB*, right brachium; *T*, tegumen; *V*, valva.

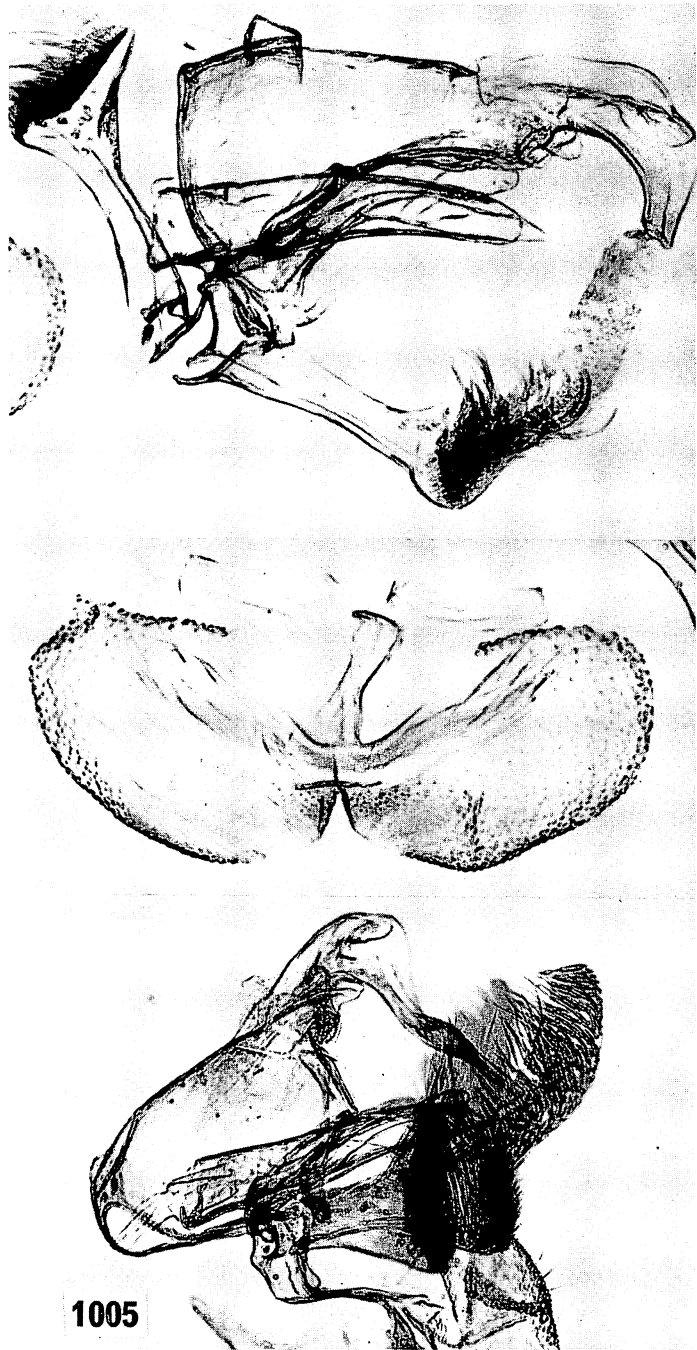


Figure 1005—Male genitalia of *Hyposmocoma* (*Euperissus*) formerly placed in "*Neelysia*". Top, *basivittata* (Walsingham), holotype (BM slide 4440); Haleakala, 5,000 feet, Maui; distal part of left valva missing and apex of right brachium broken. Middle, genital flaps of same. Bottom, *cleodorella* (Walsingham), holotype (BM slide 4435); Kona, 4,000 feet, Hawaii.

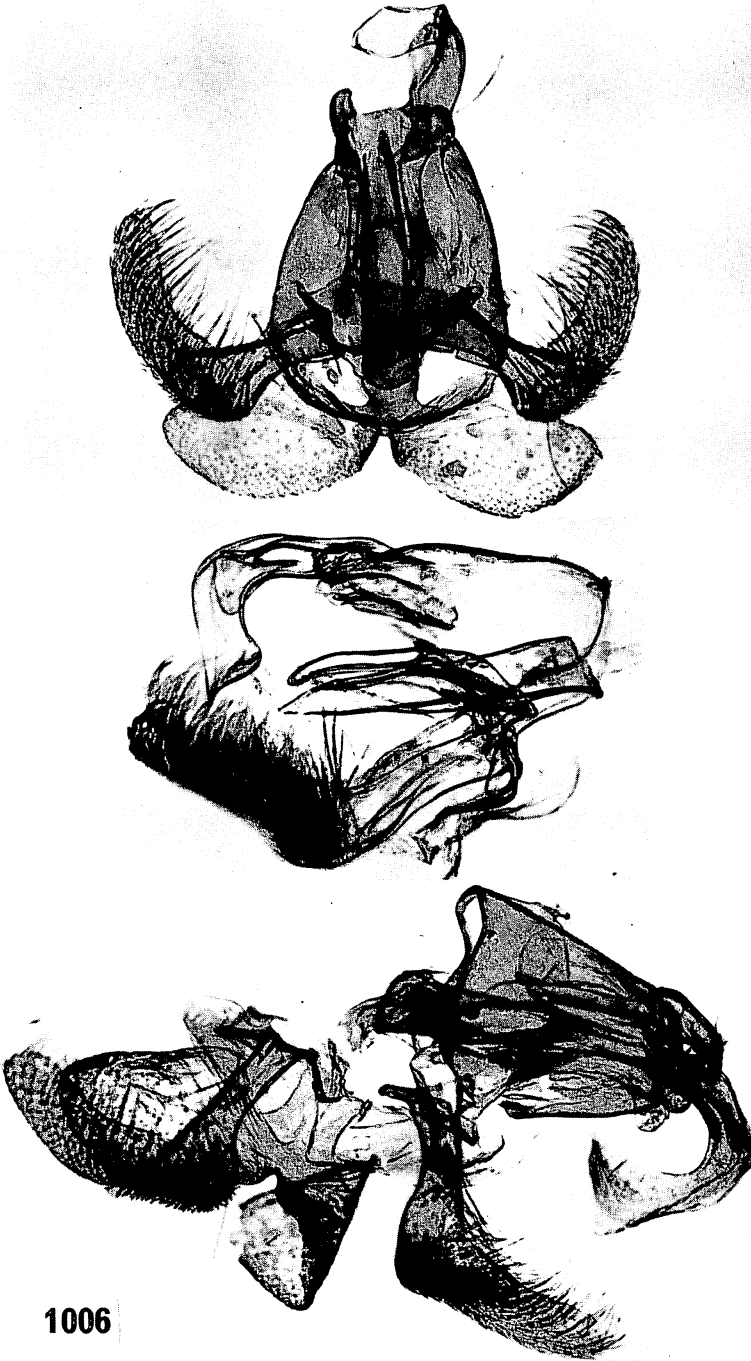
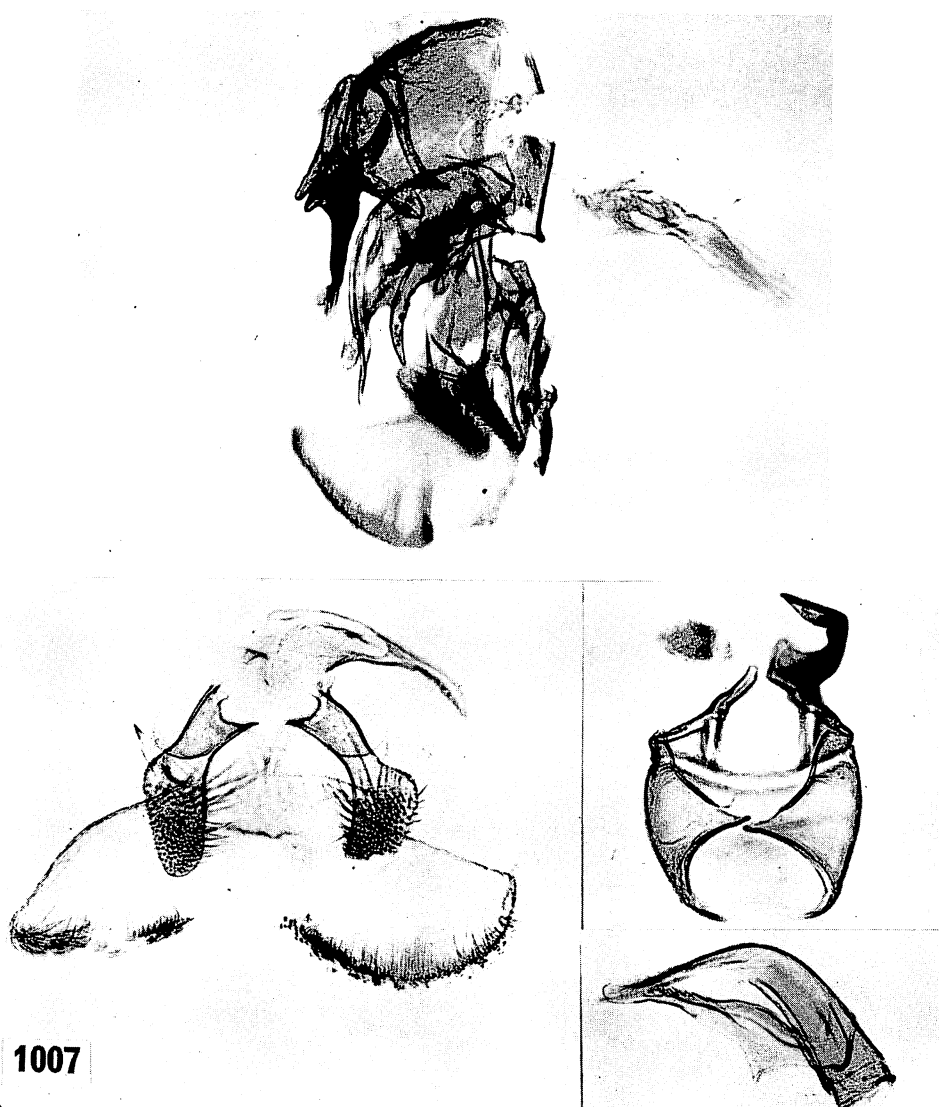
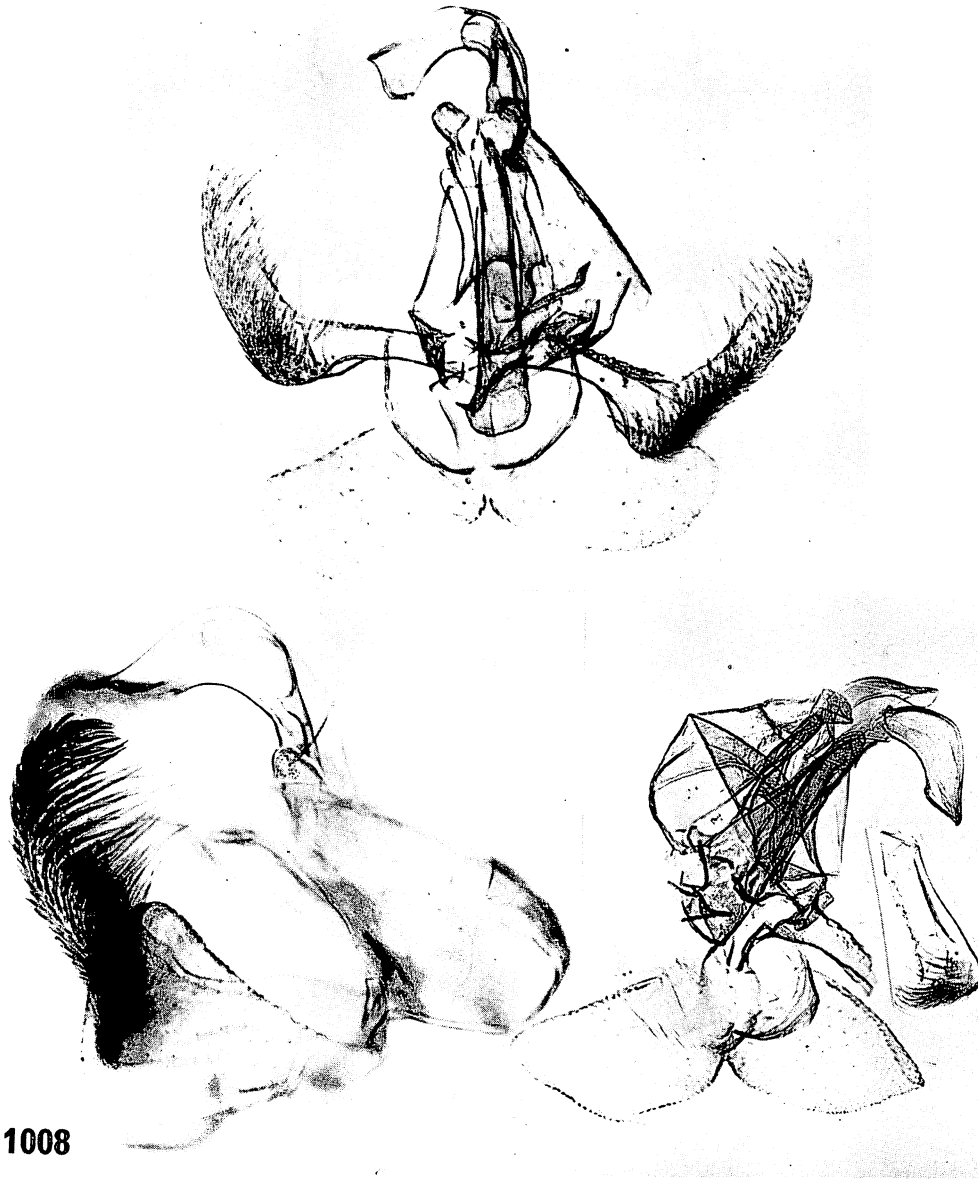
**1006**

Figure 1006—Male genitalia of *Hyposmocoma* (*Euperissus*), originally placed in "*Neelysia*". Top, *complanella* (Walsingham), holotype (BM slide 4459); Molokai, over 3,000 feet. Middle, *cuprea* (Walsingham), holotype (BM slide 4433); Kauai, 3,000 to 4,000 feet. Bottom, *fuscosusa* (Walsingham), holotype (BM slide 4439); Kauai, 3,000 to 4,000 feet.



1007

Figure 1007—Male genitalia of *Hyposmocoma* (*Euperissus*) (*“Neelysia”*) *exaltata* (Walsingham). Top, holotype (BM slide 4444); Haleakala, over 5,000 feet, Maui. Bottom, a paratype (Walsingham specimen 28371) of the same species (BM slide 2008); Haleakala, 5,000 feet, Maui; the tegumen and brachia are shown in ventral aspect at right (note the strong suture between the tegumen and the brachia); the acedeagus with the left anellar lobe adhering to it is at right bottom.



1008

Figure 1008—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top, *incongrua* (Walsingham), holotype (BM slide 4512); Haleakala, 5,000 feet, Maui. Bottom left, *lignicolor* (Walsingham), holotype (BM slide 4392); Haleakala, 5,000 feet, Maui. Bottom right, a paratype (Walsingham specimen 26540) of the same with a separate photograph of the distal part of the valva inset (Busck slide 24).





Figure 1009—Male genitalia of *Hypsmocoma* (*Euperissus*) ("Neelysia"). Top left, *mactella* (Walsingham), holotype (BM slide 4450); Kauai, 3,000 to 4,000 feet. Top right, the same species from a paratype (BM slide 2010); Molokai, about 4,000 feet. There are small differences between these two specimens which appear to be individual variations. Middle and bottom, *nemoricola* (Walsingham), holotype (BM slide 4447); above Pelekunu, Molokai. The right valva and genital flap are on the right. The development of the sclerotized abdominal process (at bottom), is unusual in the *Neelysia* group. This may be an independent development and not a pseuduncus of the typical "strong" *Hypsmocoma* type, if it is not merely an abnormality on this specimen. The dissection is broken so that interpretation of it is difficult. Only this one male specimen is known.



1010

Figure 1010—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top, *ningorella* (Walsingham), holotype (BM slide 4446); Haleakala, over 5,000 feet. Middle, the same specimen before an unsuccessful attempt was made to remount it. Bottom, *ningorifera* (Walsingham), holotype (BM slide 4441); Haleakala, 5,000 feet, Maui.

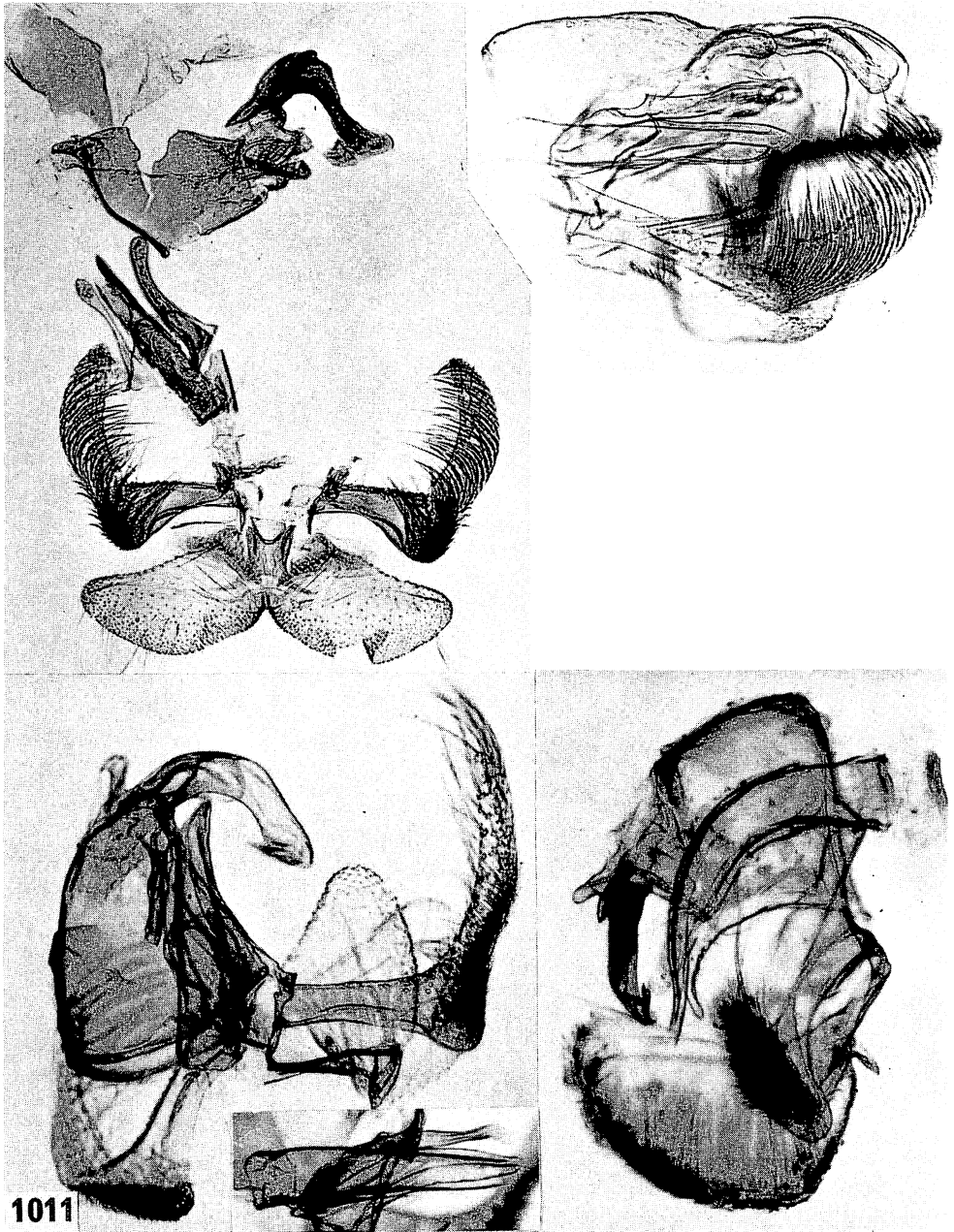


Figure 1011—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top left, *palmifera* (Meyrick), Haleauau, Oahu, ex *Pterolyxia* (slide Z-IV-6-61-1). Top right, *paltodorella* (Walsingham), allotype (BM slide 4438); Kauai, 3,000 to 4,000 feet. Bottom left, *petalifera* (Walsingham), holotype (BM slide 4442); Olinda, 4,000 feet, Maui; aedeagus and anellar lobe shown on inset photograph. Bottom right, *poeciloceras* (Walsingham), holotype (BM slide 4445); Haleakala, 4,000 feet, Maui. Note the differently shaped valvae and aedeagi. Do not confuse the genital flaps with the valvae in the bottom right figure. The right anellar lobe is apically attenuated.



Figure 1012—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top, *repandella* (Walsingham), allotype (BM slide 4437); Molokai, over 4,000 feet. Most of the right valva and the distal parts of the left valva are broken off. Bottom, *rediviva* (Walsingham), paratype (BM slide 6471); Kaholuamano, 4,000 feet, Kauai. Note the very long specialized setae on the costal margin of the valvae and note the heavy anellar lobes. This species obviously belongs to a different subgroup than does *repandella* and similar species.

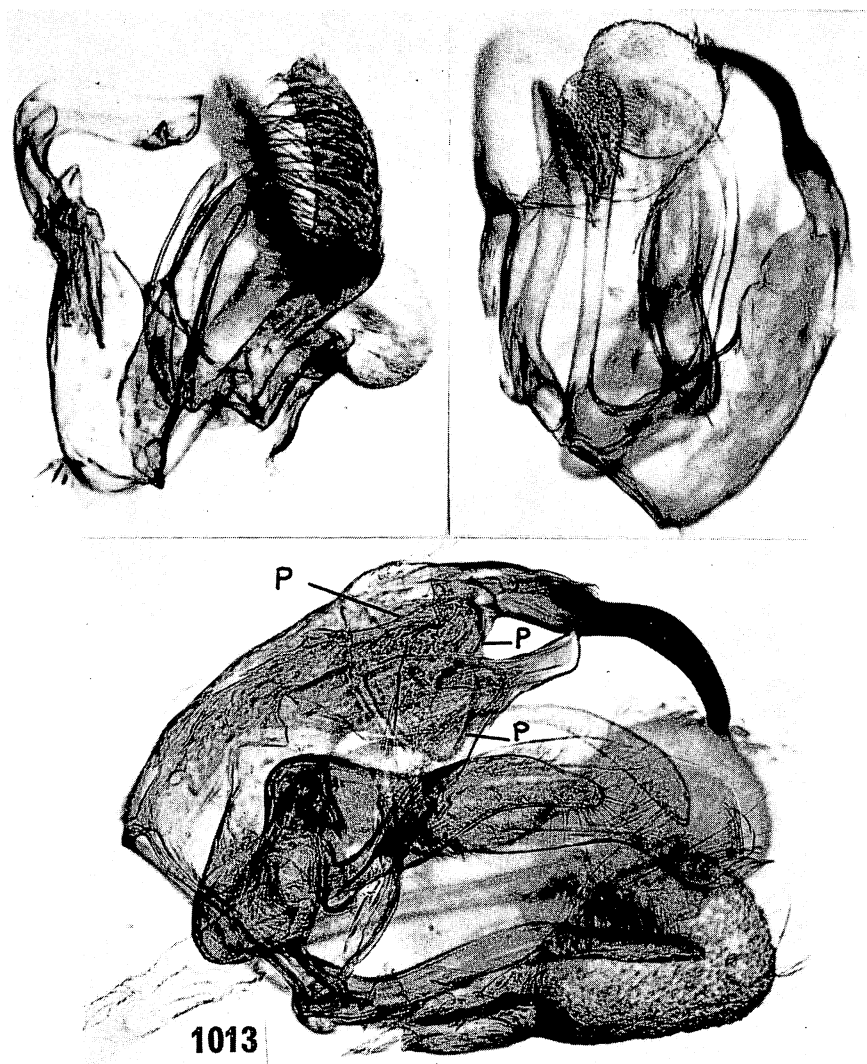


Figure 1013—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top left, *sciurella* (Walsingham), holotype (BM slide 4513); Olinda, 4,000 feet, Maui. Top right, *subaurata* (Walsingham), holotype (BM slide 4443); Kaholuamano, 4,000 feet, Kauai; photographed from the right side. Bottom, the same, photographed from the left side and enlarged. Here the left brachium is clearly visible as are the anellar lobes; the left valva is viewed from the edge, and the right valva is out of focus. The unusual, flangelike process arising from the tegumen is marked "p". Compare the paddle-shaped valvae of the upper right figure with the very different valvae of the top left figure. These species belong to different subgroups.

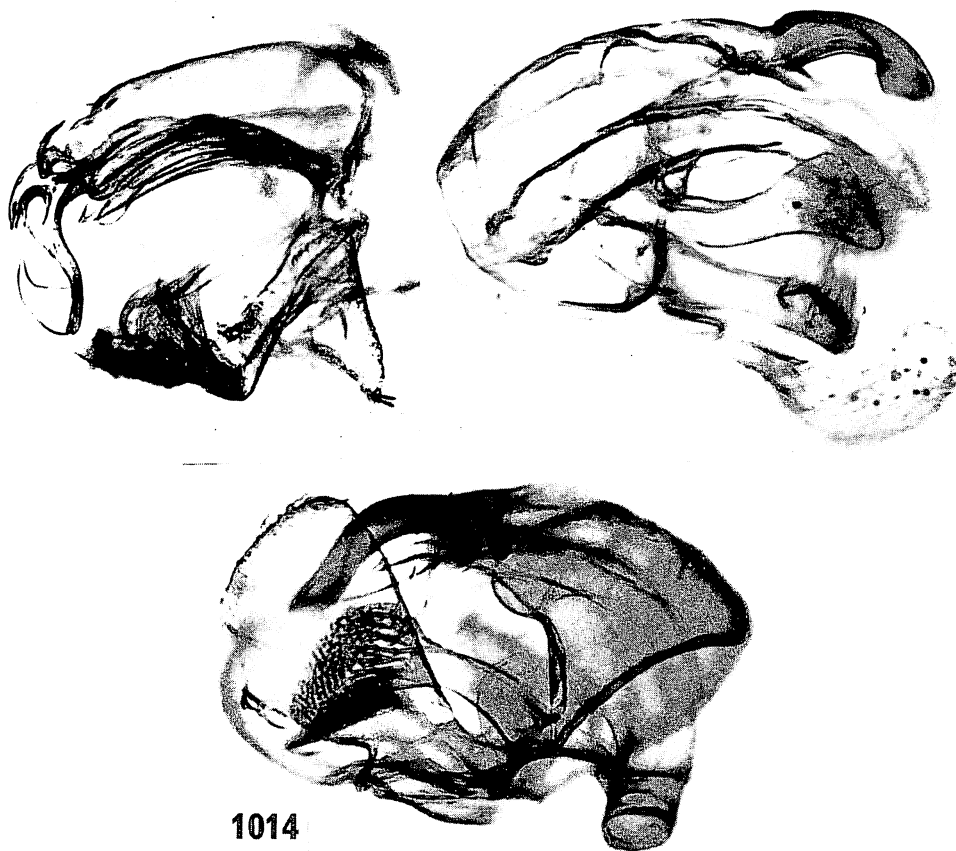
**1014**

Figure 1014—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top left, *tigrina* (Walsingham), holotype (BM slide 4434); Haleakala, Maui. Top right, *tischeriella* (Walsingham), holotype (BM slide 4458); Kaholuamano, 4,000 feet, Kauai. Bottom, *terminella* (Walsingham), holotype (BM slide 4449); Haleakala, 5,000 feet, Maui. It is obvious that *tigrina*, with its very different valvae, belongs to a different subgroup than *tischeriella* and *terminella*.

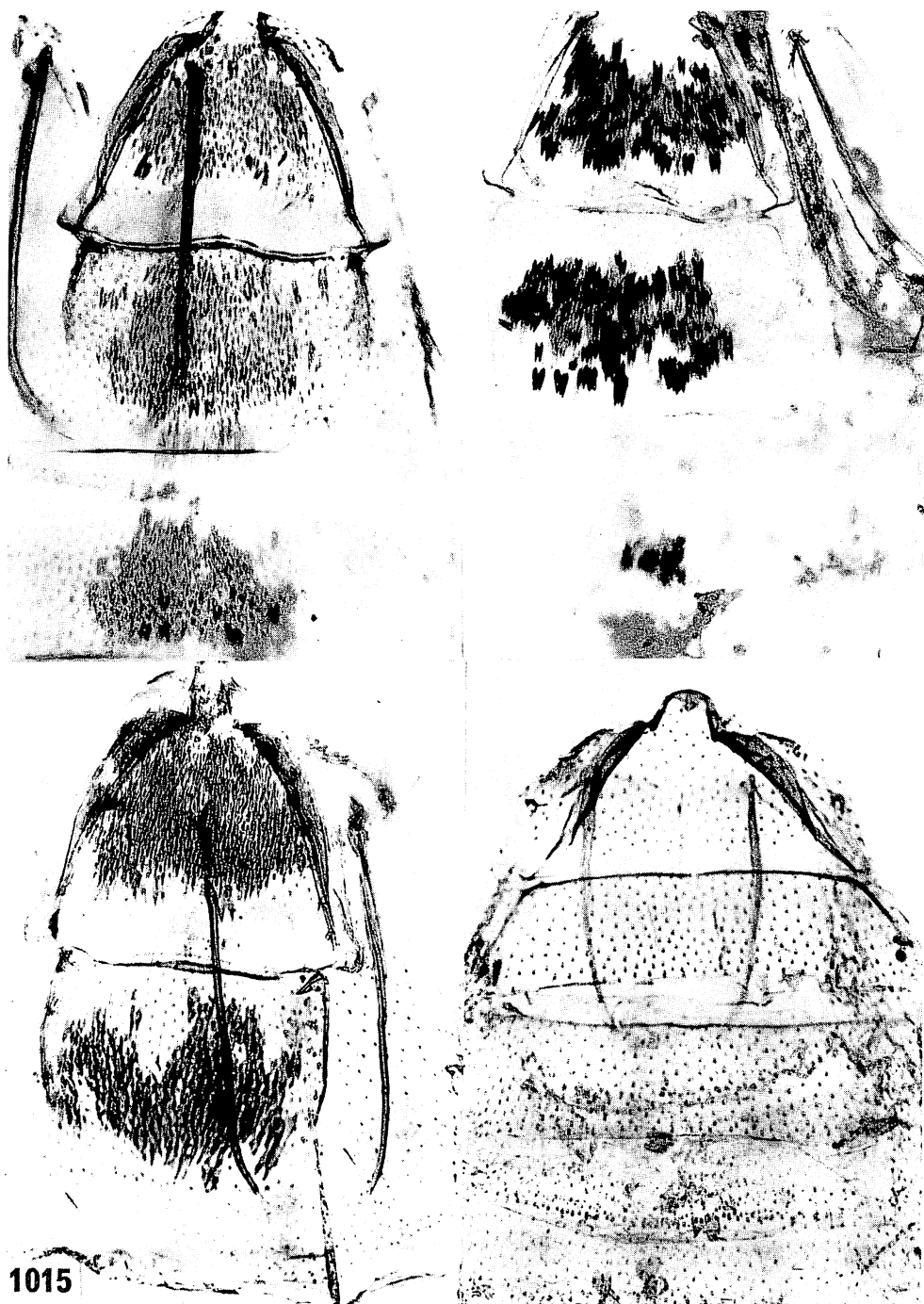


Figure 1015—Partly denuded basal abdominal tergites of *Hypsoscocoma* species to show the persistent squamae in three species of the *Aphthonetina* group compared with those of a typical *Hypsoscocoma*. Top left, ("*Aphthonetina*") *bitincta* (Walsingham), allotype female (BM slide 7555). Top right, ("*Aphthonetina*") *mediocris* (Walsingham), allotype female (BM slide 7552). Bottom left, ("*Aphthonetina*") *fugitiva* (Walsingham), holotype male (BM slide 4738). Bottom right, *Hypsoscocoma albonivea* Walsingham, determined by Swezey (slide Z-I-23-61-1).

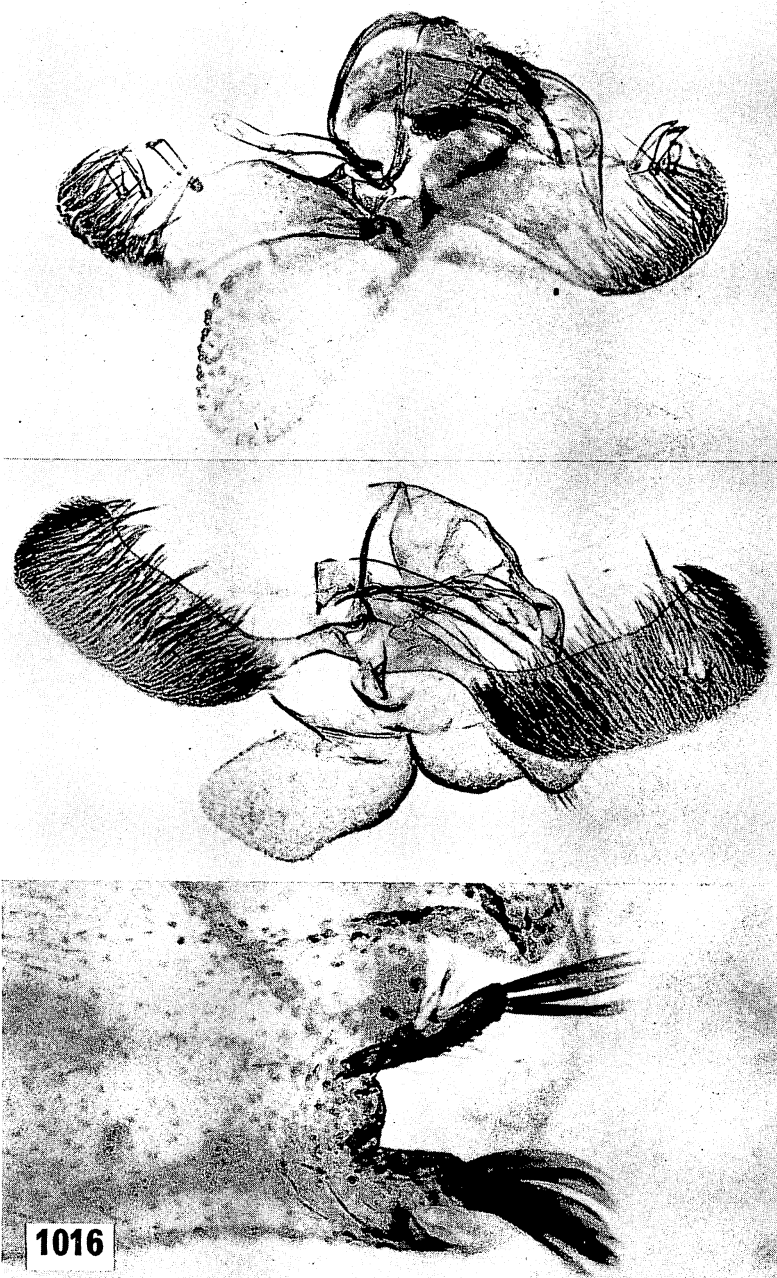


Figure 1016—Top, male genitalia of *Hypsoscoma (H.) coruscans* (Walsingham) ("Agonismus"), holotype (BM slide 5435); Kona, 4,000 feet, Hawaii. Middle and bottom, male genitalia and abdominal apex of (*E.*) *albocinerea* (Walsingham) ("Aphthonetus"), paratype (BM slide 7582); Kauai, 3,000 to 4,000 feet.



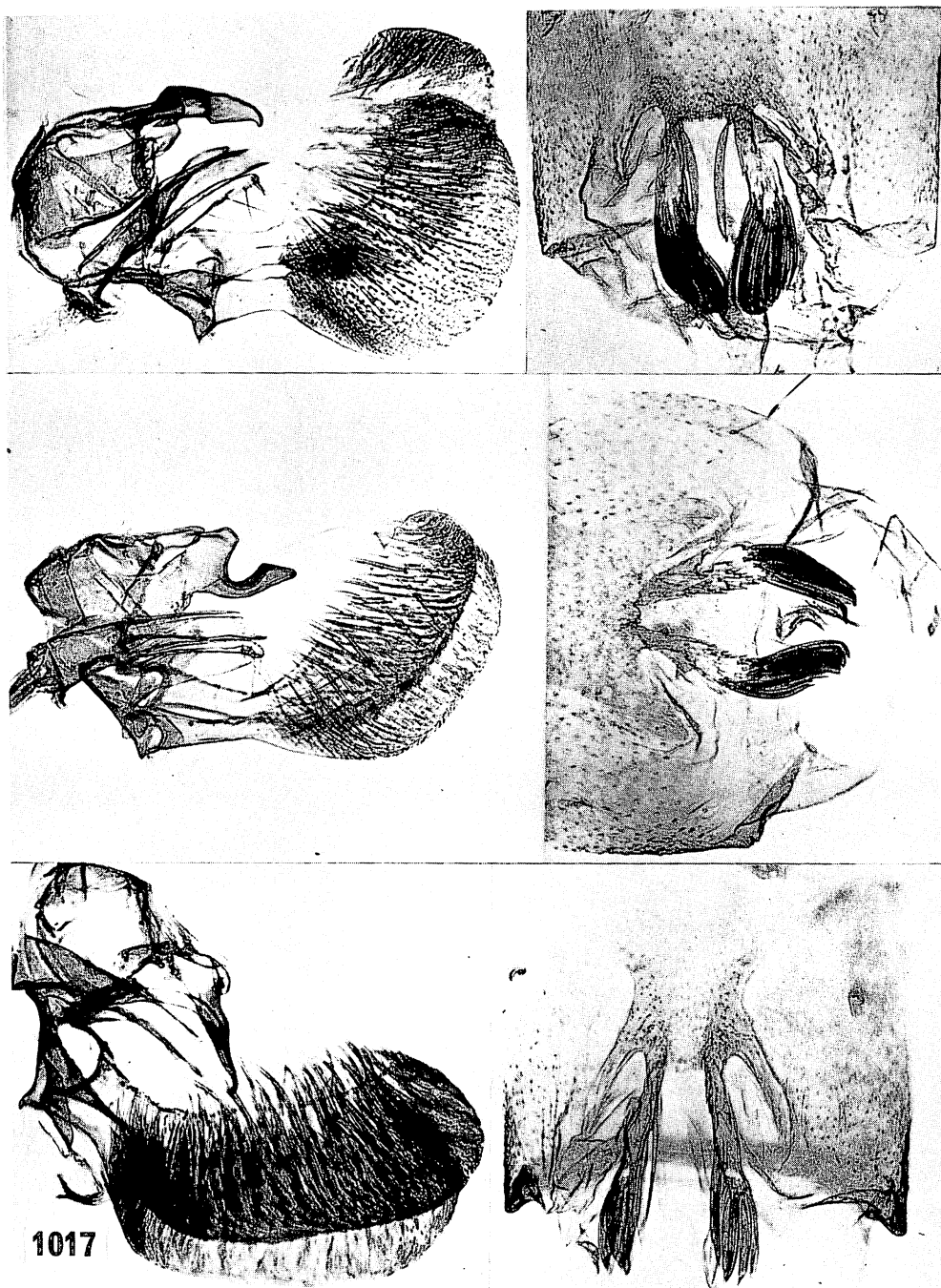
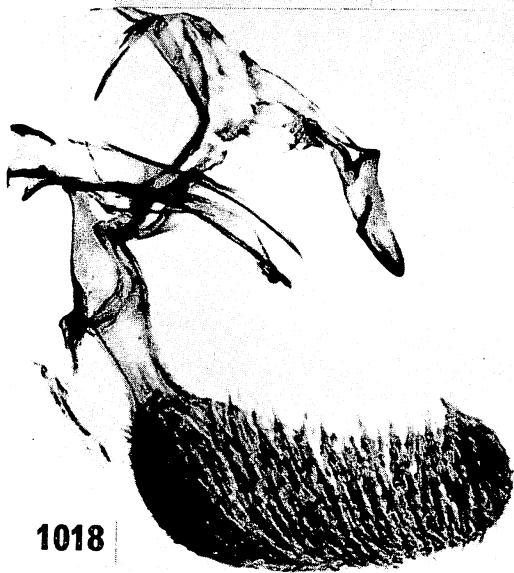
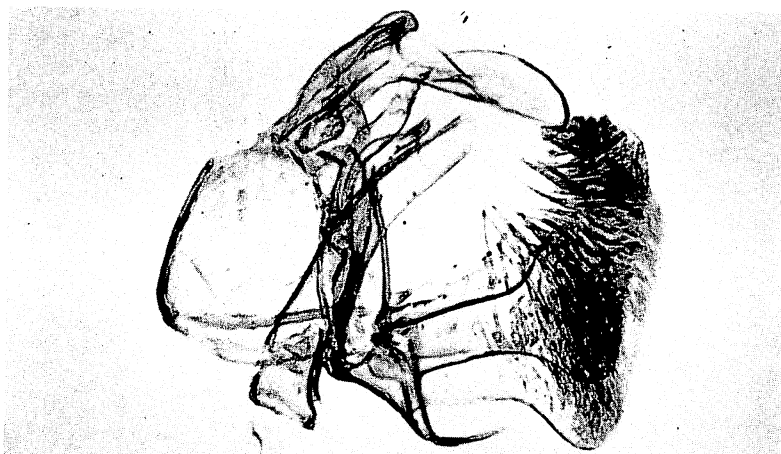


Figure 1017—Male genitalia and apices of abdomens of *Hypsoscoma* (*Euperissus*) ("Aphthonetus"). Top, *bitincta* (Walsingham), holotype (BM slide 4743); Haleakala, below 4,000 feet, Maui. Middle, *columbella* (Walsingham), allotype (BM slide 4744); Molokai, above 3,000 feet. Bottom, *confusa* (Walsingham), holotype (BM slide 4746); Olinda, 4,000 feet, Maui.



1018

Figure 1018—Male genitalia and abdominal apex of *Hyposmocoma* (*Euperissus*) ("*Aphthonetus*"). Top, *corticolor* (Walsingham), holotype (BM slide 4740); Haleakala, 5,000 feet, Maui; the abdomen lacks caudal processes. Middle, *digressa* (Walsingham), holotype (BM slide 4745); Haleakala, 5,000 feet, Maui. Bottom, *divergens* (Walsingham), holotype (BM slide 5237); Molokai, over 3,000 feet; the abdomen has typical *Aphthonetus* caudal processes, but they were not photographed.

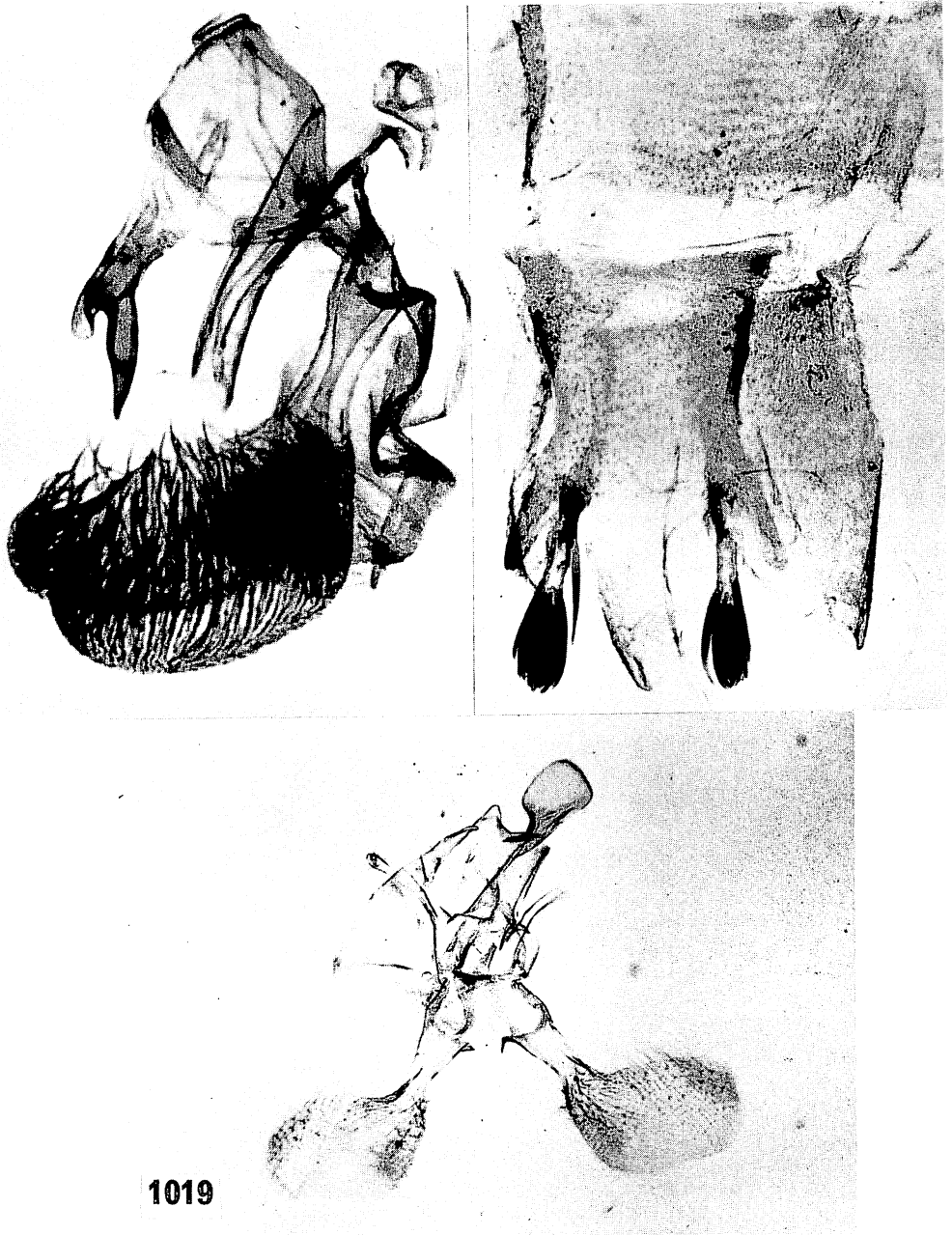


Figure 1019—Male genitalia of *Hyposmocoma* (*Euperissus*) *diffusa* (Walsingham) ("Aphthonetus"). Top, holotype (BM slide 4423); Olinda, 4,000 feet, Maui. Bottom, a paratype (Walsingham specimen 27864) of the same (Busck slide 18); Kauai; note that the apex of the right anellar lobe is broken off. These may not be the same species.

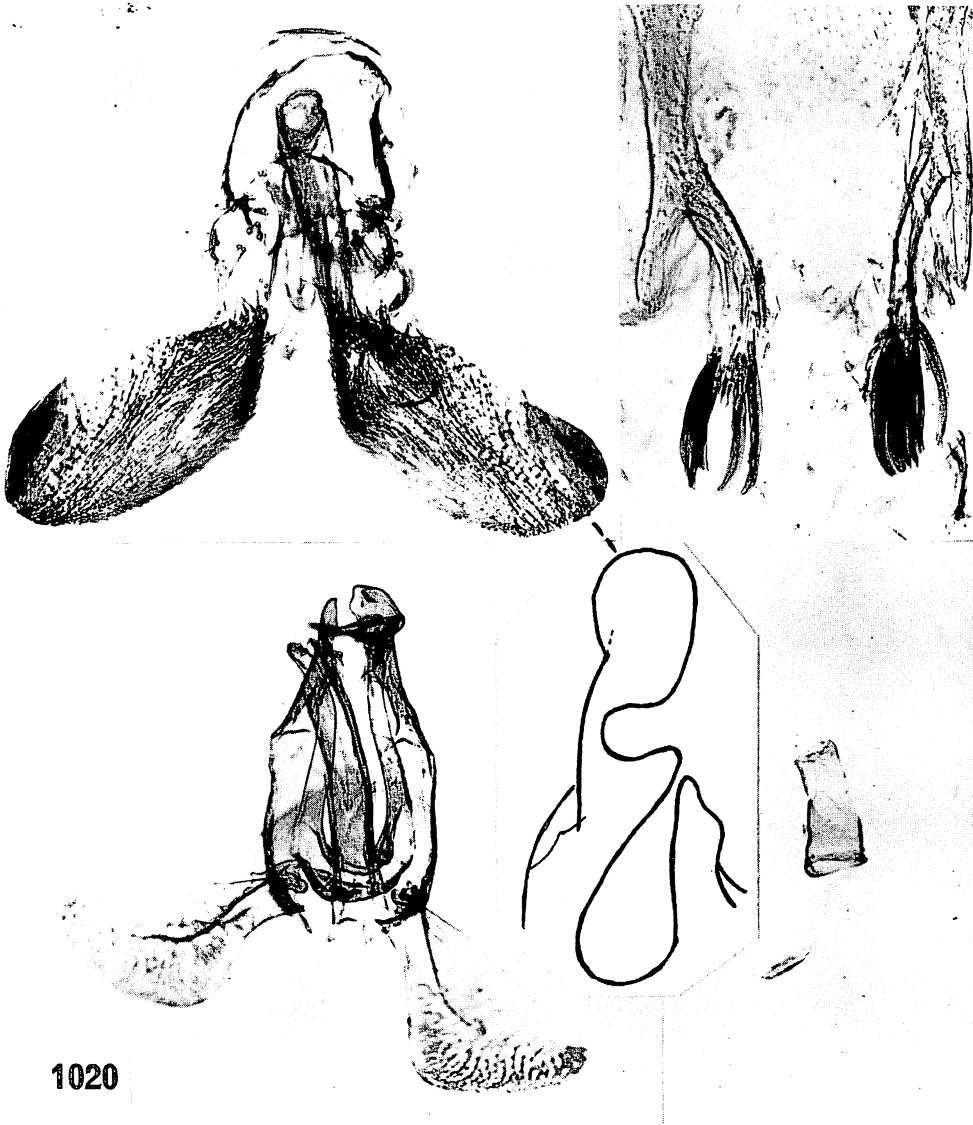


Figure 1020—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Aphthonetus"). Top and inset drawing, *elegans* (Walsingham), holotype (BM slide 4756); Olinda, 4,000 feet, Maui. The specimen is poorly oriented—the genitalia have been photographed from beneath the slide. I have inserted a sketch of the brachia in dorsal aspect. Bottom (excluding the sketch), *empetra* (Meyrick), (BM slide 9579 Clarke); "Kaala Mts.", Oahu. This does not belong to typical *Aphthonetus*; it lacks the abdominal caudal appendages. Compare *exsul*, *fluctuosa*, *humerella*, *inflexa*, *kauaiensis*, *nemo*, *plumbifera*, and *sideroxyloni*.

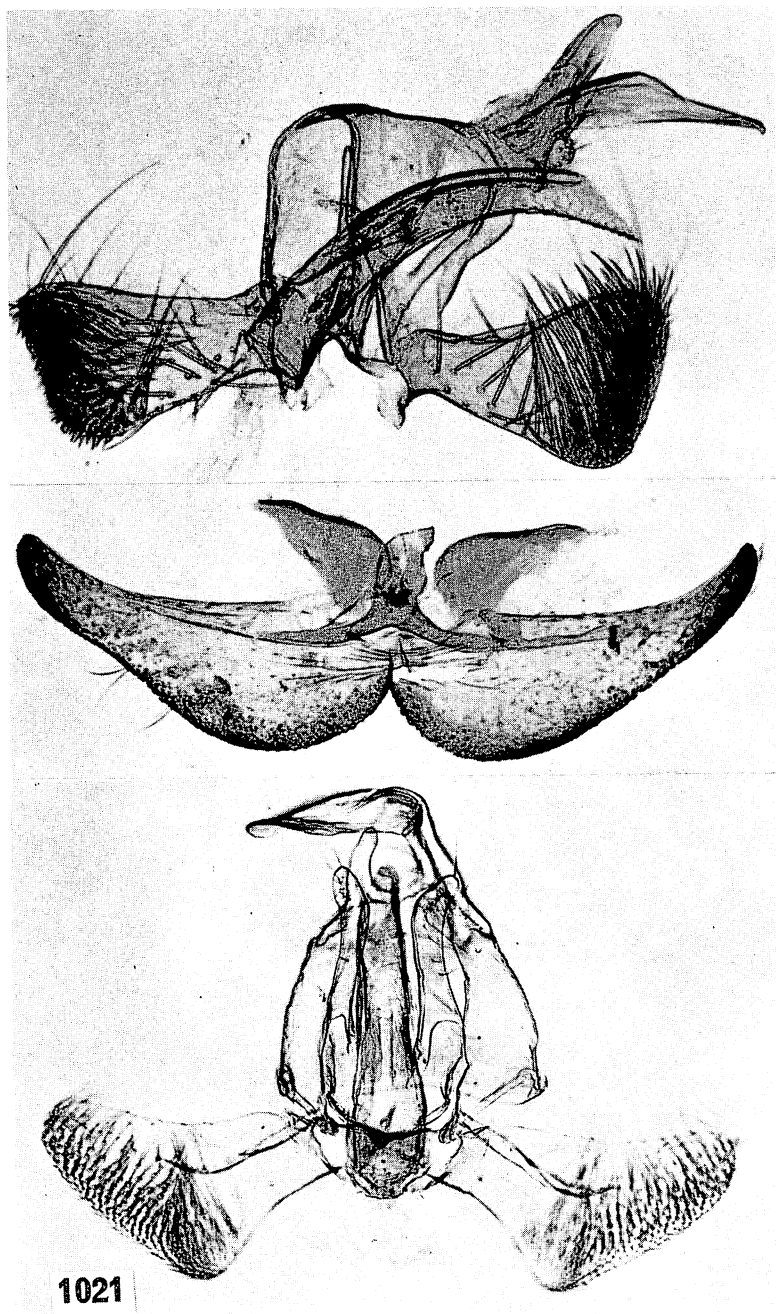


Figure 1021—Male genitalia of *Hypsoscoma* (*Euperissus*) ("Aphthonetus"). Top, *exsul* (Walsingham), paratype (BM slide 6470); Kona, 5,000 feet, Hawaii. Middle, genital flaps of the same species, but from a specimen from Kilauea, Hawaii (BM slide 5457). Bottom, *fluctuosa* (Walsingham), holotype (BM slide 4741); Kauai, 3,000 to 4,000 feet. These two species lack the abdominal caudal appendages of typical *Aphthonetus*—they do not belong to that subgroup. Compare *empetra* and associates.

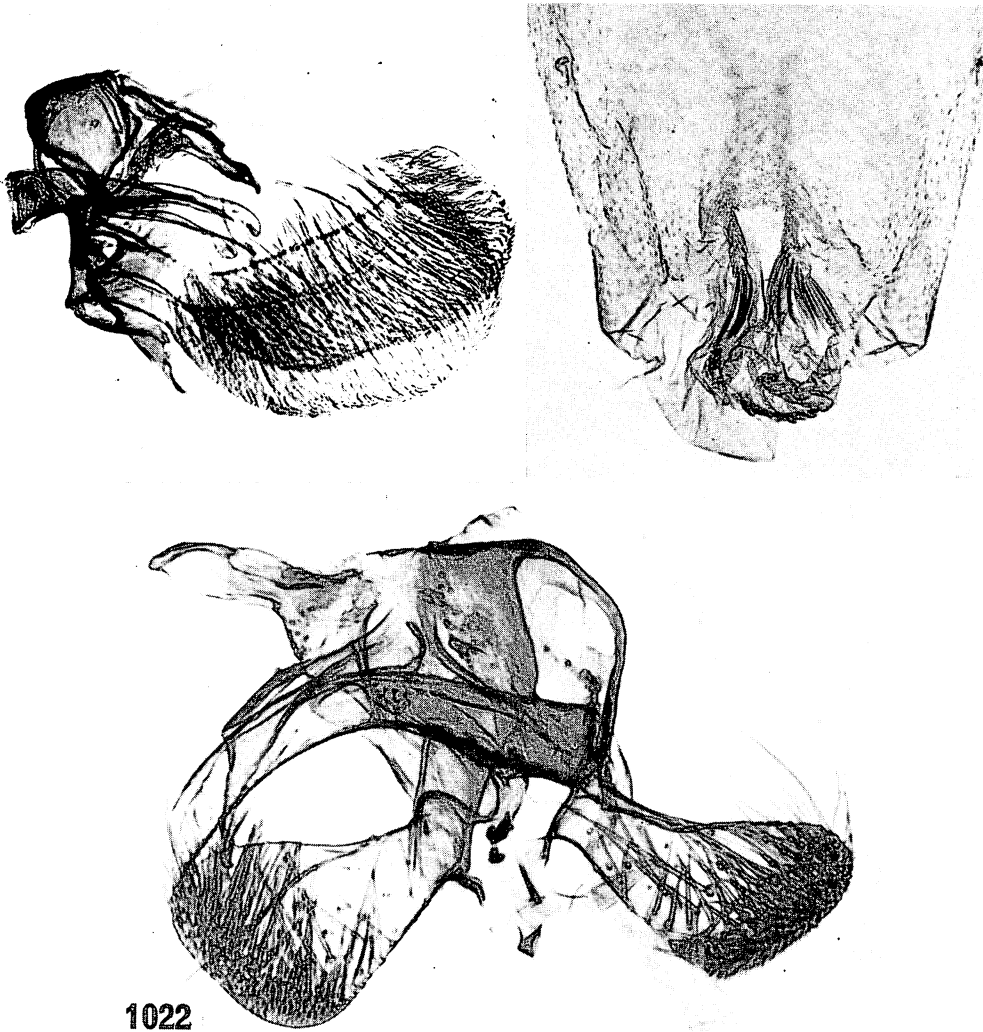


Figure 1022—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Aphthonetus"). Top, *fugitiva* (Walsingham), holotype (BM slide 4738); Kaholuamano, 4,000 feet, Kauai; the seventh abdominal segment shows the caudal processes on the tergite. Bottom, *humerella* (Walsingham), allotype (BM slide 4754); Haleakala, 5,000 feet, Maui; the abdomen lacks processes on the seventh tergite. Compare *empetra* and associates.

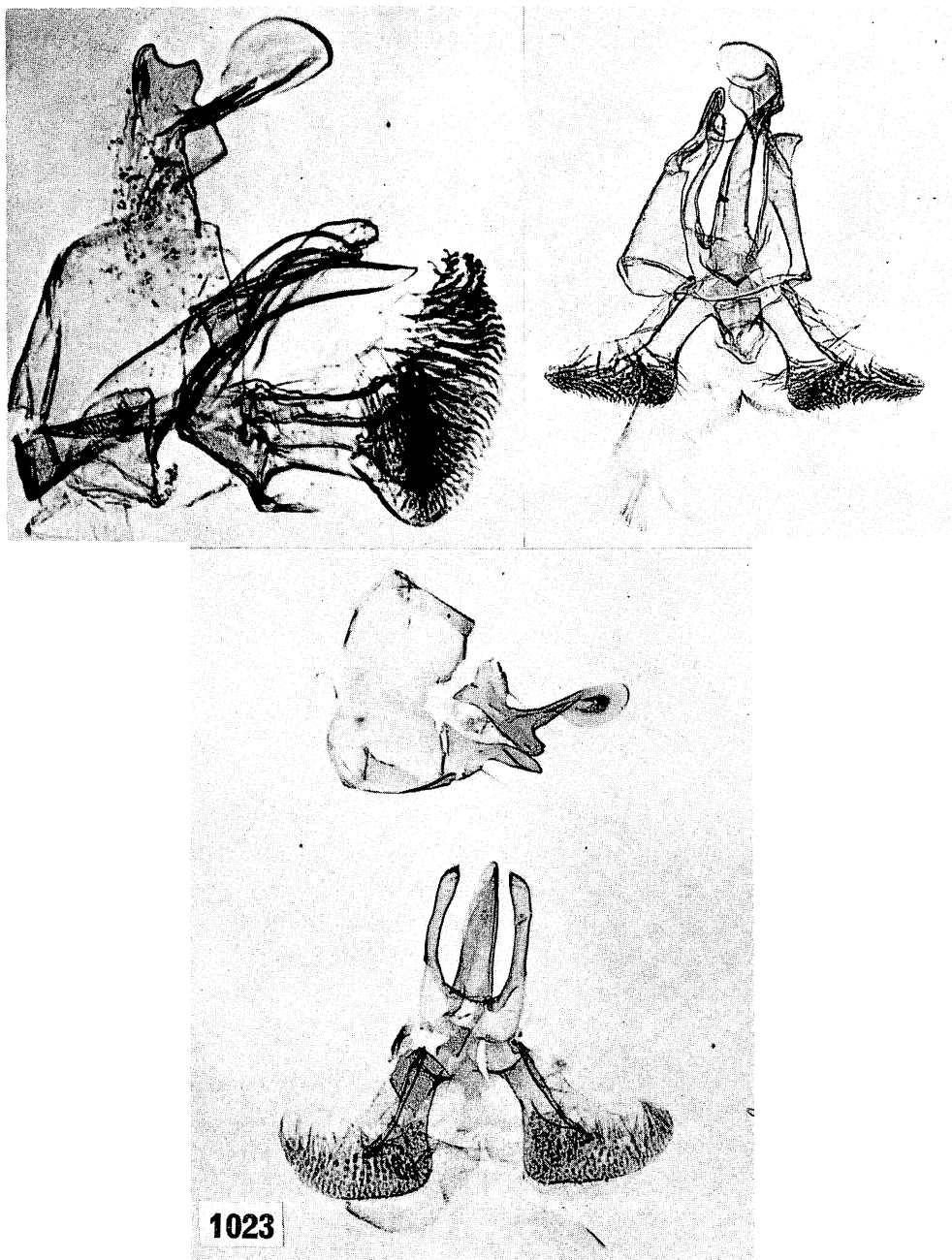


Figure 1023—Male genitalia of *Hypsmocoma* (*Euperissus*) ("Aphthonetus"). Top left, *kauaiensis* (Walsingham), holotype (BM slide 4739); Halemanu, 4,000 feet, Maui. Top right, a paratype of the same species from the same locality (BM slide 2016). Middle and bottom, a specimen of new species 14, heretofore wrongly identified by Swezey as *kauaiensis* (note the differences in the brachia, for example); Mt. Tantalus, Oahu, ex *Acacia koa* (slide Z-IV-3-61-2). These species lack the abdominal caudal appendages of typical *Aphthonetus*—they belong to a different subgroup. See *empetra* and allies.

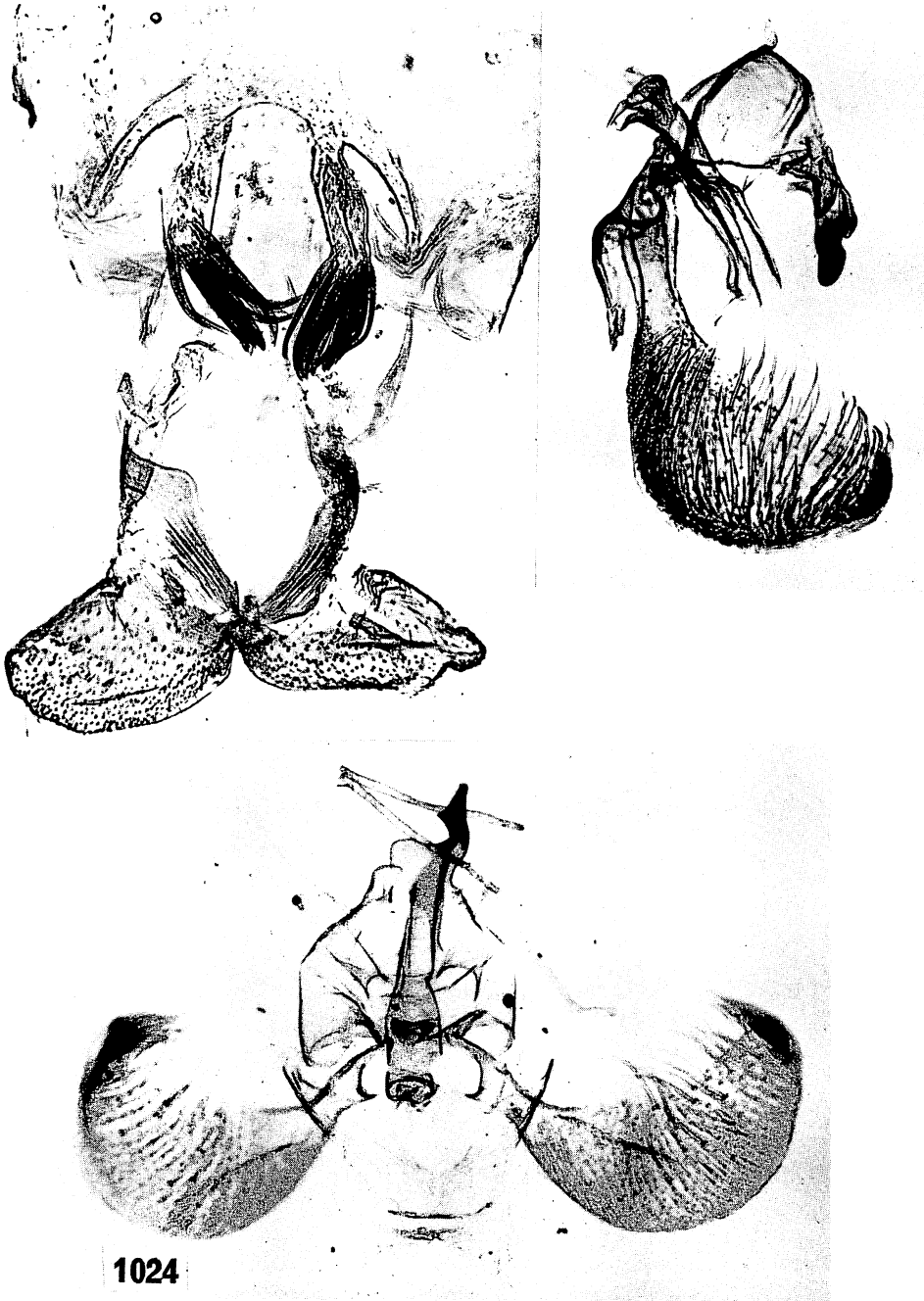


Figure 1024—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Aphthonetus") *mediocris* (Walsingham). Top, holotype (BM slide 4737); Haleakala, 5,000 feet, Maui. Bottom, another specimen from Olinda, 4,000 feet, Maui, spread open (BM slide 2015).



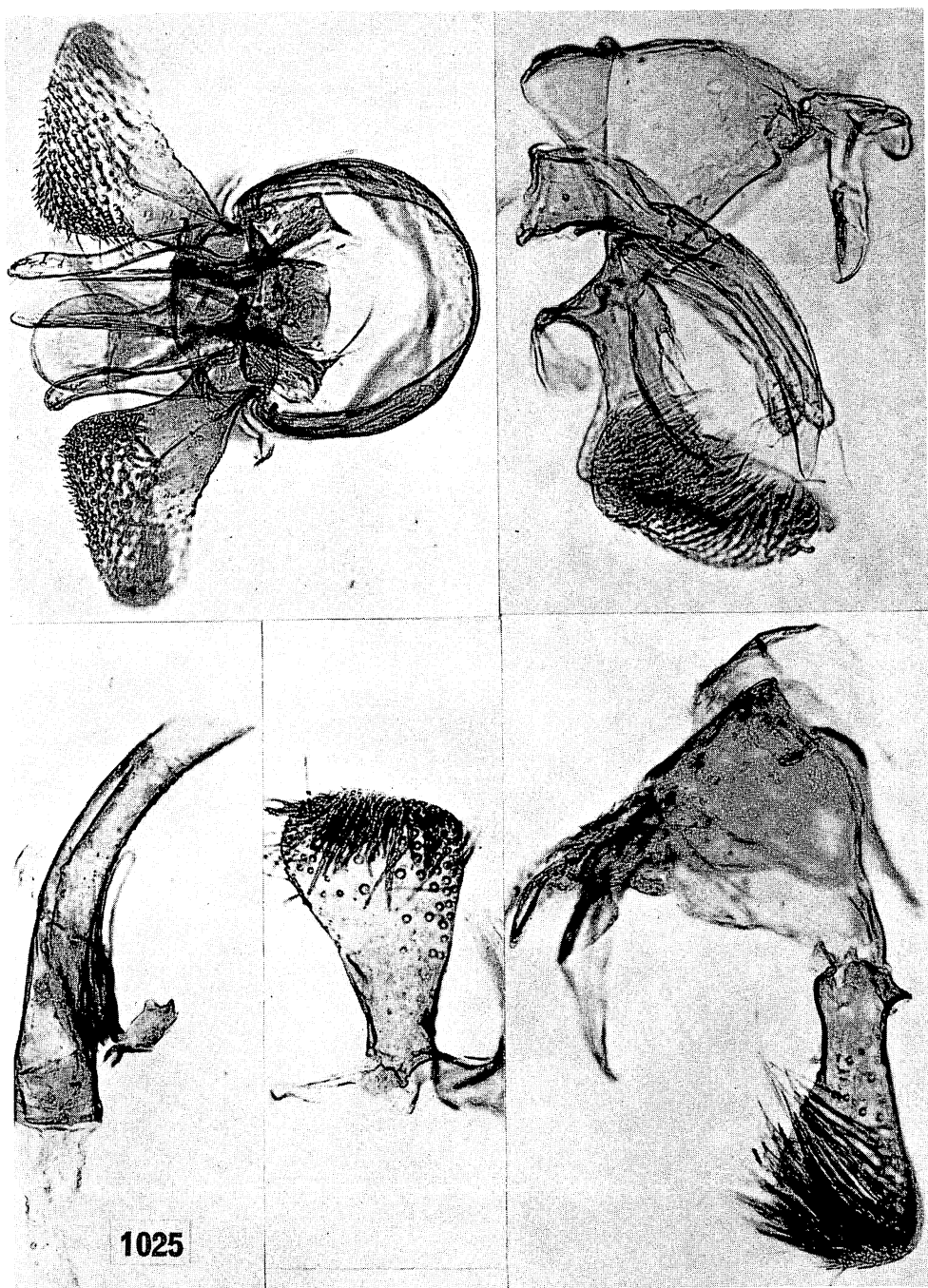


Figure 1025—Male genitalia of *Hyposmocoma* (*Euperissus*) ("Aphthonetus"). Top left, *nemo* (Walsingham), holotype (BM slide 4752); Haleakala, 5,000 feet, Maui. Top right, *passerella* (Walsingham), holotype (BM slide 4742); Kauai, 3,000 to 4,000 feet. Bottom, *plumbifera* (Walsingham), holotype (BM slide 4748); Kauai, 3,000 to 4,000 feet; note the small, slender anellar lobe close to and beneath the aedeagus. None of these species has *Aphthonetus*-type appendages on the seventh abdominal tergite—they belong to a different subgroup. Compare *empetra* and associated species.

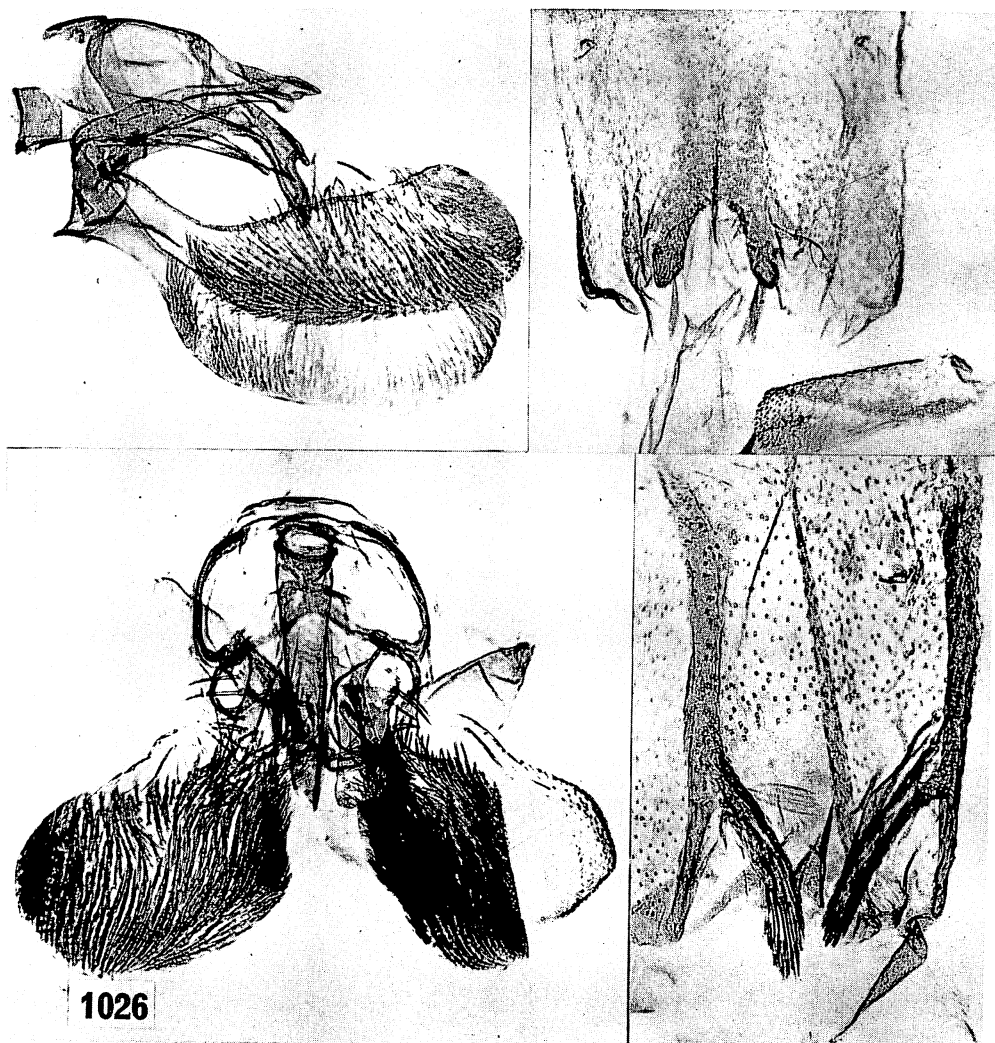


Figure 1026—Male genitalia of *Hypsocoma* (*Euperissus*) ("*Aphthonetus*"). Top, *polia* (Walsingham), holotype (BM slide 4750); Kauai, 3,000 to 4,000 feet. Bottom, *puncticiliata* (Walsingham), holotype (BM slide 4755); Kona, 4,000 feet, Hawaii. Although this is a dorsal view of the genitalia, the brachia are not revealed. They resemble my sketch of *elegans* (figure 1020) with some small differences in outline.

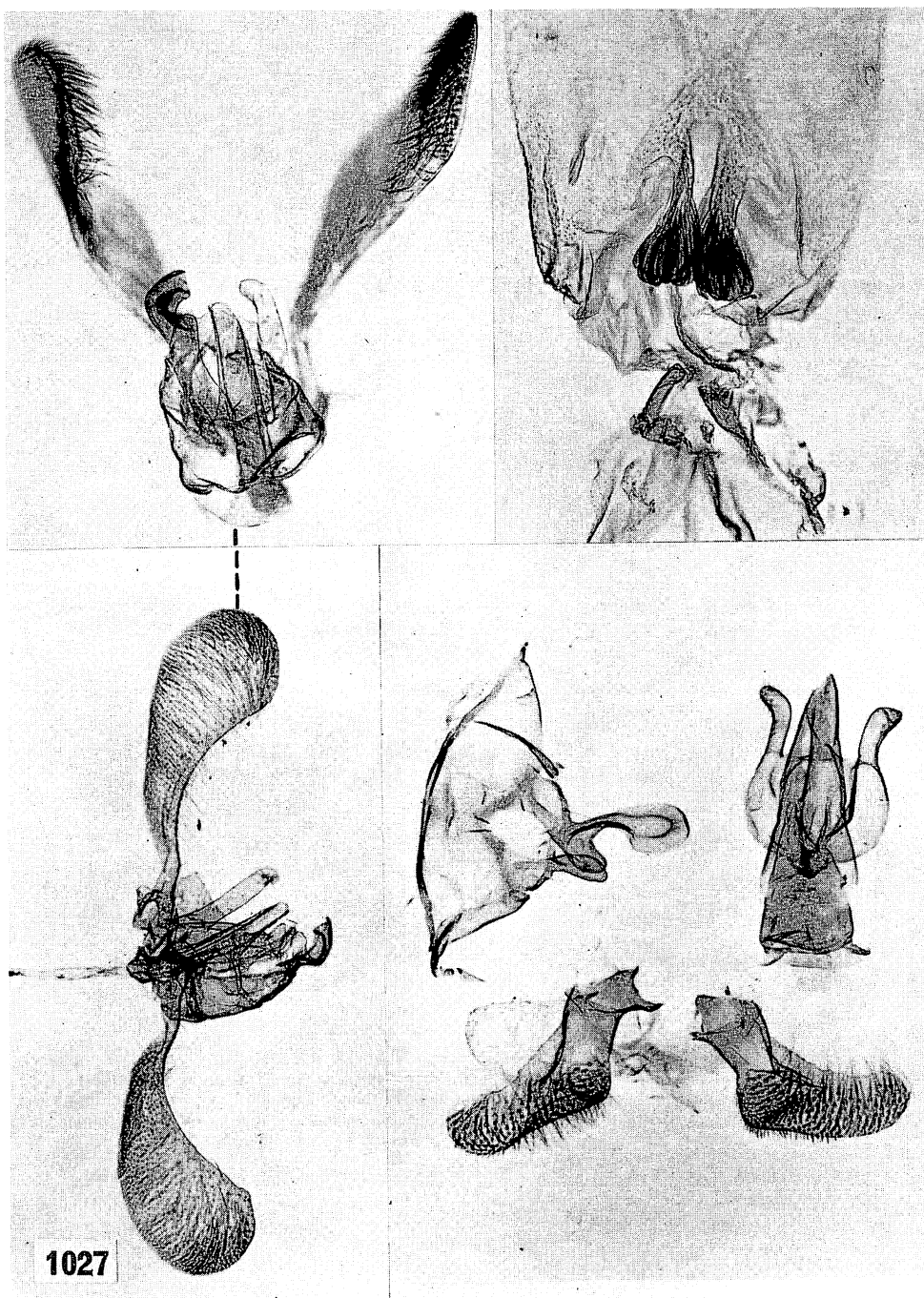
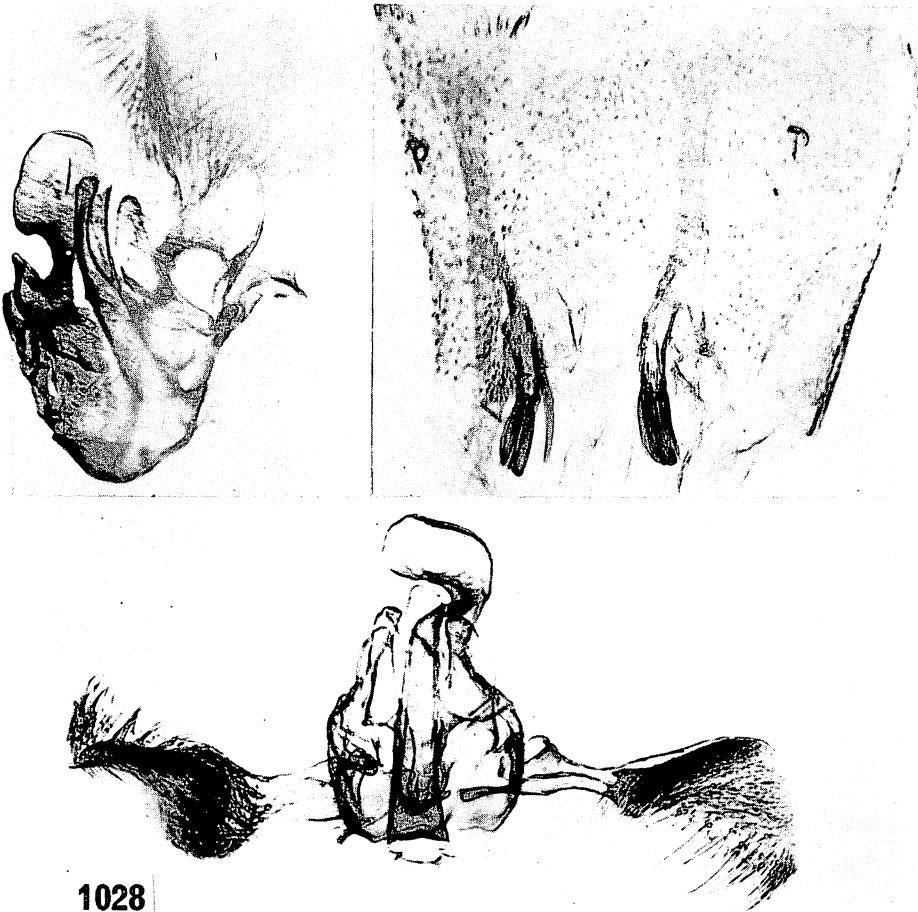


Figure 1027—Male genitalia of *Hypsmocoma* (*Euperissus*) ("*Aphthonetus*"). Top, left and right, and bottom left, *sagittata* (Walsingham), holotype (BM slide 4757); Kauai, 4,000 feet. The lower left figure is the same specimen as that shown at the top left, but it has been remounted and spread. Bottom right, *sideroxyloni* (Swezey), paratype (slide Z-IV-3-61-1); Puu Peahinaia, Koolau Mts., Oahu. The abdomen lacks caudal processes. This species belongs in association with *empetra* and its allies rather than with typical *Aphthonetus*.



1028

Figure 1028—Male genitalia of *Hypsmocoma* (*Euperissus*) ("*Aphthonetus*") *subocellata* (Walsingham), holotype (BM slide 4751); Haleakala, 5,000 feet, Maui. Top left, the specimen as previously mounted, lateral aspect. Bottom, the same after remounting; the valvae are, unfortunately, twisted.

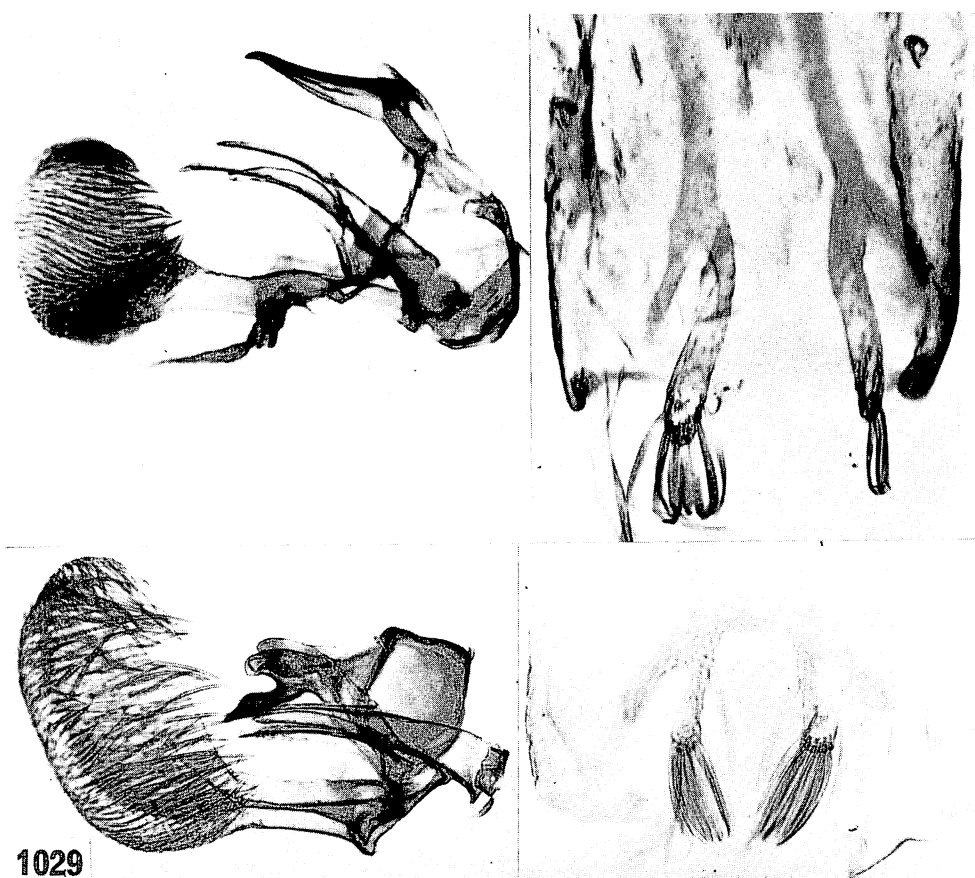


Figure 1029—Male genitalia of *Hyposmocoma* (*Euperissus*) ("*Aphthonetus*"). Top, *trichophora* (Walsingham), holotype (BM slide 4749); Kauai, 3,000 to 4,000 feet. Bottom, *spurcata* (Walsingham), holotype (BM slide 4747); Haleakala, 5,000 feet.

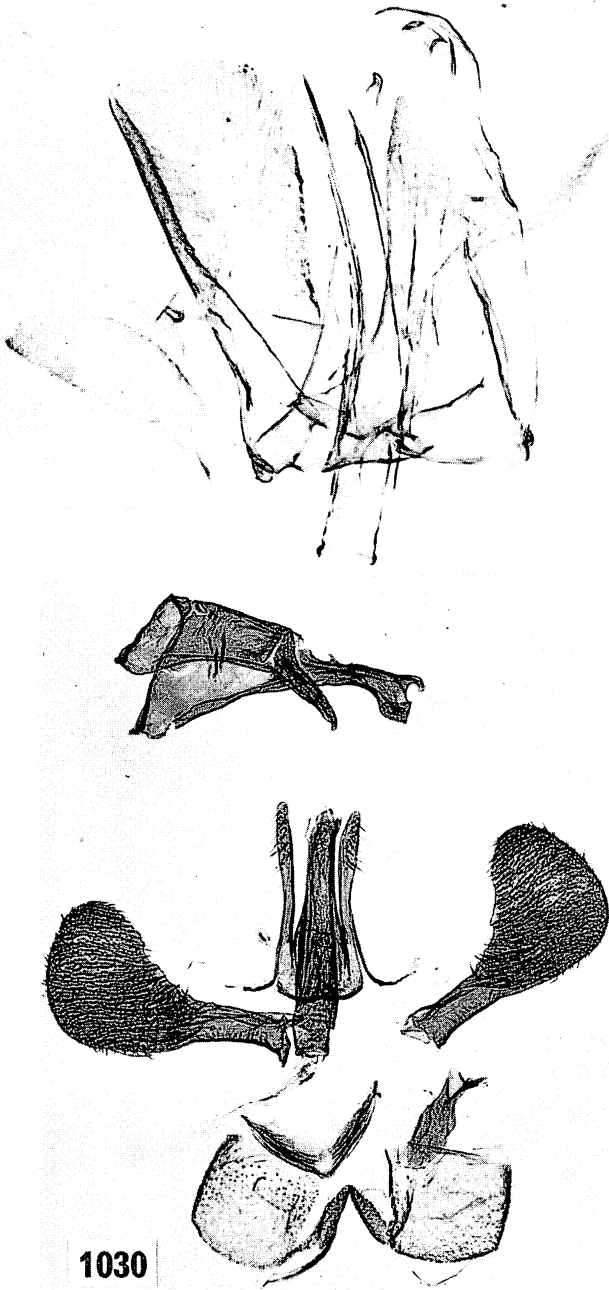


Figure 1030—Male genitalia of *Hypsmocoma* (*E.*) species originally included in "*Euhypsmocoma*". Top, *ekaha* (Swezey), a poor preparation with the apical part of the right valva torn off (Busck slide 162); Oahu. Bottom, *trivittella* (Swezey), the type-species of *Euhypsmocoma* (slide Z-I-20-61-2); Kilohana, Kauai.

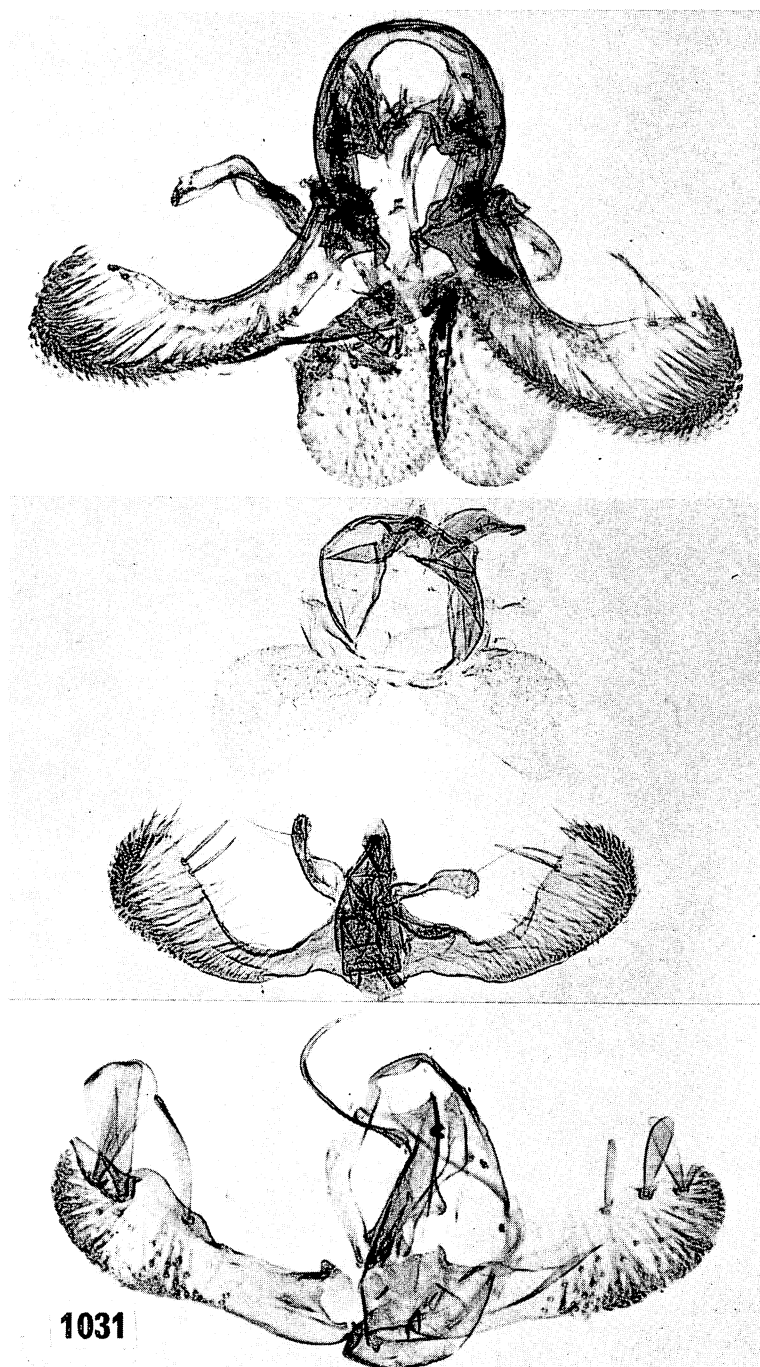
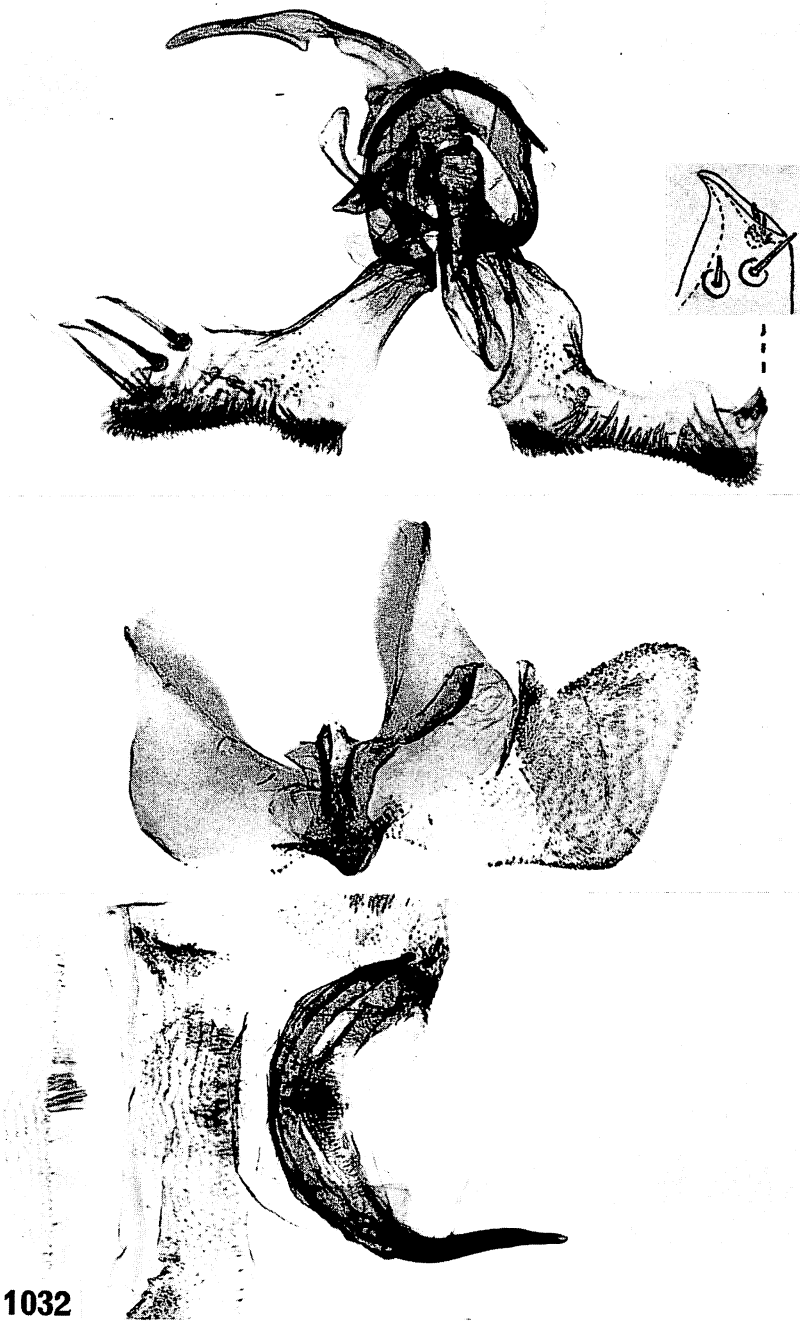


Figure 1031—Male genitalia of *Hyposmocoma* (*H.*) species originally placed in "*Petrochroa*". Top, *communis* (Swezey); Honolulu (BM slide 5432); the two spurs are broken off the left valva; compare the middle figure. Middle, another supposed specimen of *communis* from Kokee, Kauai (slide Z-IV-6-61-4) with the valvae, aedeagus, and anellar lobes separated from the tegumen and its attached brachia and genital flaps. There is no pseuduncus. Compare *canella* and associates. Bottom, *swezeyi* (Busck); Kaimuki, Honolulu (Busck slide 193); note the long, slender right brachium (the tegumen is deformed in the mount so that it is pictured somewhat confusingly). This species has a strong pseuduncus. Compare *mimema*, which is evidently an allied species.



1032

Figure 1032—Male genitalia of *Hyposmocoma* (*H.*) determined as *abjecta* (Butler) by Swezey, but possibly not that species. Pacific Heights, Oahu (slide lettered JDB X-1960). Despite its appearance the right valva is not damaged, but the spurs are greatly reduced, as the enlarged sketch indicates. The hulllike eighth sternum with its right genital flap is the middle figure, and the strong pseuduncus is shown in ventral aspect at bottom. The way the pseuduncus is placed on the slide conceals its broadly expanded apex and is, thus, misleading. Compare *albifrontella* and *lebetella*.



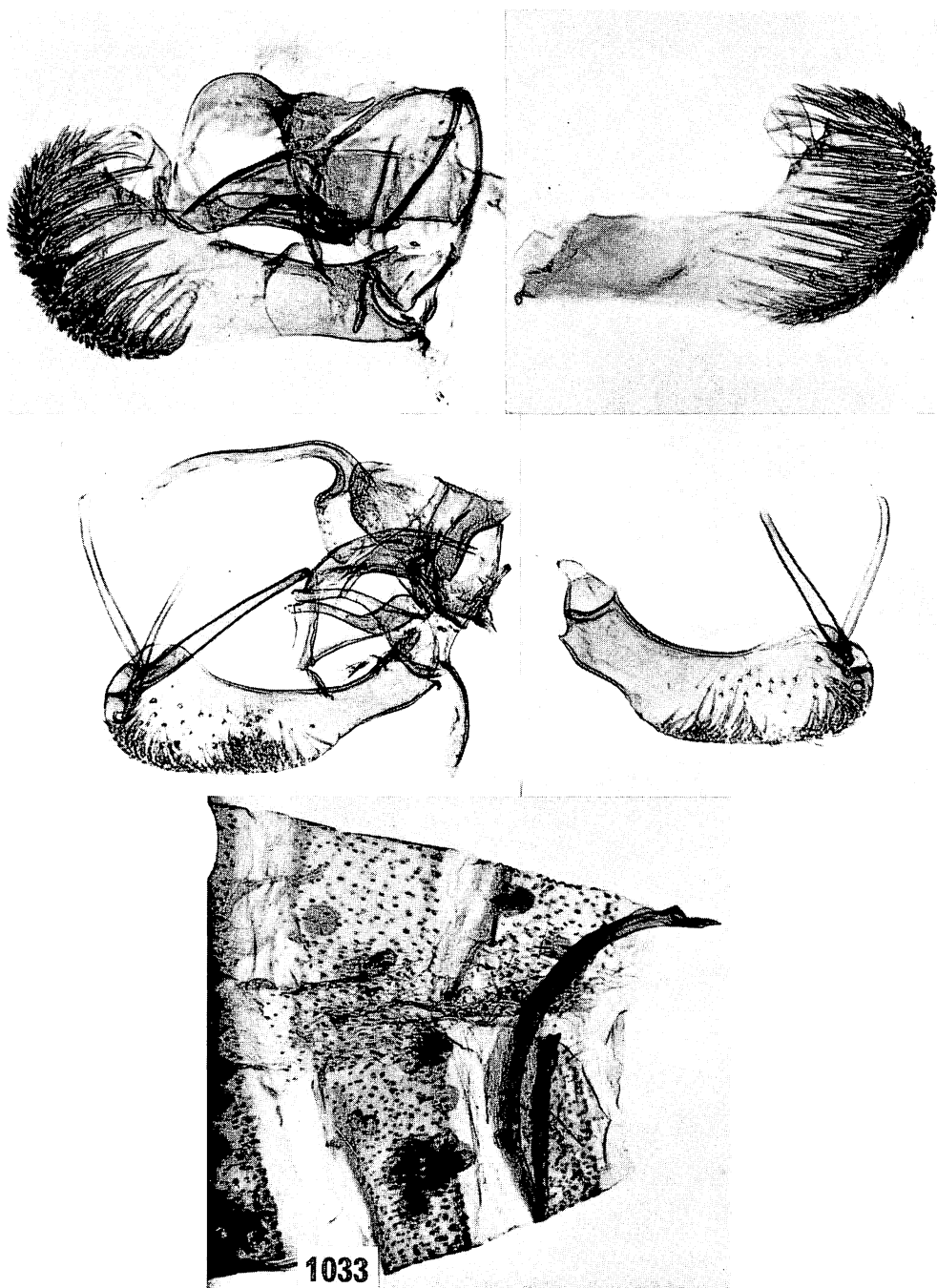


Figure 1033—Male genitalia of *Hypsoscoma* (H.). Top, left and right, *bella* Walsingham, holotype (BM slide 4350); Halemanu, 4,000 feet, Kauai. Compare *phalacra*. Middle and bottom, *admirationis* Walsingham, holotype (BM slide 4124); Molokai, 4,000 feet (the third spur on the right valva has been lost). Compare *albonivea*, *alveata*, *carbonenotata*, *irregularis*, *oxypetra*, *persimilis*, *propinqua*, *scolopax*, *somatodes*, *subcitrella*, *subscolopax*, *tetraonella*, *torella*, *trimaculata*, and *turdella*.

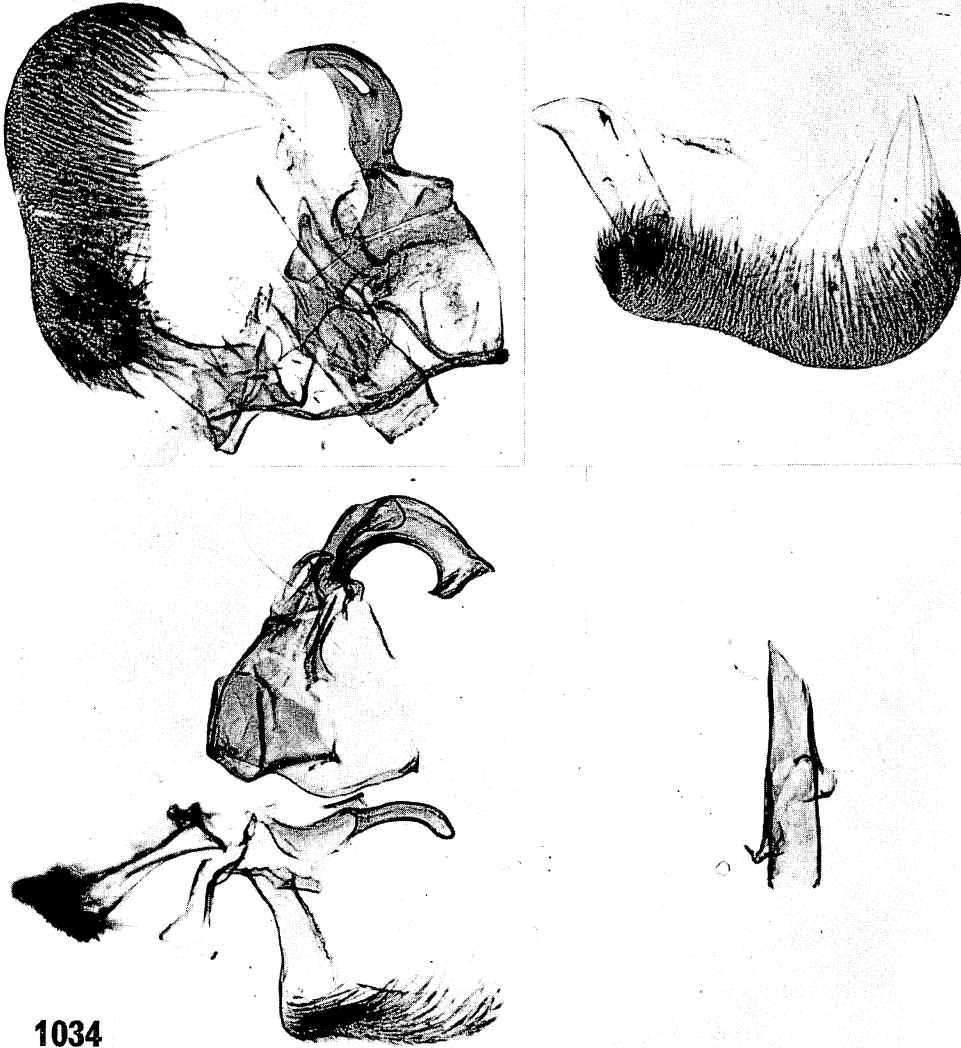


Figure 1034—Male genitalia of *Hypsmocoma* (*Euperissus*). Top, *adolescens* Walsingham, holotype (BM slide 4137); Kilauea, Hawaii. Compare *adelphella*, *auroargentea*, *emendata*, *ensifer*, *falsimella*, *fulvocervinella*, *niveiceps*, *ocellata*, *pucciniella*, *punctifumella*, *scepticella*, and *stigmatella*. Bottom, *alticola* Meyrick, lectotype (BM slide 9559 Clarke): Koolau Mts., near Honolulu. The left valva and left anellar lobe are out of focus. This is a member of the typical *Neelysia* group. Although it was originally described in *Hypsmocoma*, it should be placed in association with *lignicolor*.

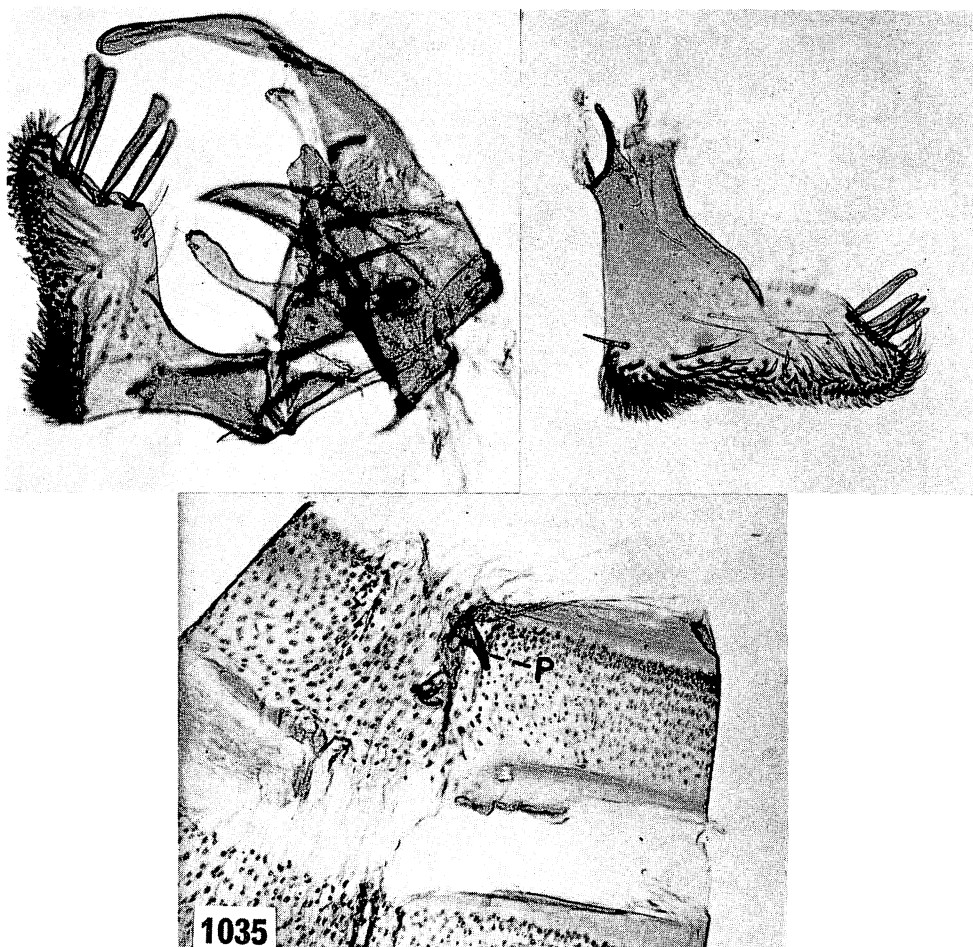


Figure 1035—Male genitalia of *Hypsmocoma* (*H.*) *albifrontella* Walsingham, holotype (BM slide 4100); Molokai, about 4,000 feet. Compare figure 1032 of *abjecta*, and note particularly the differences in the pseuduncus ("P") and the right valva. Compare also *lactea*, *lebetella*, and *tenuipalpis*.

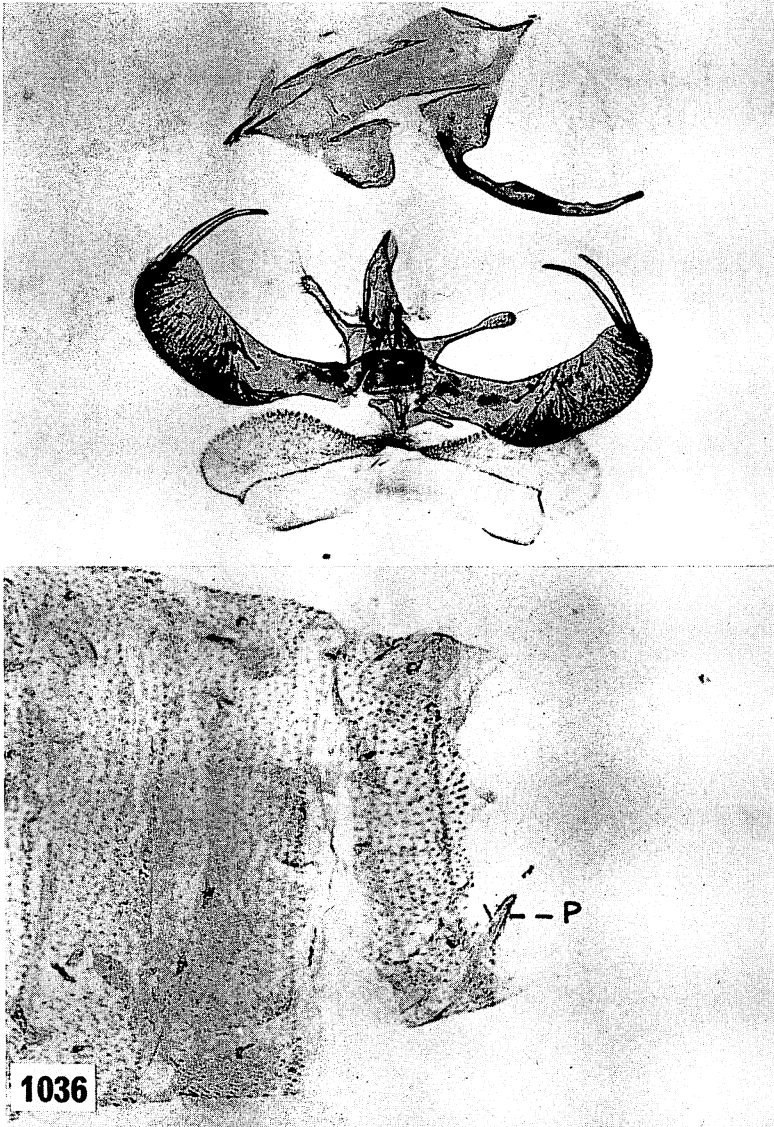


Figure 1036—Male genitalia of *Hypsmocoma* (*H.*) *albonivea* Walsingham, determined by Swezey and collected by him at Punaluu, Oahu (slide Z-I-22-61-1); note the incipient pseuduncus at "P"; compare the main text. Compare *admirationis*, *carbonenotata*, and allies.

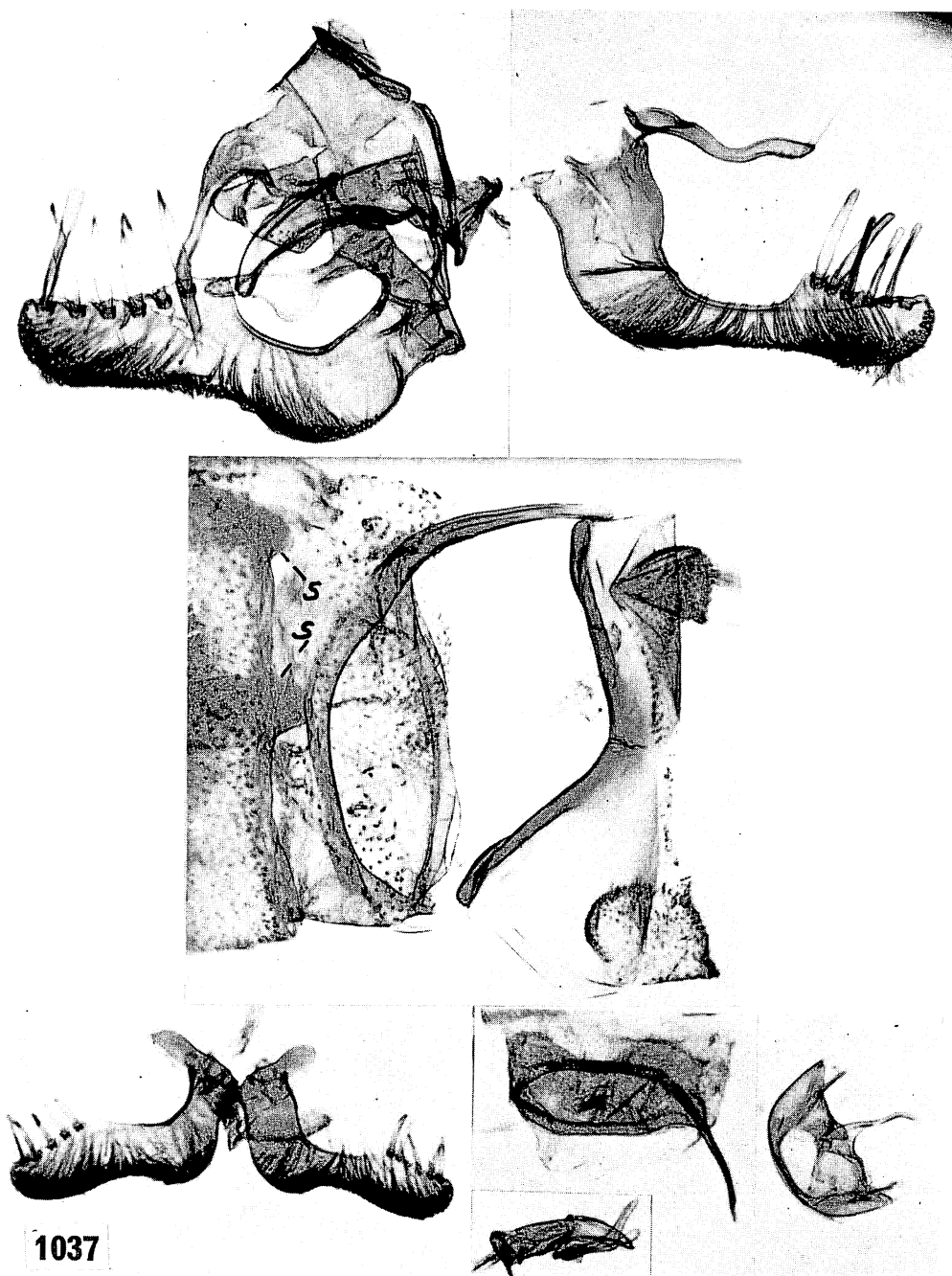


Figure 1037—Male genitalia of *Hypsoscyma* (*H.*) *alliterata* Walsingham. Top and middle, holotype (BM slide 4322); Molokai, 4,000 feet; the outer spur is missing from right valva. Note the sclerotizations ("S"); these are lateral on the sixth abdominal segment, but they are displaced here because of folding of the pelt in the mount. Note the strong pseuduncus and the sclerotized eighth sternum with its attached (folded) genital flaps at the right. Bottom, a paratype (BM slide 7332); Haleakala, 4,000 feet, Maui; lesser enlargement; there are only five spurs on the left valva, and one spur has been lost from the right valva. This also has the sclerotizations on the sixth abdominal segment. Is the variation between these specimens taken on different islands merely individual? Compare figure 1038 and the *iodes* group.

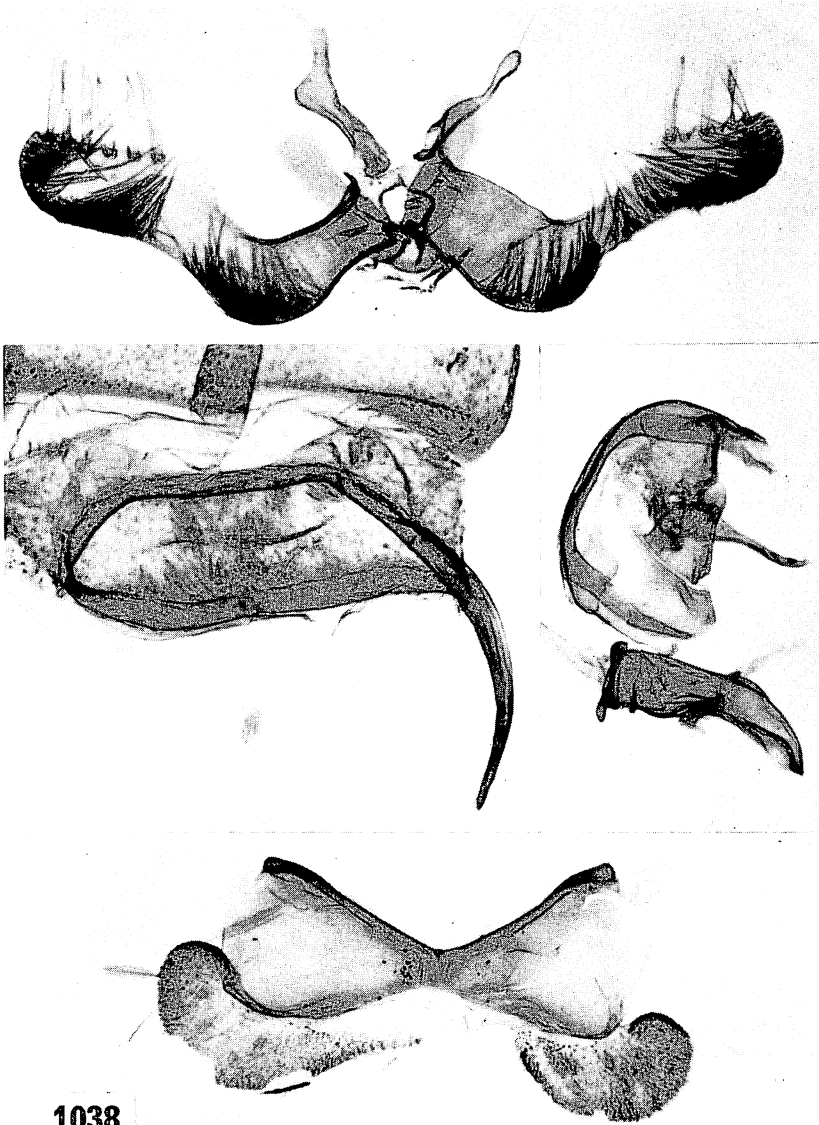
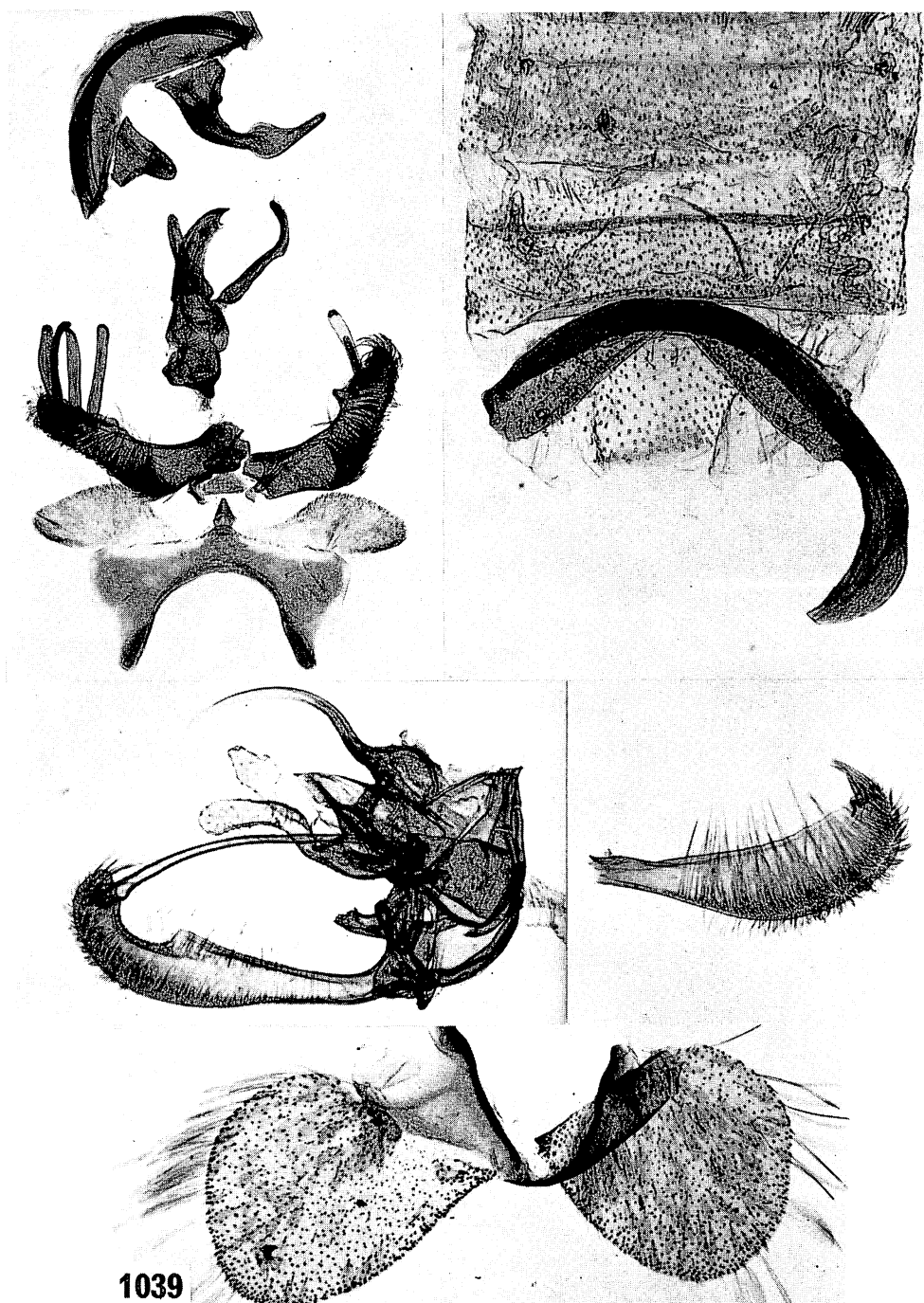
**1038**

Figure 1038—Male genitalia of *Hypsmocoma* (*H.*) *alliterata* Walsingham from a paratype (BM slide 7331); Kona, about 3,000 feet, Hawaii. Two of the right valva spurs have been lost. The postero-lateral sclerotizations on the sixth abdominal segment are not shown well here; see figure 1037 of the holotype.



1039

Figure 1039—Male genitalia of *Hypsoscoma*. Top, (*H.*) *anisoplecta* Meyrick, holotype (slide Z-I-22-61-3); Mt Kaala, Oahu. Middle and bottom, (*H.*) *bacillella* Walsingham, holotype (BM slide 4325); Halemanu and Kaholuamano, 4,000 feet, Kauai. Note the extraordinarily long, single spur on the left valva. There is no pseuduncus on the abdomen of this species. It would appear to belong to the *saccophora* group.

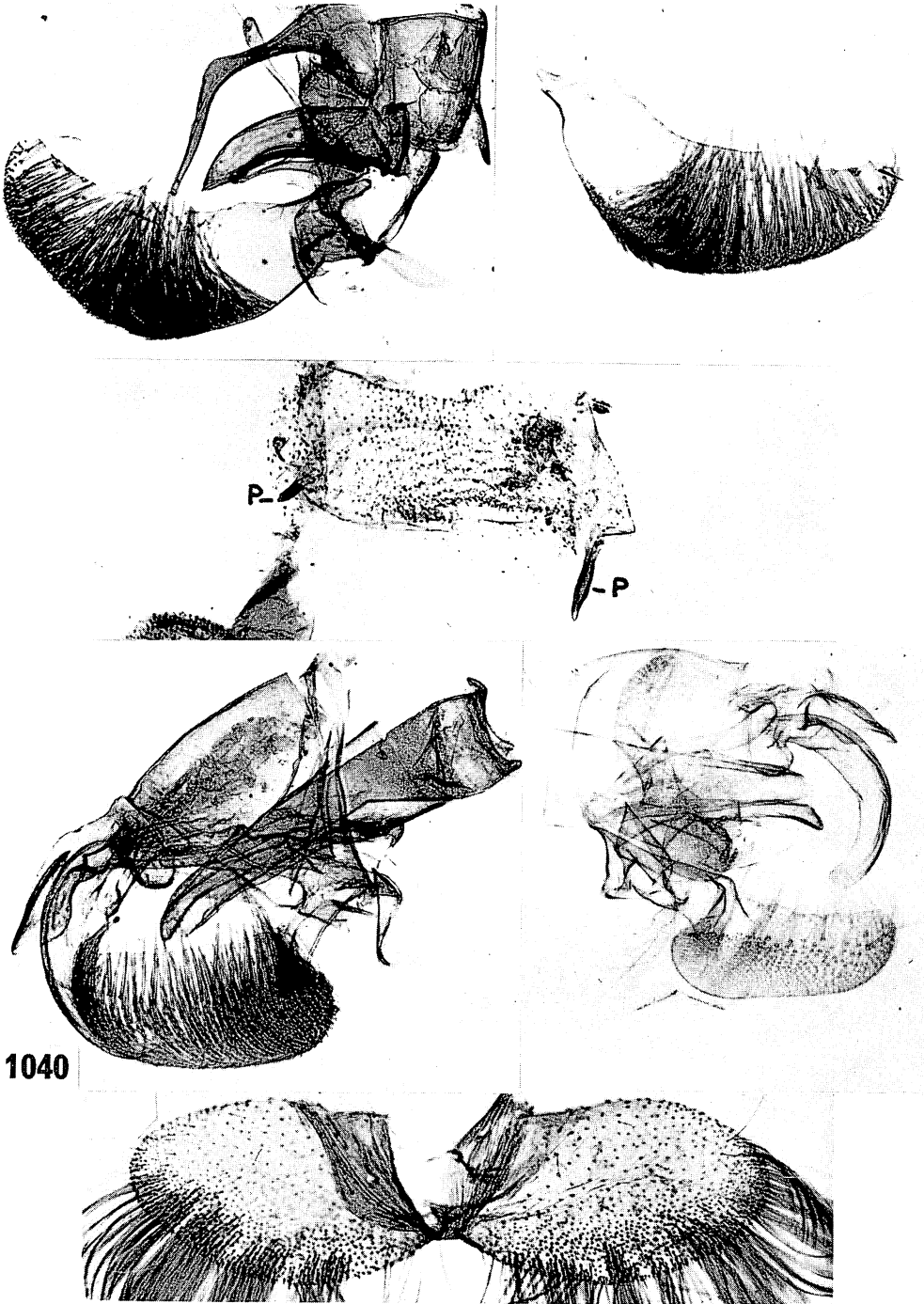
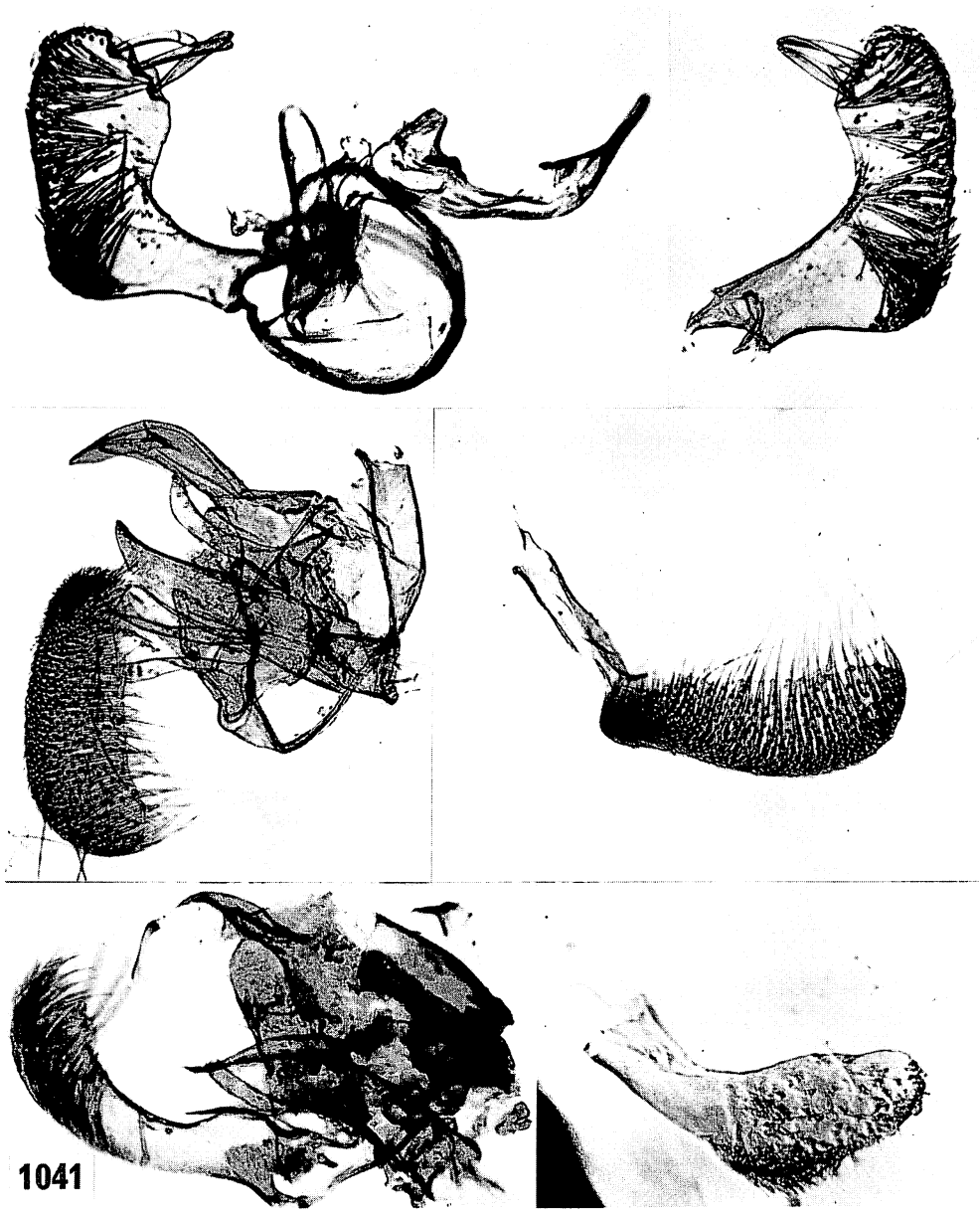


Figure 1040—Male genitalia of *Hyposmocoma*. Top three figures, (*H.*) *arenella* Walsingham, holotype (BM slide 4486); Kona, 2,000 feet, Hawaii. The spurs are aborted, but the setal sockets remain; a paratype is similar in this respect. Note the two processes of an incipient pseuduncus at "P" on the seventh sternite. Compare *carnea*, *nephelodes*, and *rubescens*. Bottom three figures are of (*E.*) *argentea* Walsingham; left, from the holotype (BM slide 4317); Molokai, about 4,000 feet; far bottom, genital flaps of same; near bottom right, from a paratype (Busck slide 43 from Walsingham specimen 28717).





1041

Figure 1041—Male genitalia of *Hypsoscoma*. Top, (*H.*) *auripennis* (Butler), holotype (BM slide 4109); Haleakala, Maui. Compare *costimaculata* and *virgata*. Middle, (*E.*) *auroargentea* Walsingham, holotype (BM slide 4107); Haleakala, 5,000 feet, Maui. Compare *adolescens*. Bottom, (*H.*) *auropurpurea* Walsingham, holotype (BM slide 4352); Waianae Mts., 2,000 feet, Oahu. The unusual appearance of the right valva is caused by its being beneath rough balsam at the edge of the coverslip and by its having its spurs broken off. The left valva is optically distorted. The abdomen was partly decomposed; this is not a satisfactory preparation.

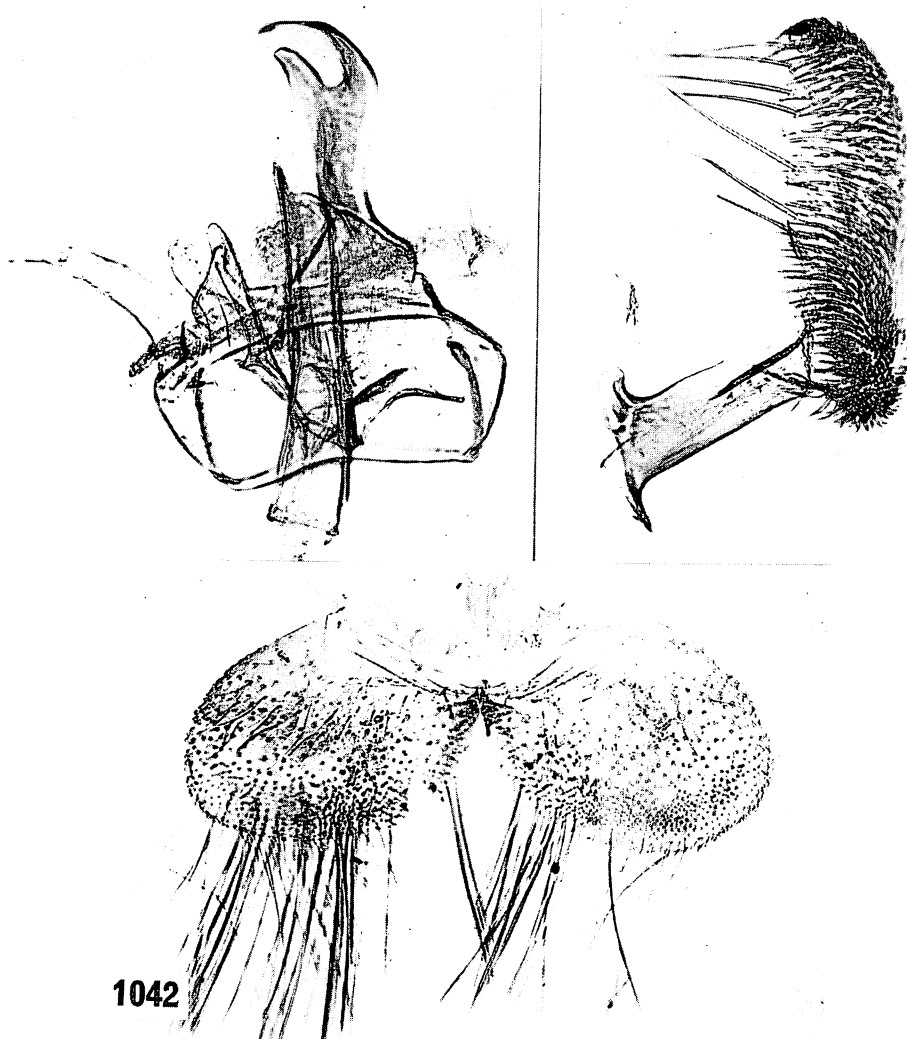


Figure 1042—Male genitalia of *Hypsoscoma* (*E.*) *adelphella* Walsingham, holotype (BM slide 4353); Kona, 4,000 feet, Hawaii. Compare *adolescens* and associates.

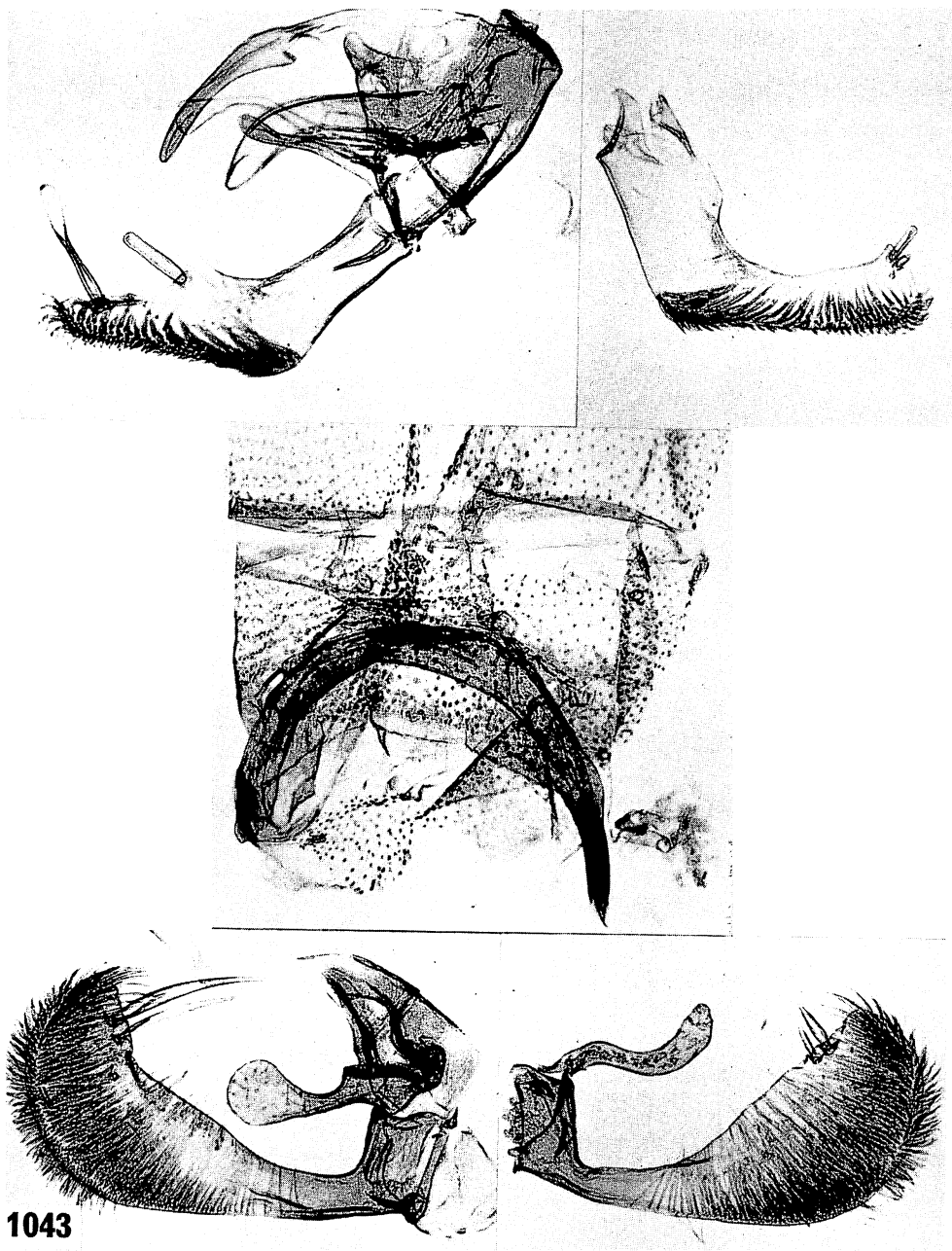


Figure 1043—Male genitalia of *Hypsomocoma*. Top, (*H.*) *belophora* Walsingham, holotype (BM slide 4490); near head of Kawailoa Gulch, Oahu. Compare the *blackburnii* group. Bottom, *cinereosparsa* Walsingham, holotype (BM slide 4328); Kauai, 3,000 to 4,000 feet. The tegumen and brachia have not been photographed. The aedeagus is the part above the base of the left valva with the attached left anellar lobe. Compare *canella* and allies.

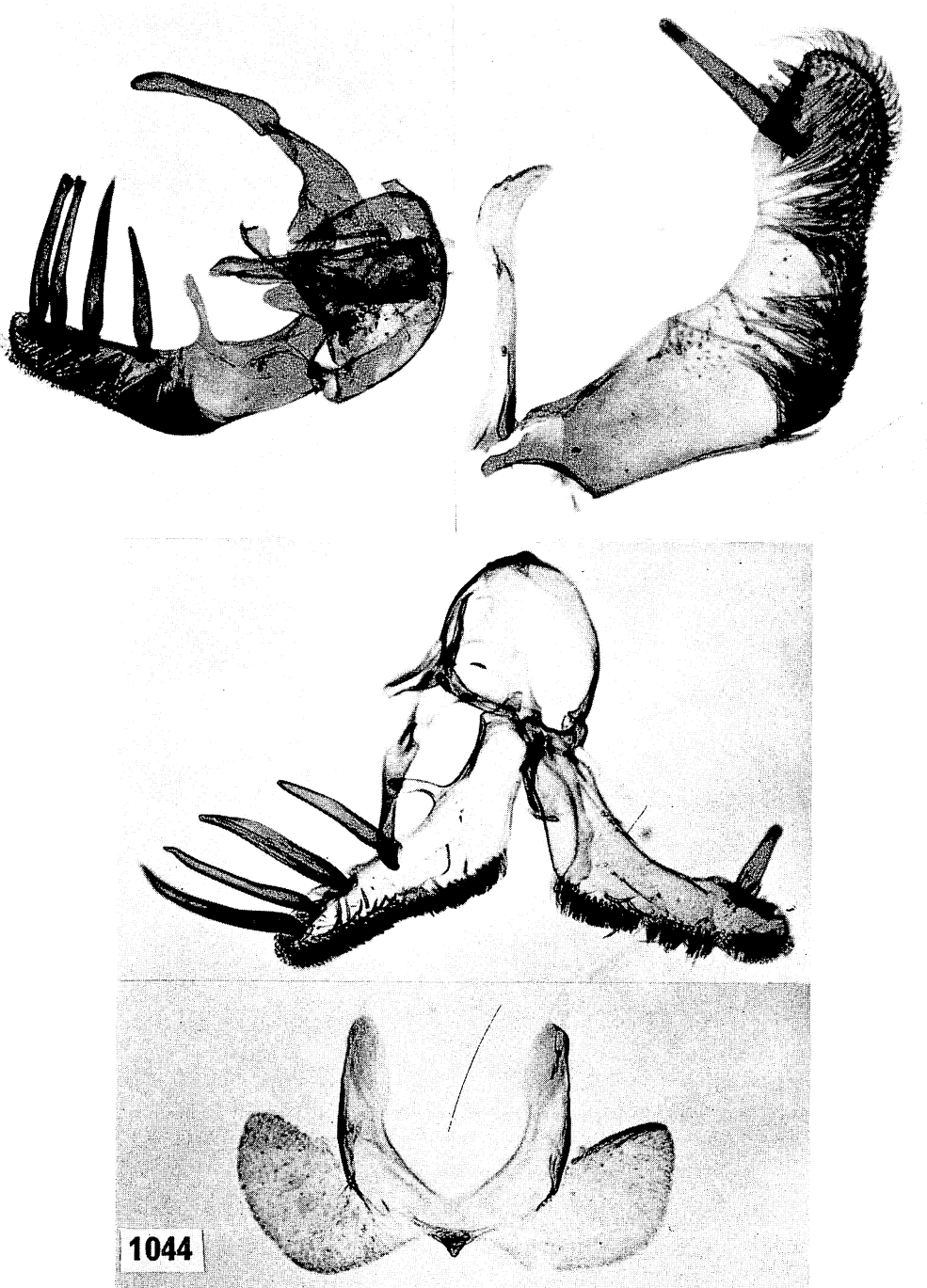


Figure 1044—Male genitalia of *Hypsocoma* (*H.*) *blackburnii* Butler. Top, the holotype (BM slide 4088); Maui, about 4,000 feet. The abdomen has a heavy C-shaped pseuduncus. Note the submedian, slender, thumblike extension from the costa of the left valva. Middle and bottom, a specimen determined by Walsingham and labeled "cenotype" (BM slide 1691); Olinda, 4,000 feet, Maui; the right valva is twisted in the mount and is thus optically distorted (the aedeagus with the adhering left anellar lobe is not shown). Note the hulllike eighth sternite and the genital flaps at bottom.

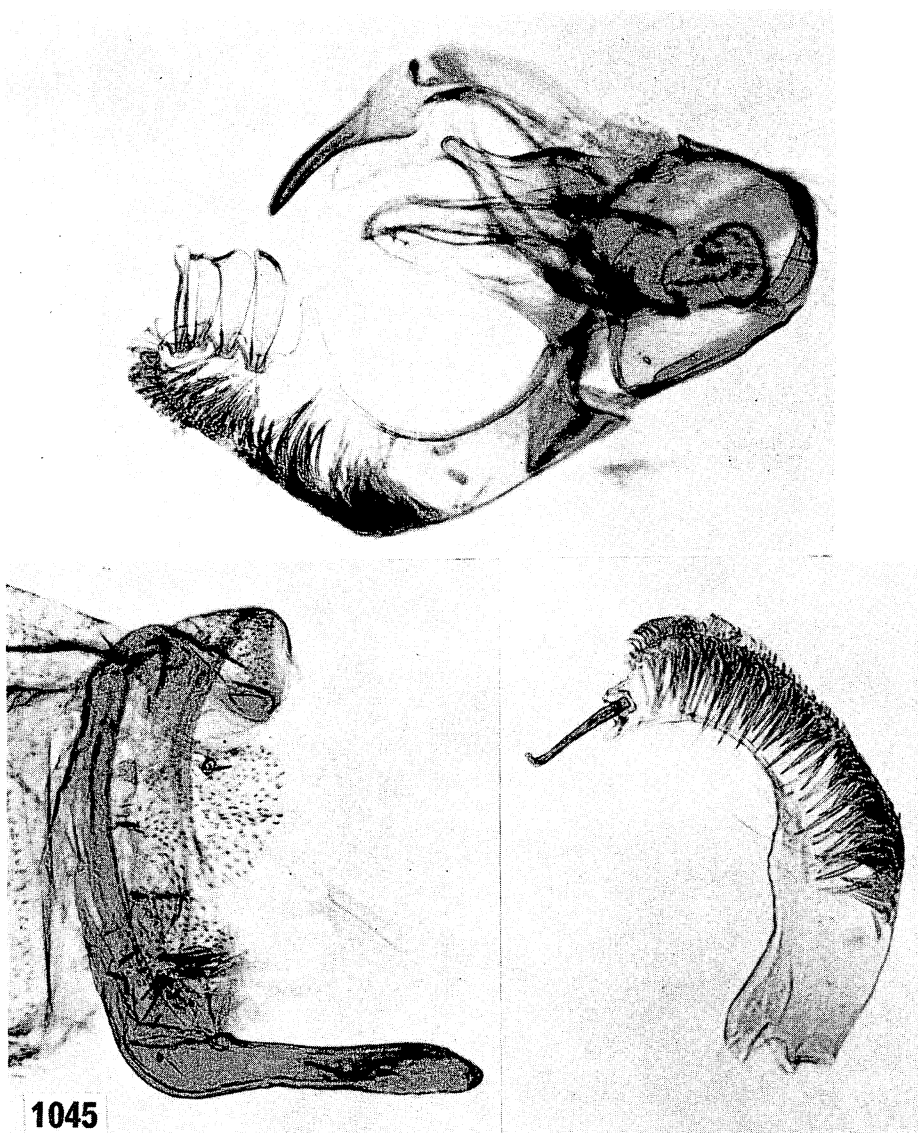
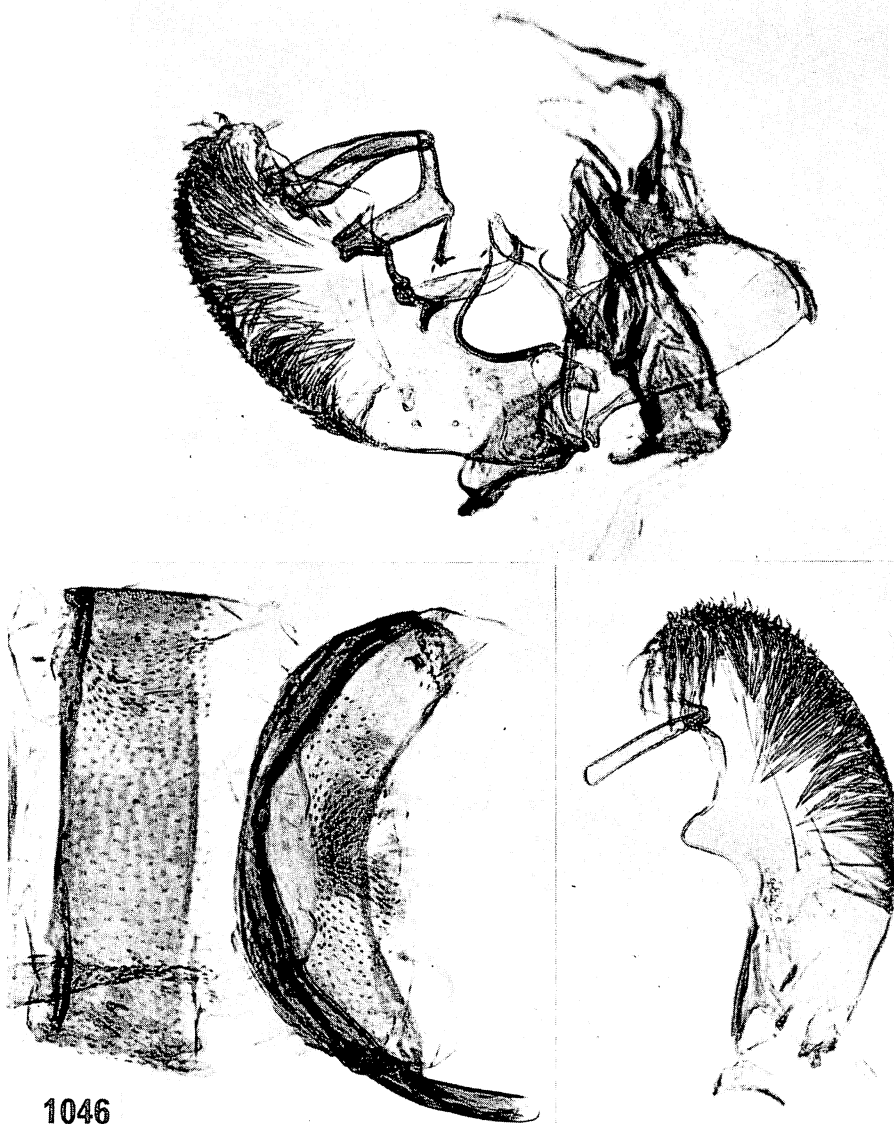


Figure 1045—Male genitalia of *Hypsoscuma* (*H.*) new species 1, formerly confused with *blackburnii* (BM slide 5512); Kaholuamano, 4,000 feet, Kauai; seventh abdominal segment with pseuduncus in ventral aspect.



1046

Figure 1046—Male genitalia of *Hypsmocoma* (*H.*) new species 2, formerly confused with *blackburnii* (BM slide 5511); Halemanu, 4,000 feet, Kauai; sixth and seventh abdominal segments with pseuduncus in ventral aspect.

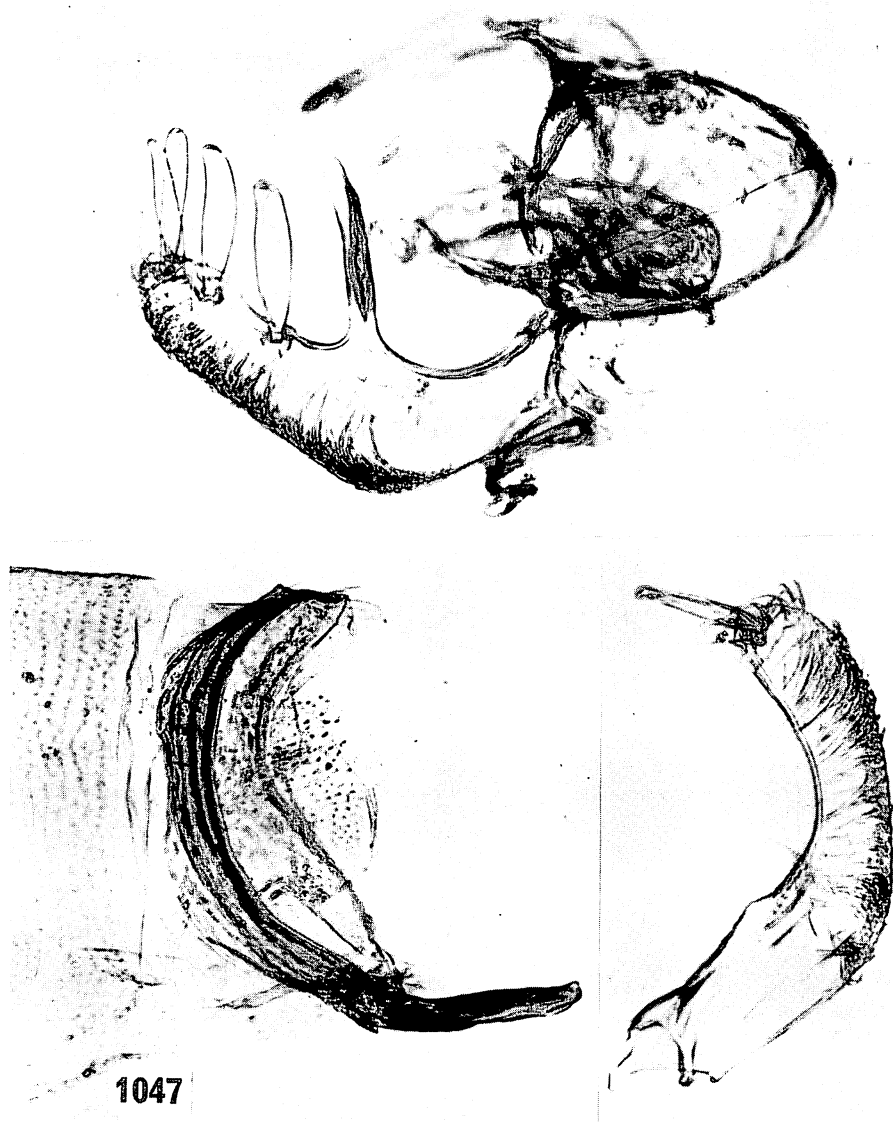


Figure 1047—Male genitalia of *Hypsmocoma* (*H.*) new species 3, formerly confused with *blackburnii* (BM slide 5505); Kauai, 3,000 to 4,000 feet; pseuduncus in ventral aspect.

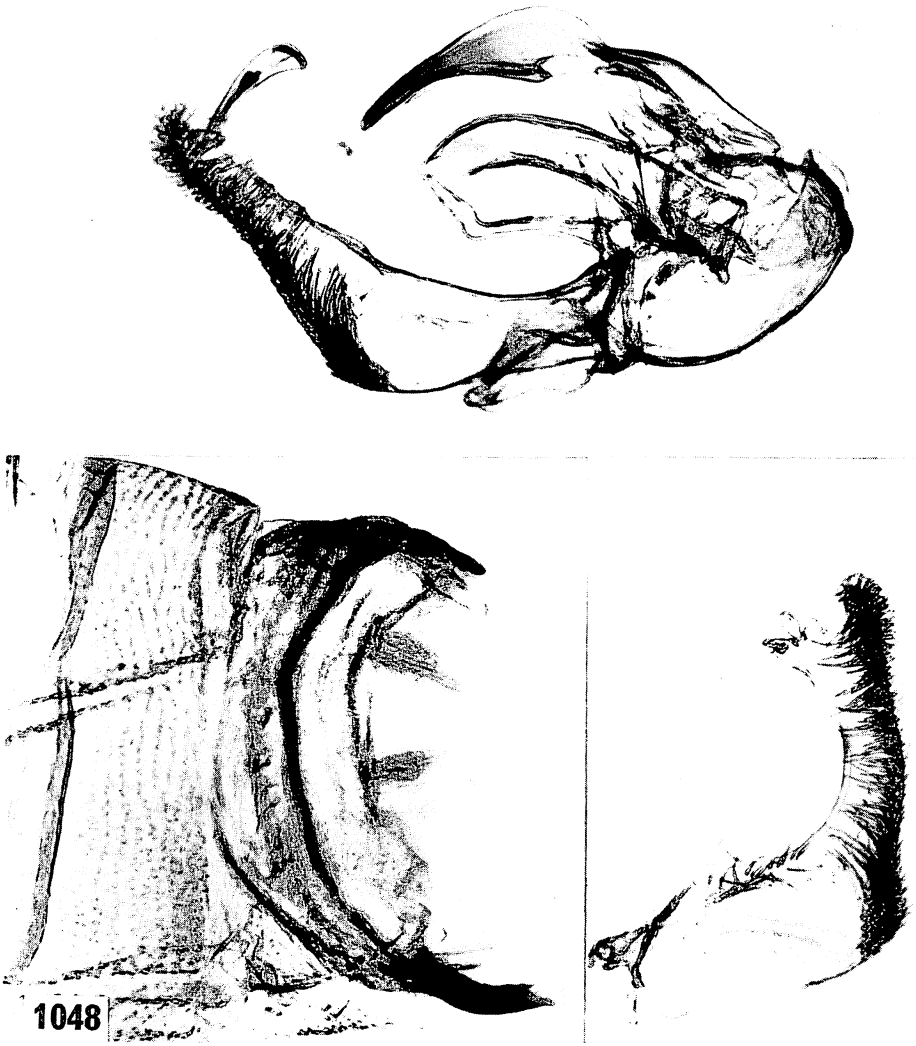


Figure 1048—Male genitalia of *Hypsoscocoma* (*H.*) new species 4, formerly confused with *blackburnii* (BM slide 5506); Waianae Mts., 2,000 feet, Oahu. Apex of abdomen in ventral aspect with the pseuduncus foreshortened because of its being strongly curved dorsad. Note the sclerotized margin of the sixth sternite. The fourth and fifth sternites also have sclerotized margins.



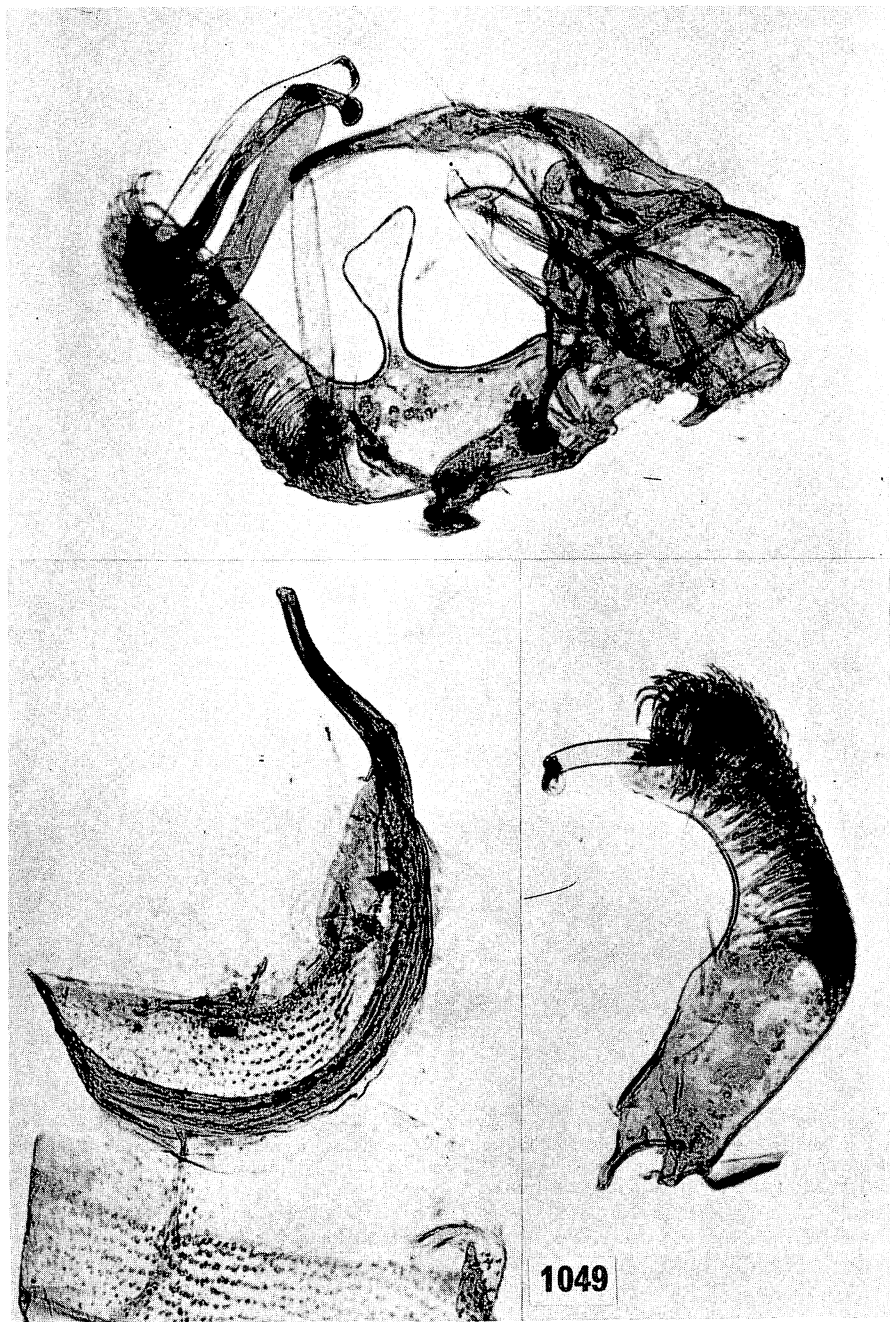


Figure 1049—Male genitalia of *Hypsmocoma* (*H.*) new species 5, formerly confused with *blackburnii* (BM slide 5507); Waianae Mts., about 2,000 feet, Oahu. Apex of abdomen viewed from beneath.

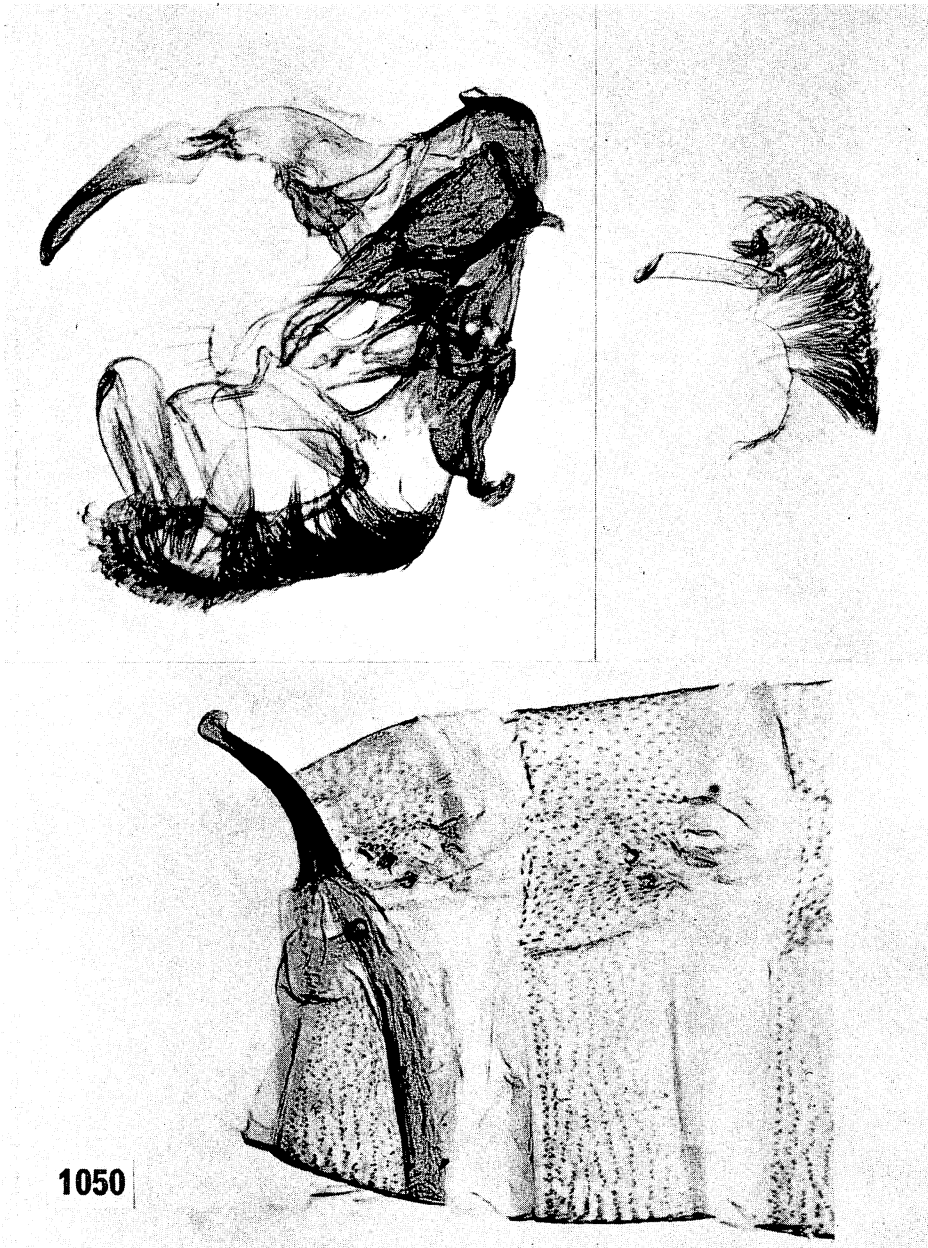


Figure 1050—Male genitalia of *Hypsmocoma* new species 7, formerly confused with *blackburni* (BM slide 5513); Kilauea, Hawaii. The end of the abdomen is viewed from the right side, and it demonstrates how the pseuduncus curves up over the genitalia. The right valva has been damaged. Compare *haleakalae* and associates.

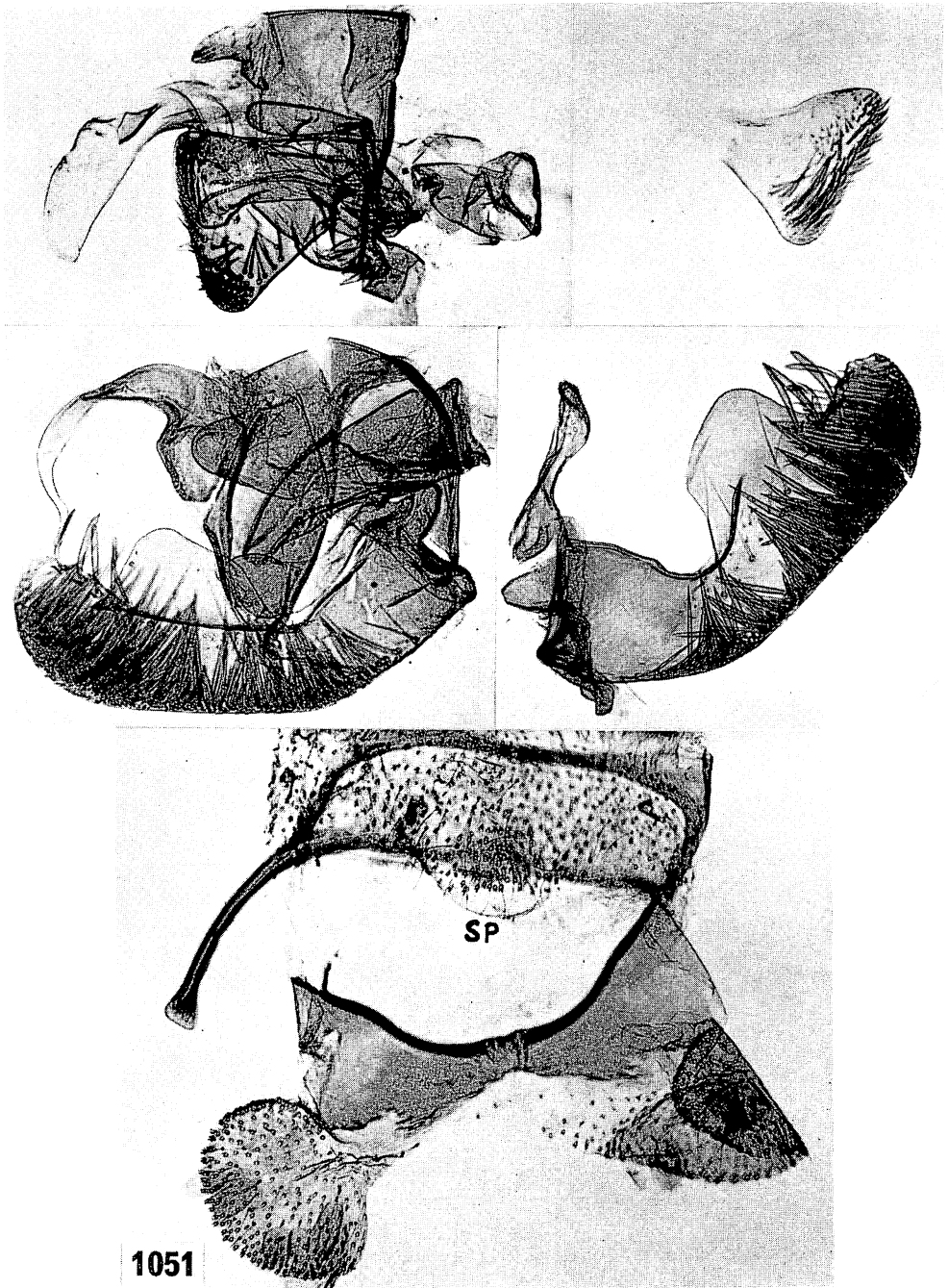


Figure 1051—Male genitalia of *Hyposmocoma*. Top, (*E.*) *brevistrigata* Walsingham, holotype (BM slide 4494); Kauai, 3,000 to 4,000 feet. Note the reduced valvae. Compare *nigrodentata*, *obliterata*, *rutilella*, and the *exsul* group incorrectly placed in *Aphthonetus*. Middle and bottom, (*H.*) *butalidella* Walsingham, holotype (BM slide 4119); Haleakala, 7,000 feet, Maui. In the bottom figure, note the complete sclerotization of the pseuduncus around the seventh segment and the sclerotized process (SP). Also note the differences between the eighth sternite and its genital flaps and those of *blackburnii*. Compare the *malornata* group.

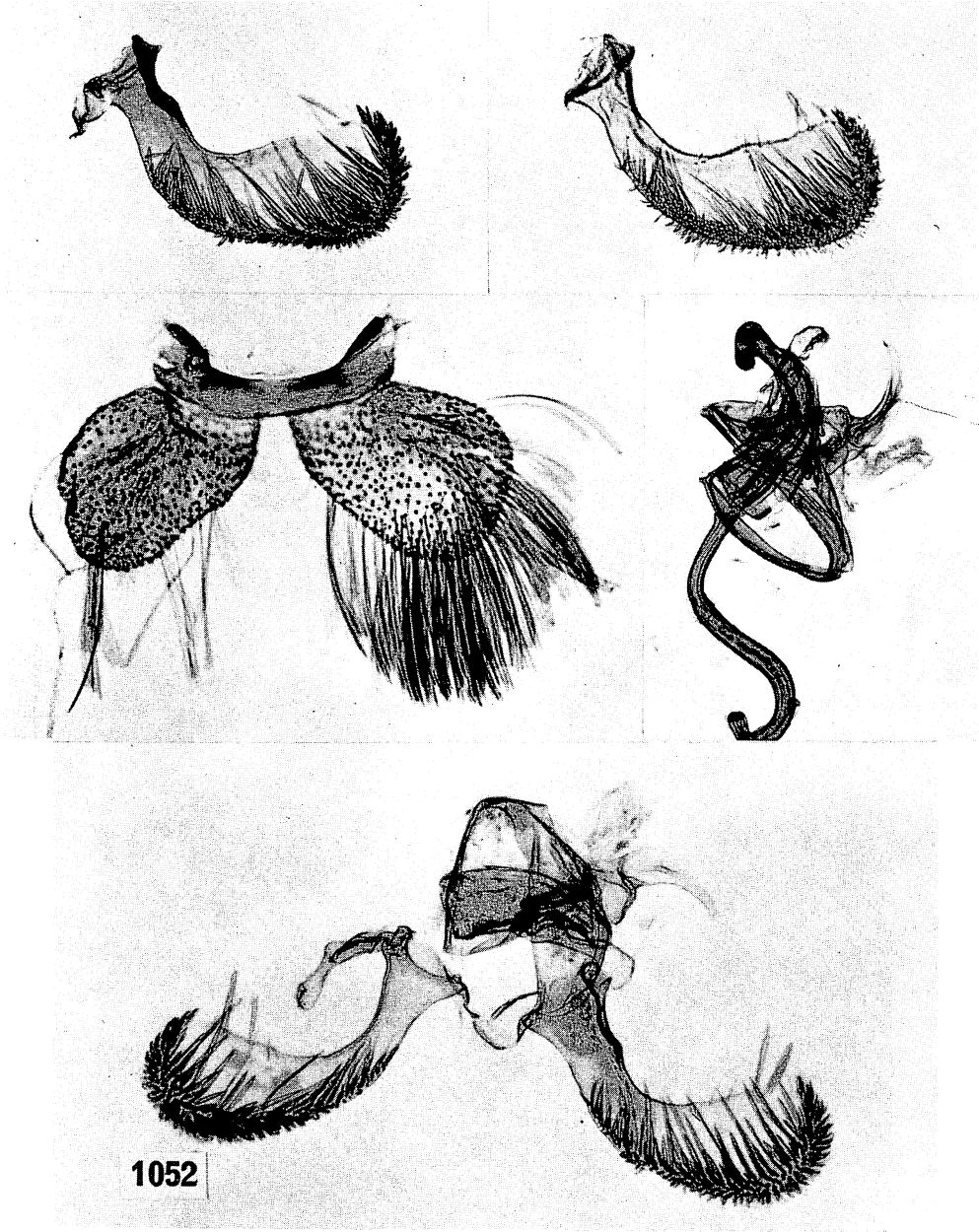


Figure 1052—Male genitalia of *Hypsmocoma* (*H.*) *canella* Walsingham. Top and middle, holotype (BM slide 4326); Molokai, 3,000 feet. The print of the valva at right has been reversed. The spermatophore protrudes from the aedeagus, distorting its appearance. Bottom, a paratype from the Waianae Mts., Oahu (BM slide 7329). Compare *cinereosparsa*, *communis*, *hemicasis*, *illuminata*, *lixiviella*, *mimica*, *nigrescens*, *parda*, and *subflavidella*.

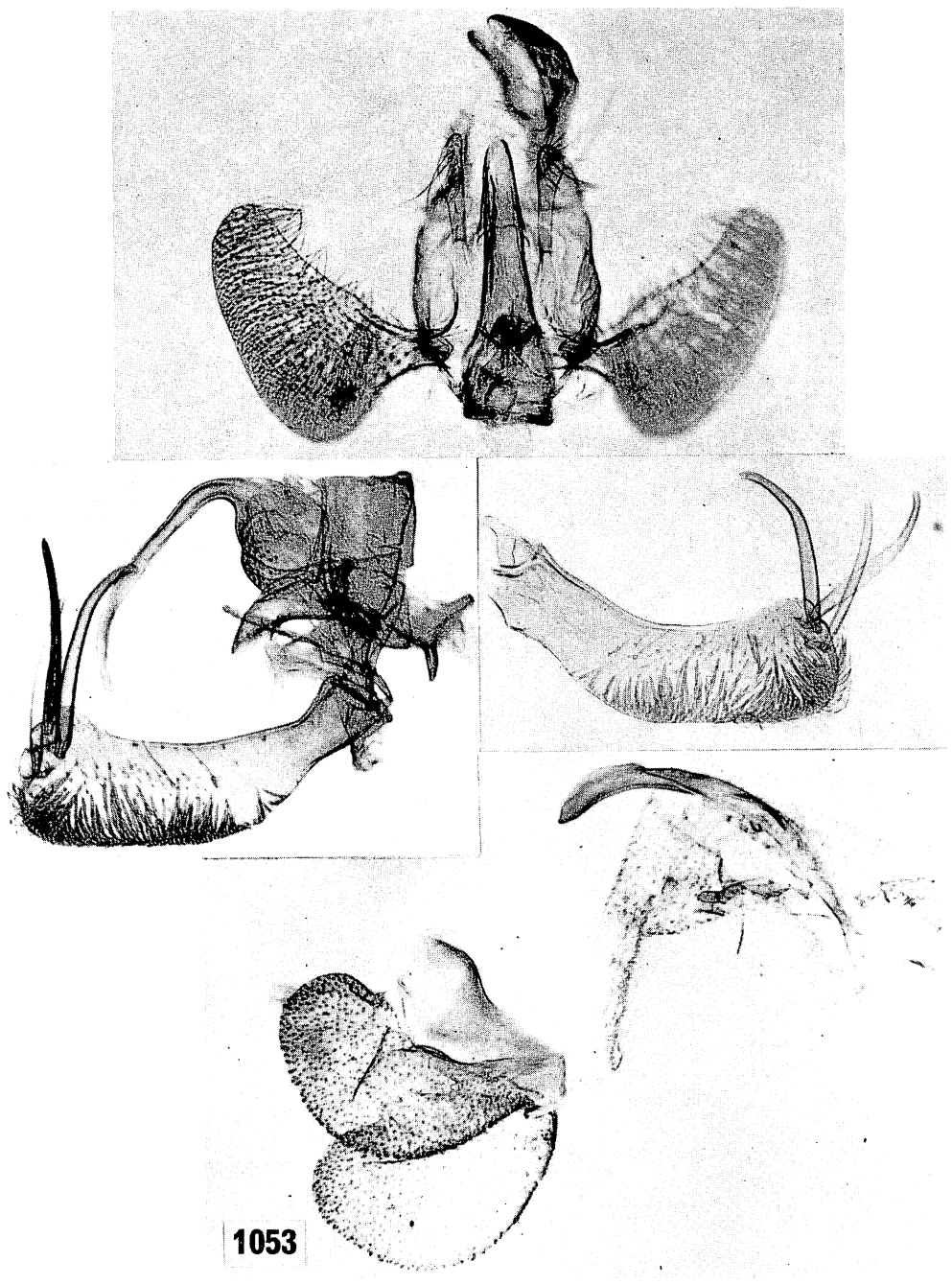


Figure 1053—Male genitalia of *Hypsmocoma*. Top, (*E.*) *caecinervis* Meyrick, paratype (BM slide 5555). There are no abdominal sclerotizations. Middle and bottom, (*H.*) *carbonenotata* Walsingham, holotype (BM slide 4321); Kauai, 3,000 to 4,000 feet. Compare *admirationis*, *irregularis*, *trimaculata*, and *propinqua*.

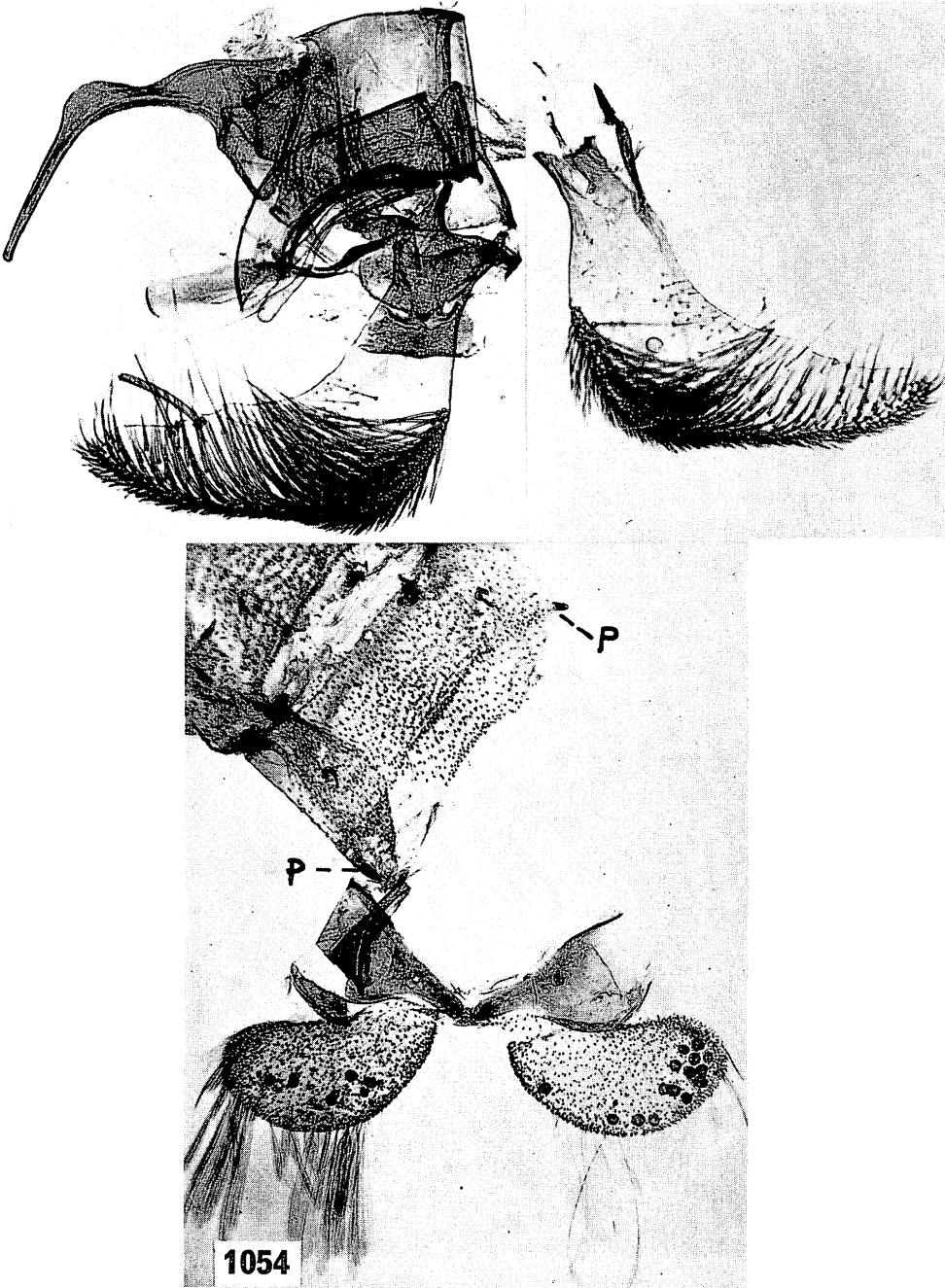


Figure 1054—Male genitalia of *Hyposmocoma* (*H.*) *carnea* Walsingham, holotype (BM slide 4343); Kauai, 3,000 to 4,000 feet. Note the incipient pseuduncus ("P"). The spurs have evidently been broken off the right valva. Compare *arenella*, *carnea*, *nephelodes*, and *rubescens*.



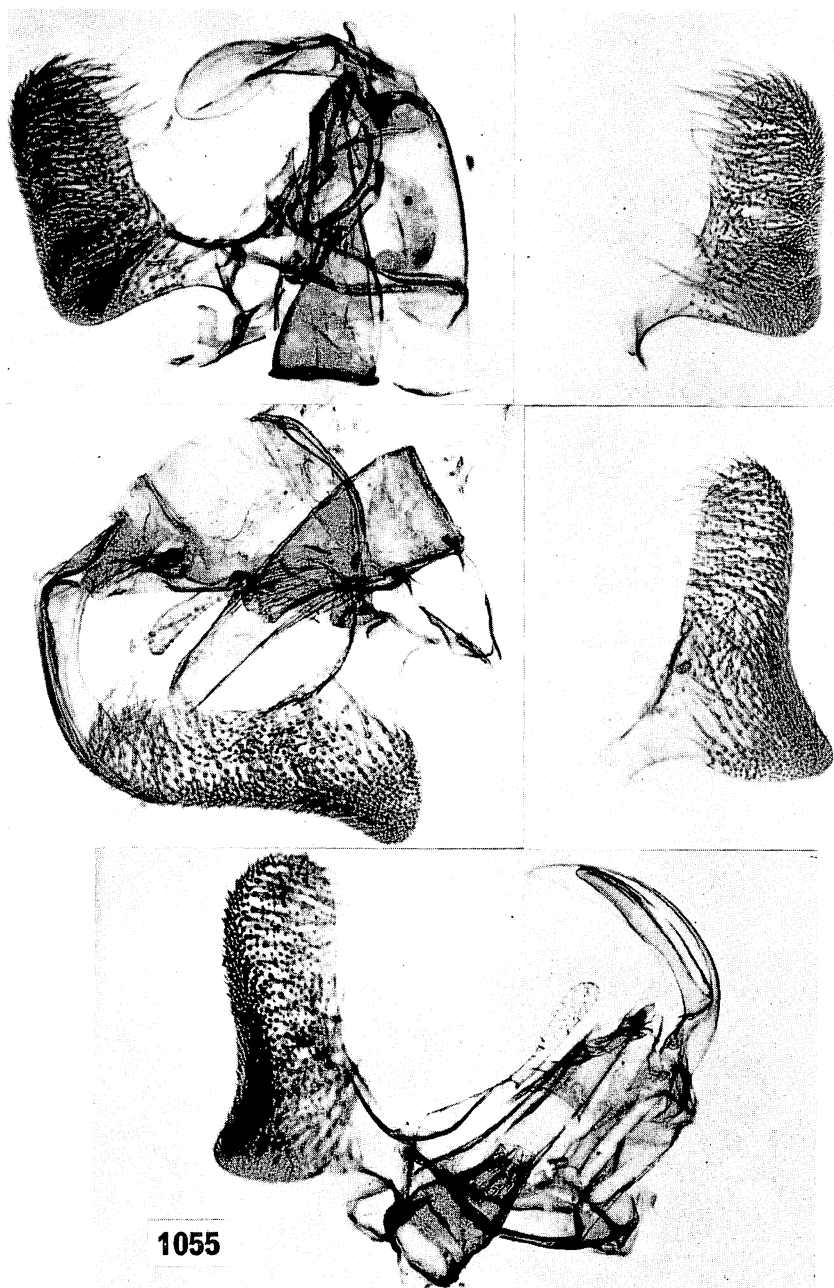
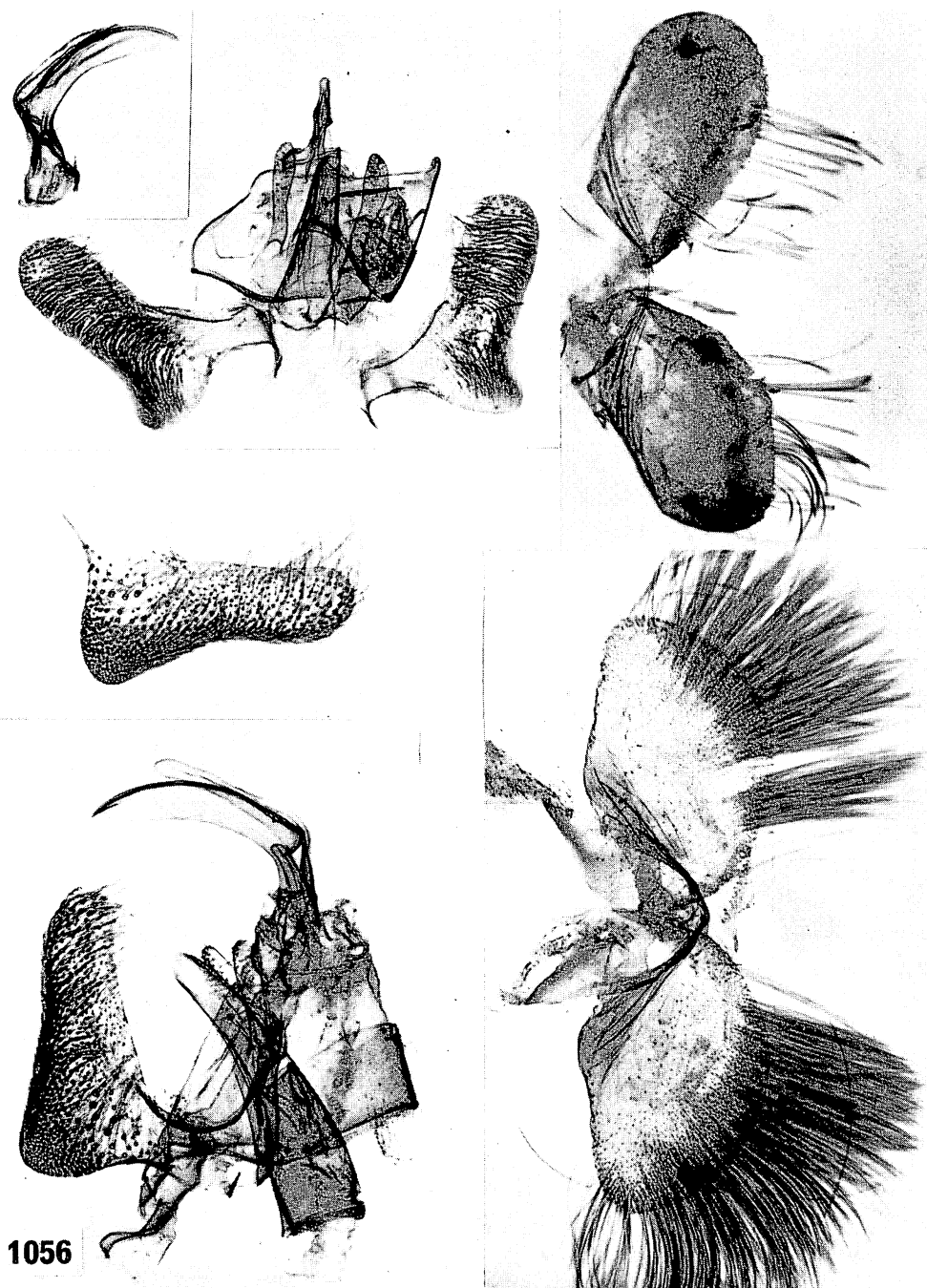


Figure 1055—Male genitalia of *Hypsmocoma*. Top, (*E.*) *centralis* Walsingham, holotype (BM slide 4497); Lihue, 4,000 feet, Kauai. Middle, (*E.*) *chilonella chilonella* Walsingham, holotype (BM slide 4499); Kauai 3,000 to 4,000 feet. Bottom, (*E.*) *chilonella triocellata* Walsingham, holotype (BM slide 4498); Molokai, about 4,000 feet.



1056

Figure 1056—Male genitalia of *Hyposmocoma*. Top three figures, (*E.*) *chilonella chilonella* Walsingham, paratype (BM slide 7340); Kilauea, Hawaii; the separated right brachium is shown at upper left. Bottom three figures, (*E.*) *chilonella percondita* Walsingham, holotype (BM slide 4501); Kilauea, Hawaii.



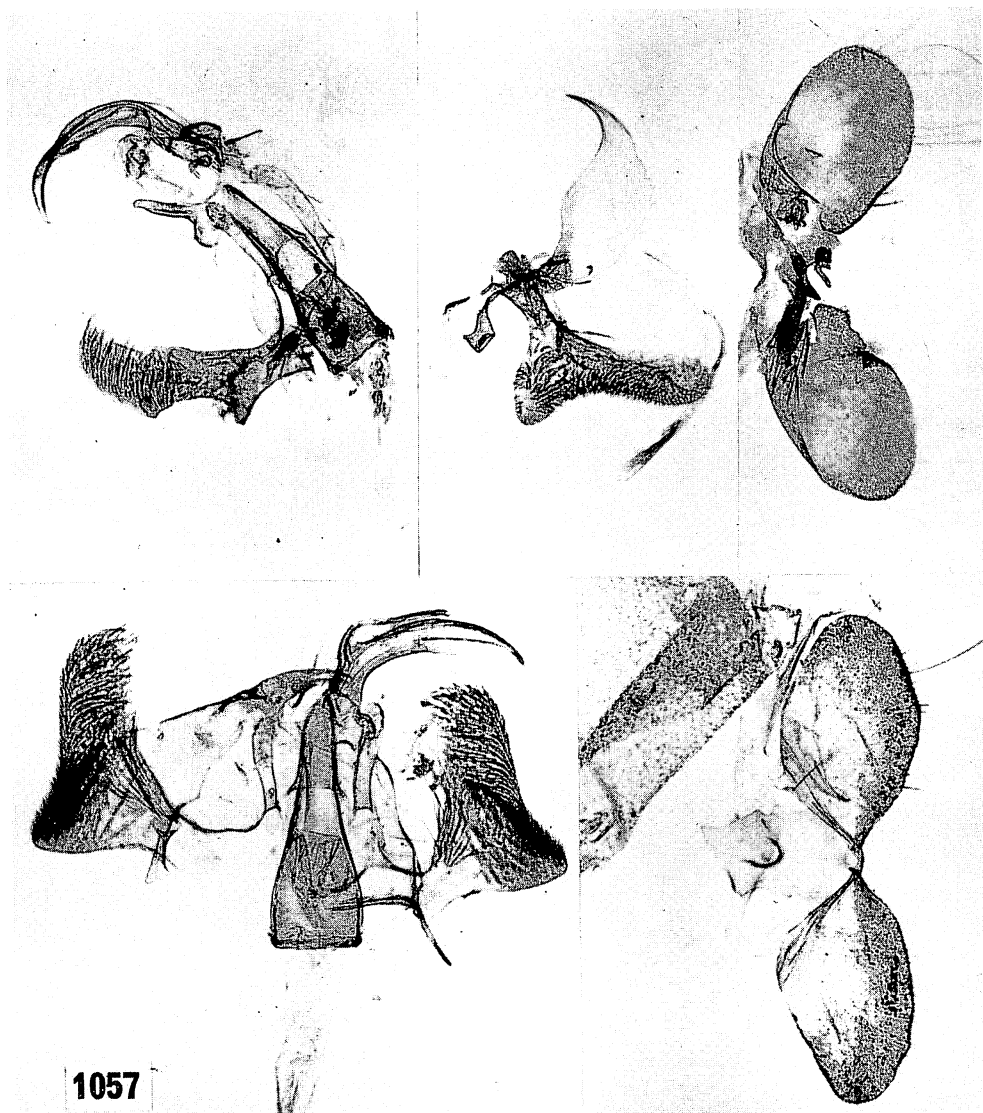
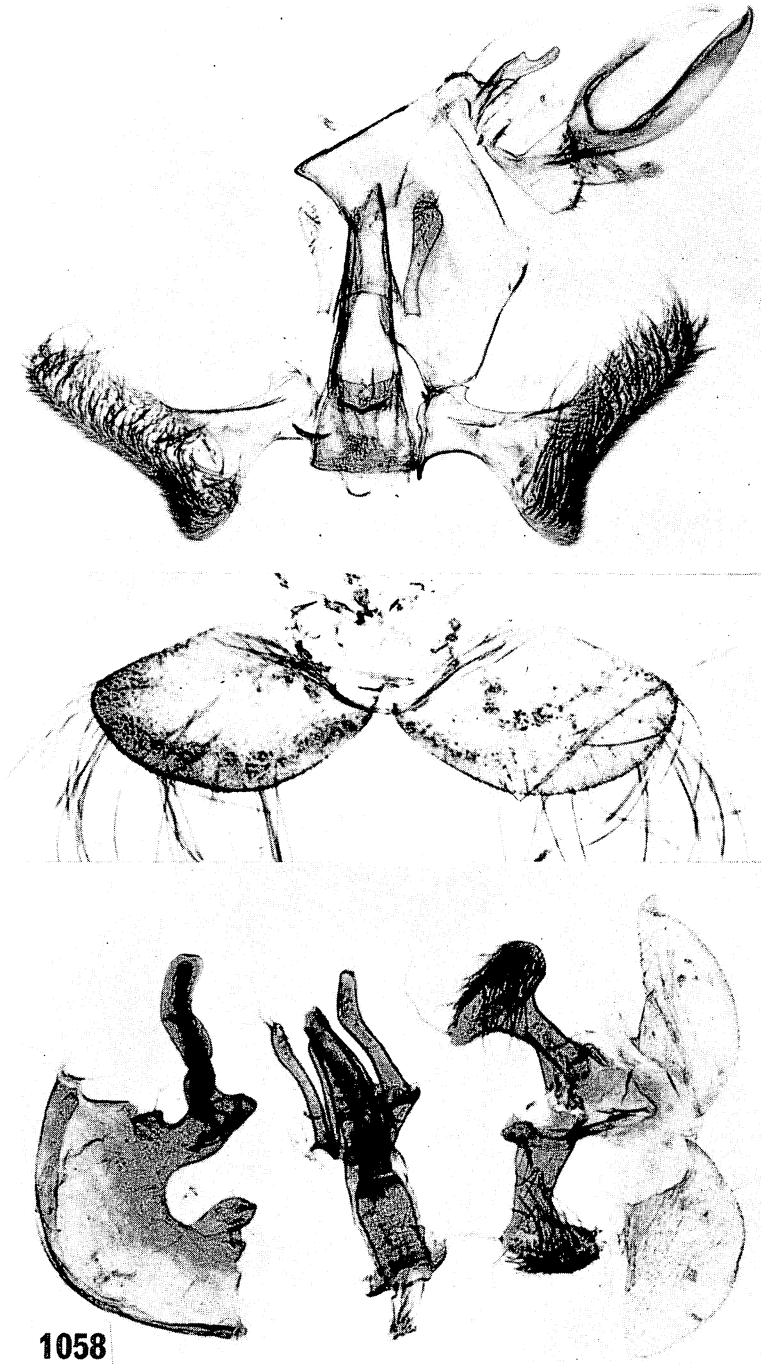


Figure 1057—Male genitalia of *Hypsocoma* (*E.*) *chilonella triocellata* Walsingham, paratype (BM slide 7342); Kona, 4,000 feet, Hawaii (the ventral part of the left valva is torn). Bottom, from a paratype (BM slide 7343); Kilauea, Hawaii. Compare the paratype from Kauai shown in figure 1058.



1058

Figure 1058—Male genitalia of *Hypsmocoma*. Top, (*E.*) *chilonella triocellata* Walsingham, paratype (BM slide 7341); Kauai, 3,000 to 4,000 feet. Compare the other paratypes from Hawaii shown in figure 1057, and note the differences (in the brachia, for example). Bottom, (*E.*) *chloraula* Meyrick, holotype (slide Z-I-23-61-2); Summit Camp, Kauai. The right brachium has been deformed in the slide mount. This species resembles some of the atypical *Neelysia* species.

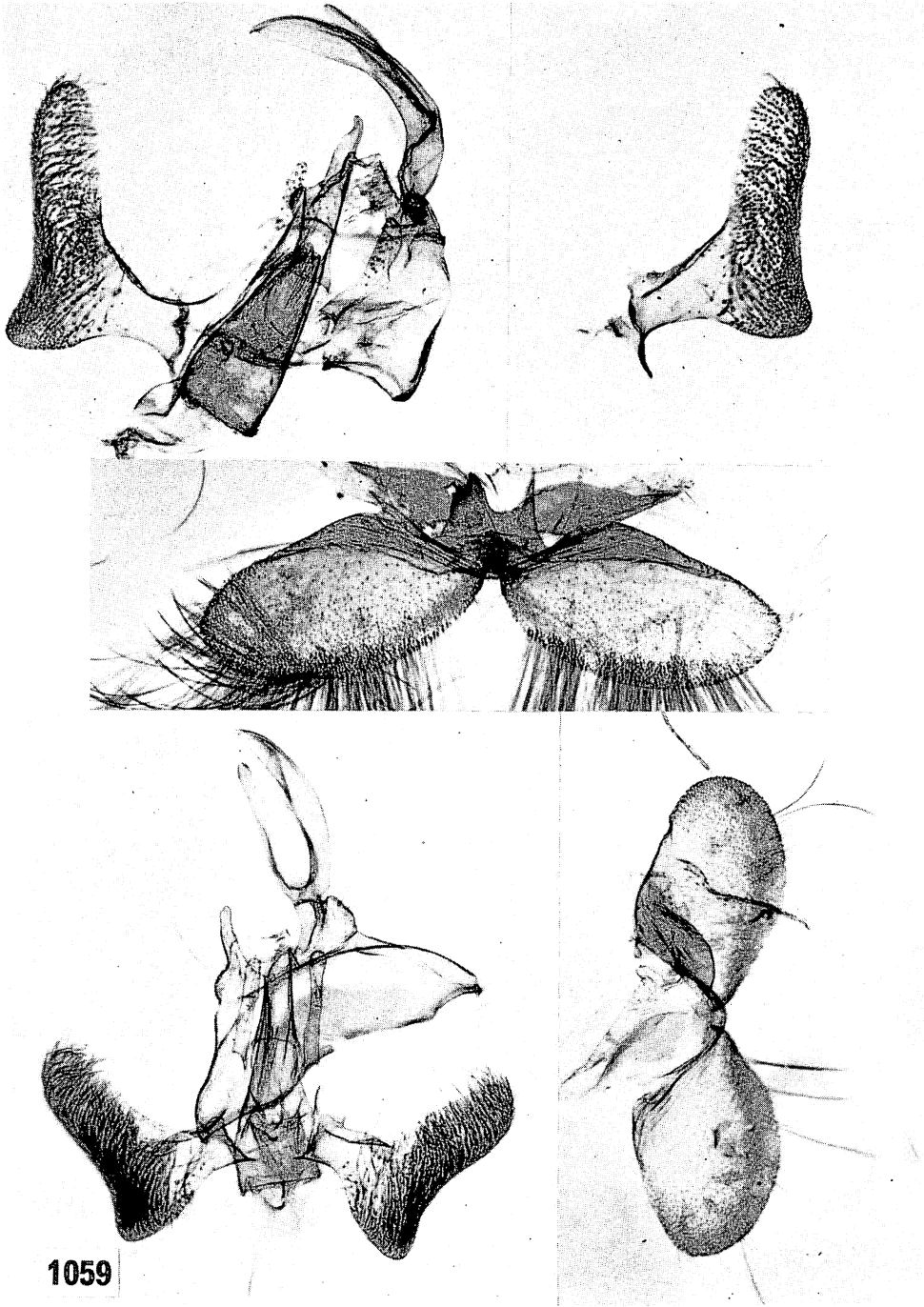


Figure 1059—Male genitalia of *Hypsocoma* (*E.*) *chilonella venosa* Walsingham. Top, holotype (BM slide 4500); Kauai, 3,000 to 4,000 feet. Bottom, paratype (BM slide 7344); Molokai, about 4,000 feet. Note the differences between the left brachia, the anellar lobes, and the genital flaps.

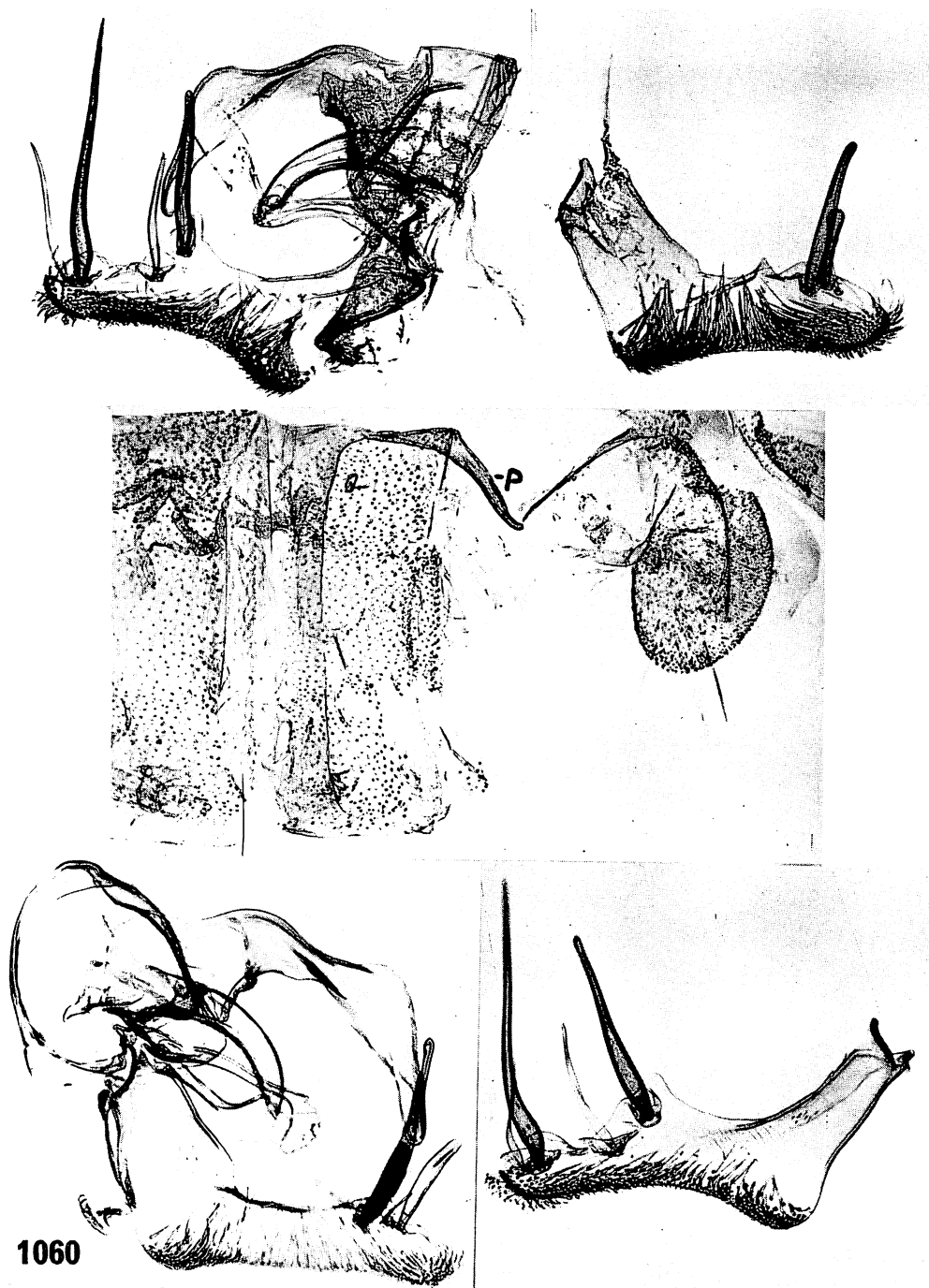


Figure 1060—Male genitalia of *Hypsoscoma* (*H.*) *commensella* Walsingham. Top and middle, holotype (BM slide 4086); Kilauea, Hawaii (note pseuduncus "P"). Bottom, paratype (BM slide 2014); Kilauea, Hawaii. Compare *domicolens*, *genitalis*, and *semicolon*.

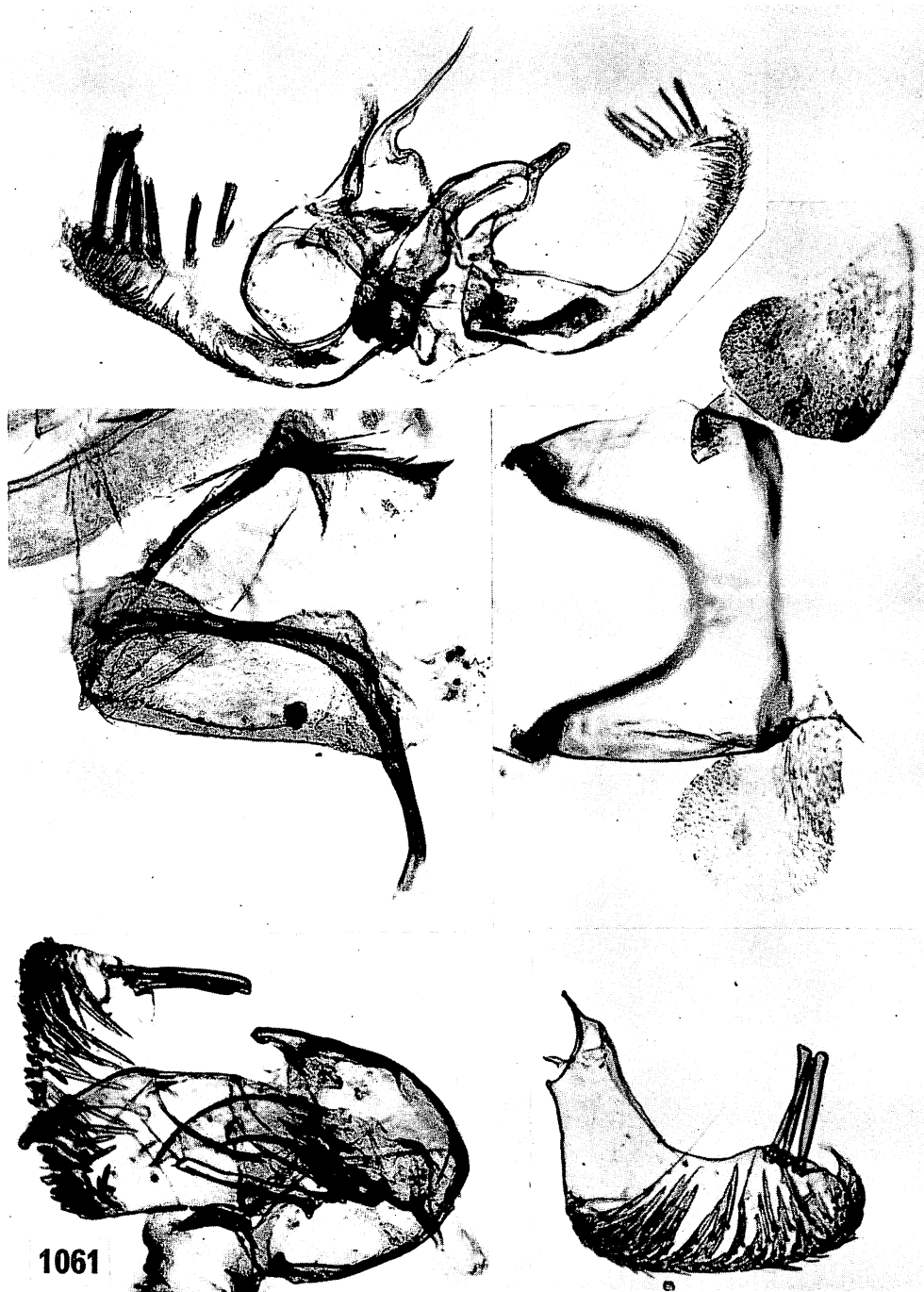


Figure 1061—Male genitalia of *Hyposmocoma*. Top and middle, (*H.*) *conditella* Walsingham, paratype (BM slide 6466); Kauai, 3,000 to 4,000 feet. Compare the *alliterata*, *iodes*, and *nebulifera* group. Bottom, (*H.*) *costimaculata* Walsingham, holotype (BM slide 4110); Molokai, above 3,000 feet. Compare *auripennis*.

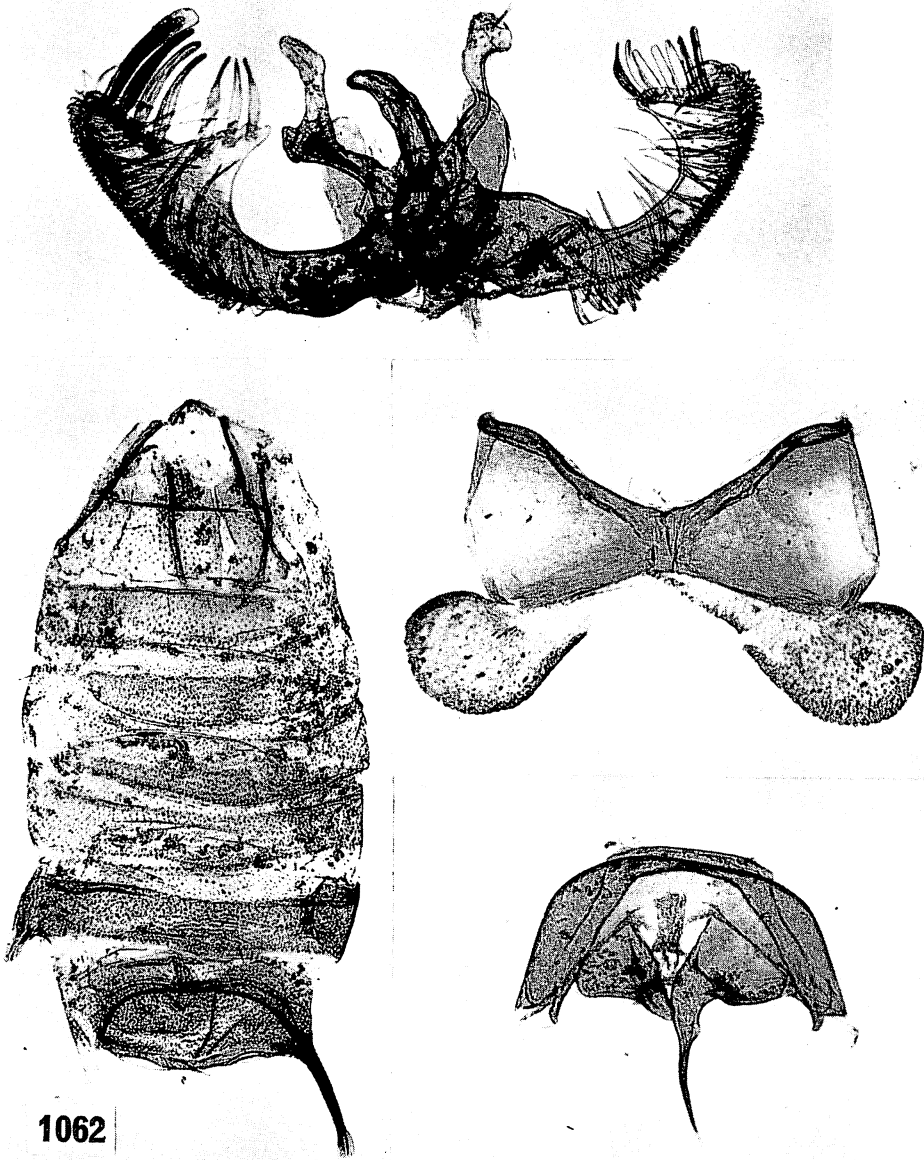
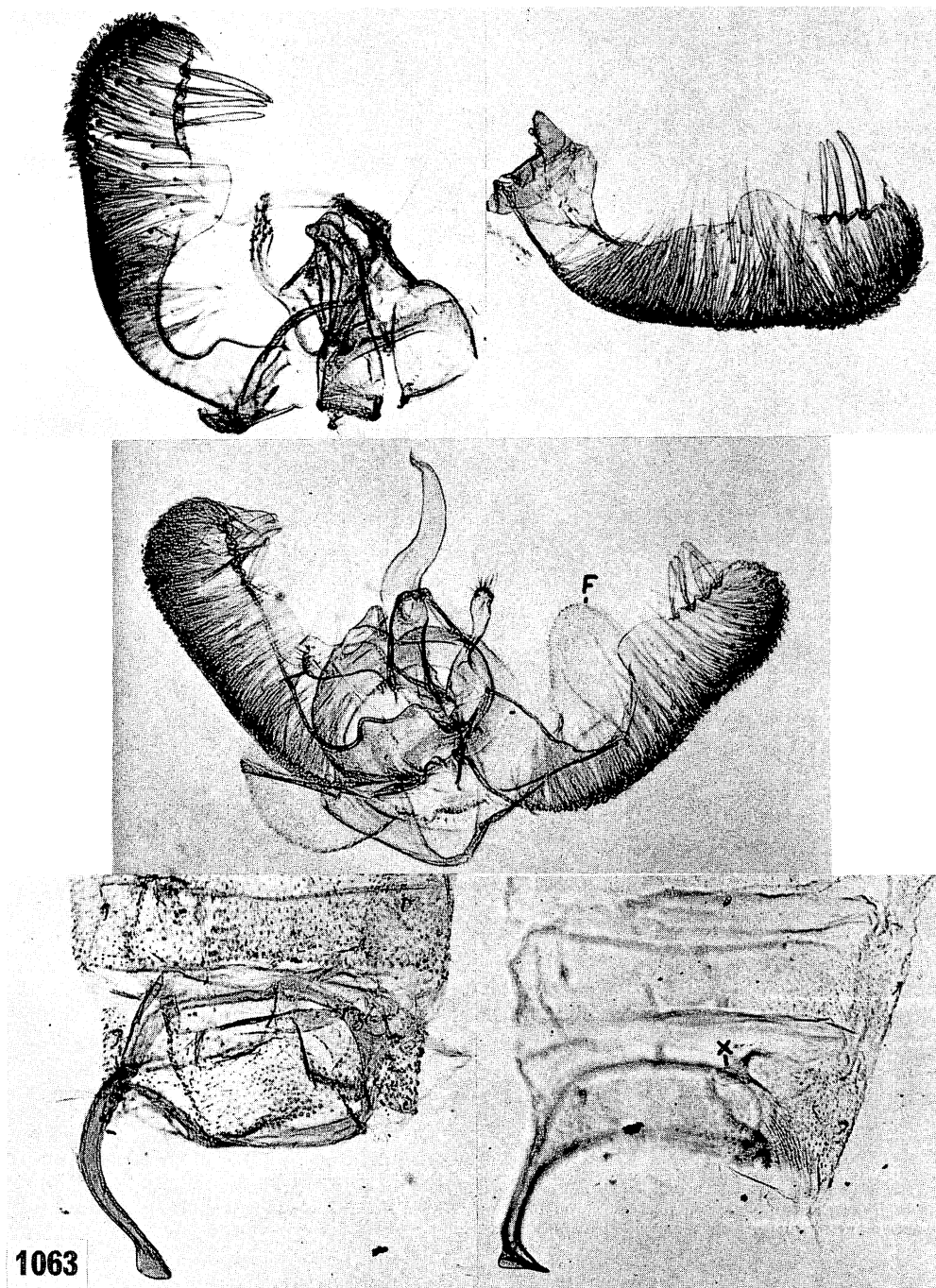


Figure 1062—Male genitalia and abdominal pelt of *Hyposmocoma* (*H.*) new species 11, a species related to *conditella* with tufts of raised squamae on the forewings (BM slide 14317); Waianae Mts., Oahu, about 3,000 feet. Note the sclerotizations on the sixth abdominal segment as well as those on the seventh.



1063

Figure 1063—Male genitalia of *Hyposmocoma*. Top and bottom left, (*H. corvina* (Butler), holotype (BM slide 4083); Haleakala, Maui. There are only three spurs on the right valva and none of them is missing. The left anellar lobe is viewed from the edge. The sixth abdominal tergite lacks the sclerotized flange which is present on the specimen illustrated at bottom right and is marked "X" there. Middle and bottom right, evidently (*H.* new species 12 (BM slide 2011); Molokai, about 4,000 feet; misidentified as *corvina* by Walsingham. Also see figure 1064. The right genital flap ("F") is folded back behind the right valva and must not be considered as a process of the valva. This species has a modified "malornata-type" dorsal sclerotized flange ("F") on the sixth abdominal segment. Note the differences in the contours of the costal margins of the valvae. These belong to, and should be compared with, the *malornata* complex.

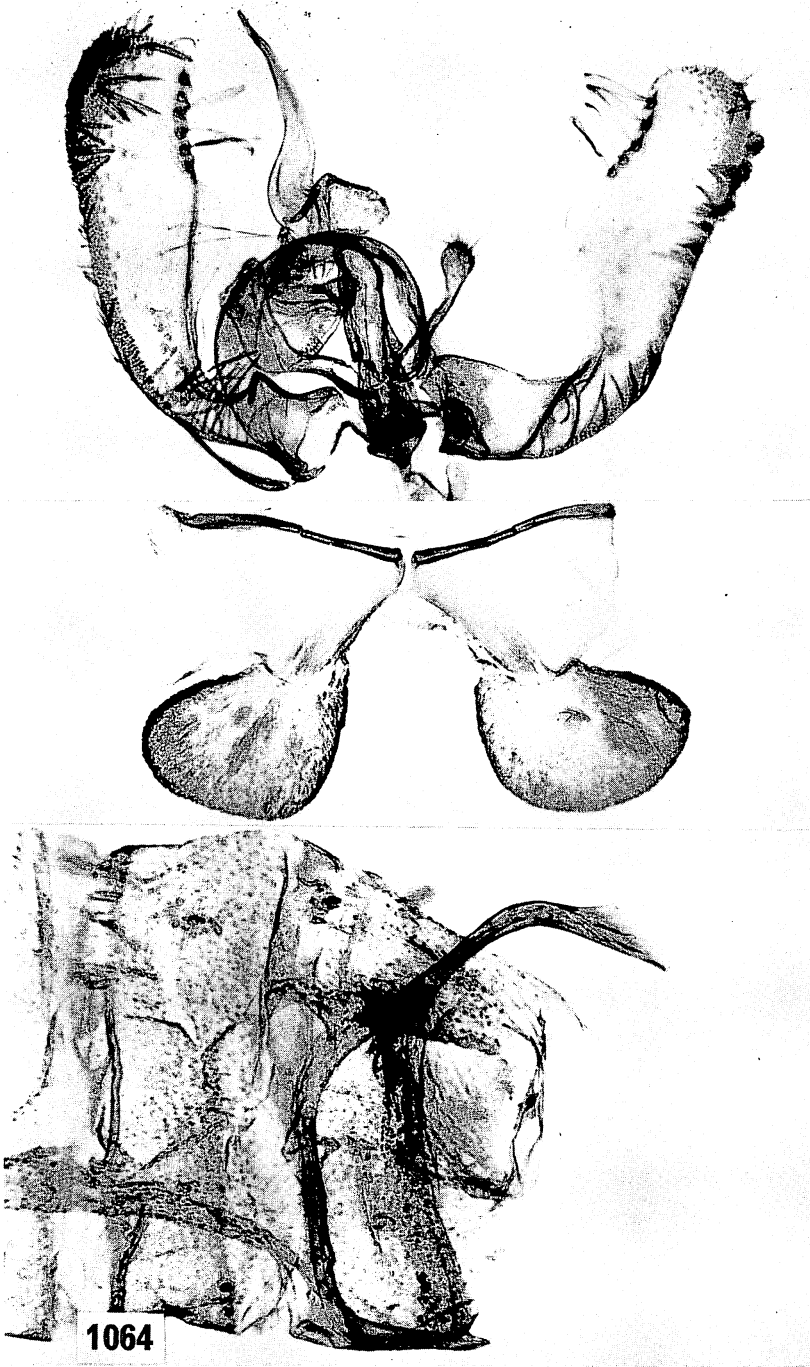


Figure 1064—Male genitalia of *Hypsomoema* (*H.*) new species 12 (BM slide 7350); Molokai, about 4,000 feet. This was called a "cenotype" of *corvina* (Butler) by Walsingham. Compare slide 2011 on figure 1063.



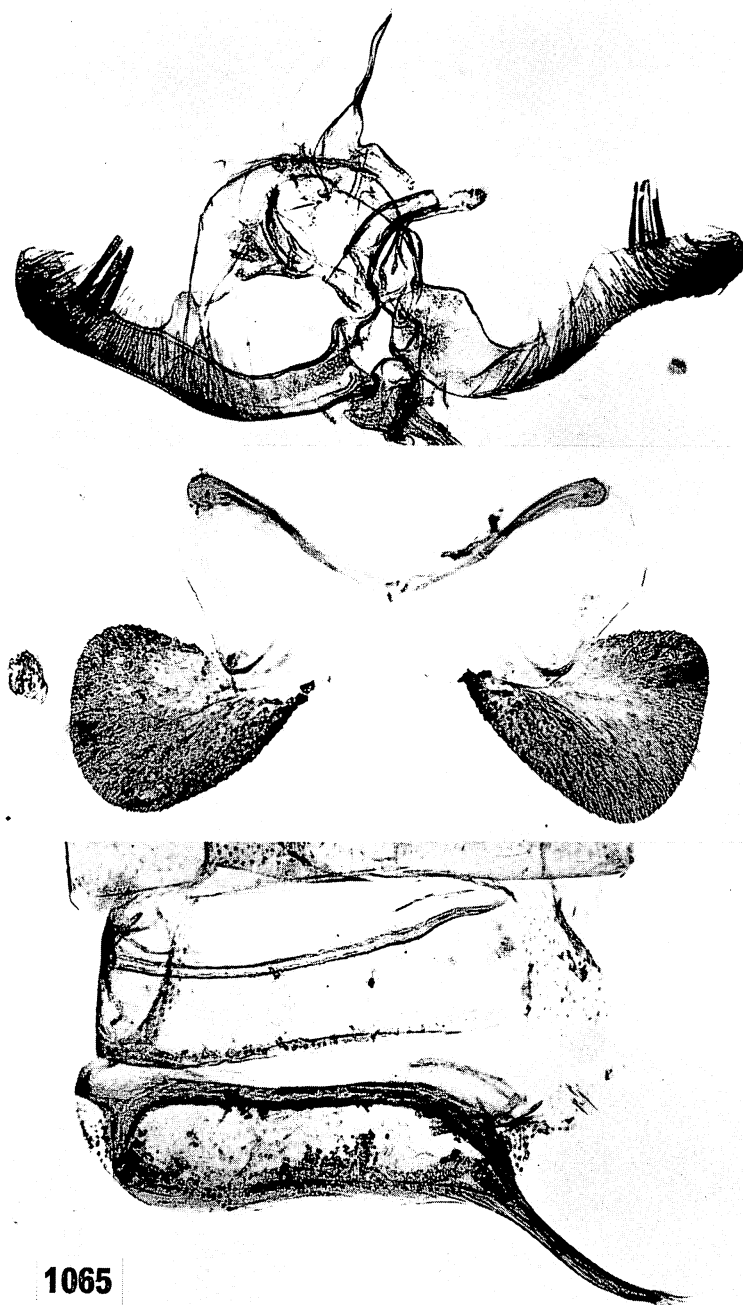
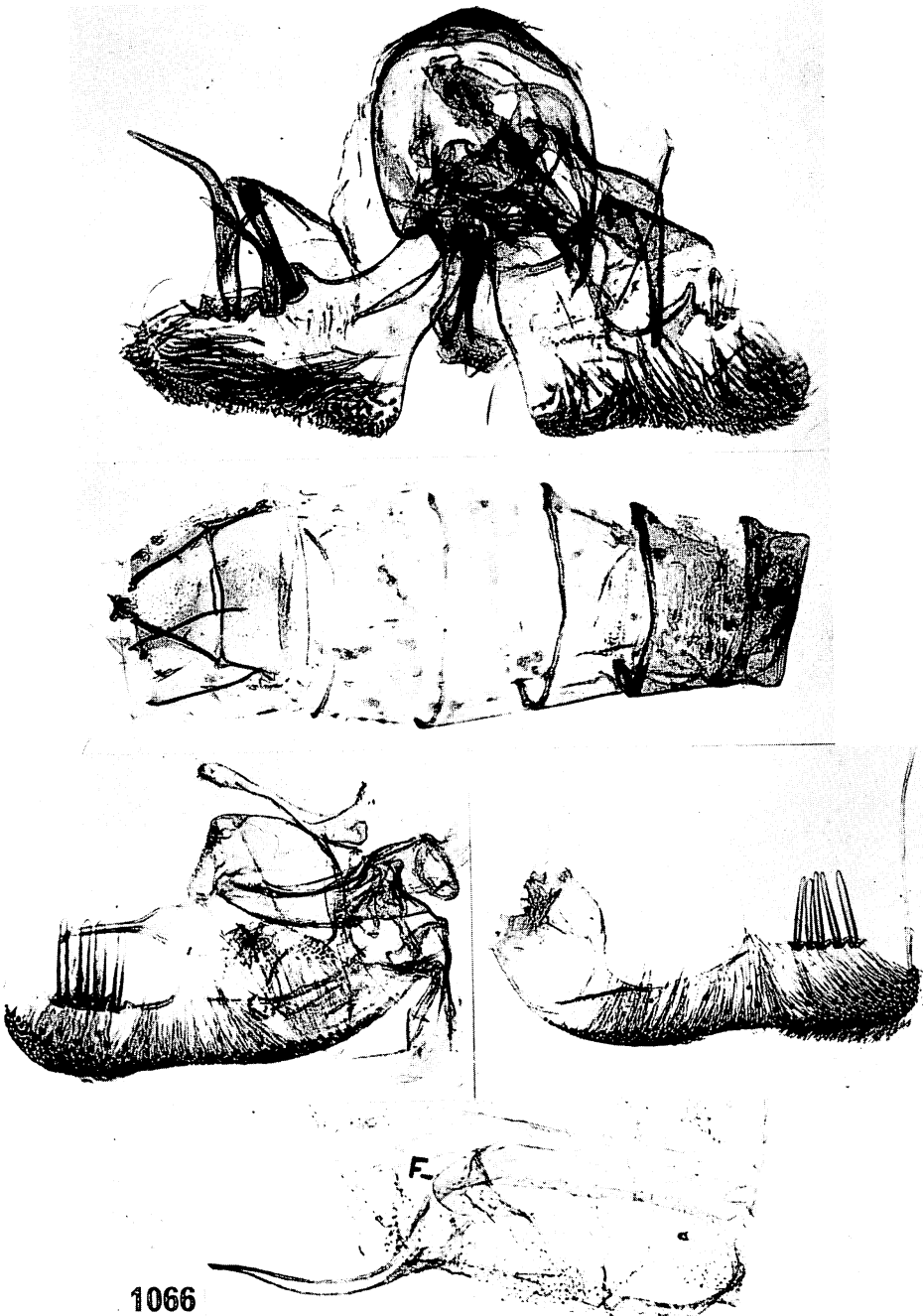


Figure 1065—*Hyposmocoma* (*H.*) *divisa* Walsingham, male genitalia, paratype (BM slide 6465); Kauai, 3,000 to 4,000 feet. The left anellar lobe overlaps the left brachium so that their outlines are confused. This is a member of the *malornata* group, which see.



1066

Figure 1066—Male genitalia of *Hyposmocoma*. Top two figures, (*H. domicolens* (Butler), paratype (BM slide 6458); Makawao, Maui. Note the ventral sclerotized bands on the abdomen. Compare figures 1067 and 1068. Compare the *commensella* group. Bottom three figures, (*H. discella* Walsingham, allotype (BM slide 4084); Kaholuamano, 4,000 feet, Kauai. The long apex of the right brachium is bent down into the spurs of the left valva. Note the “*malornata*-type” sclerotized abdominal flange (“F”). Compare the *malornata* group.

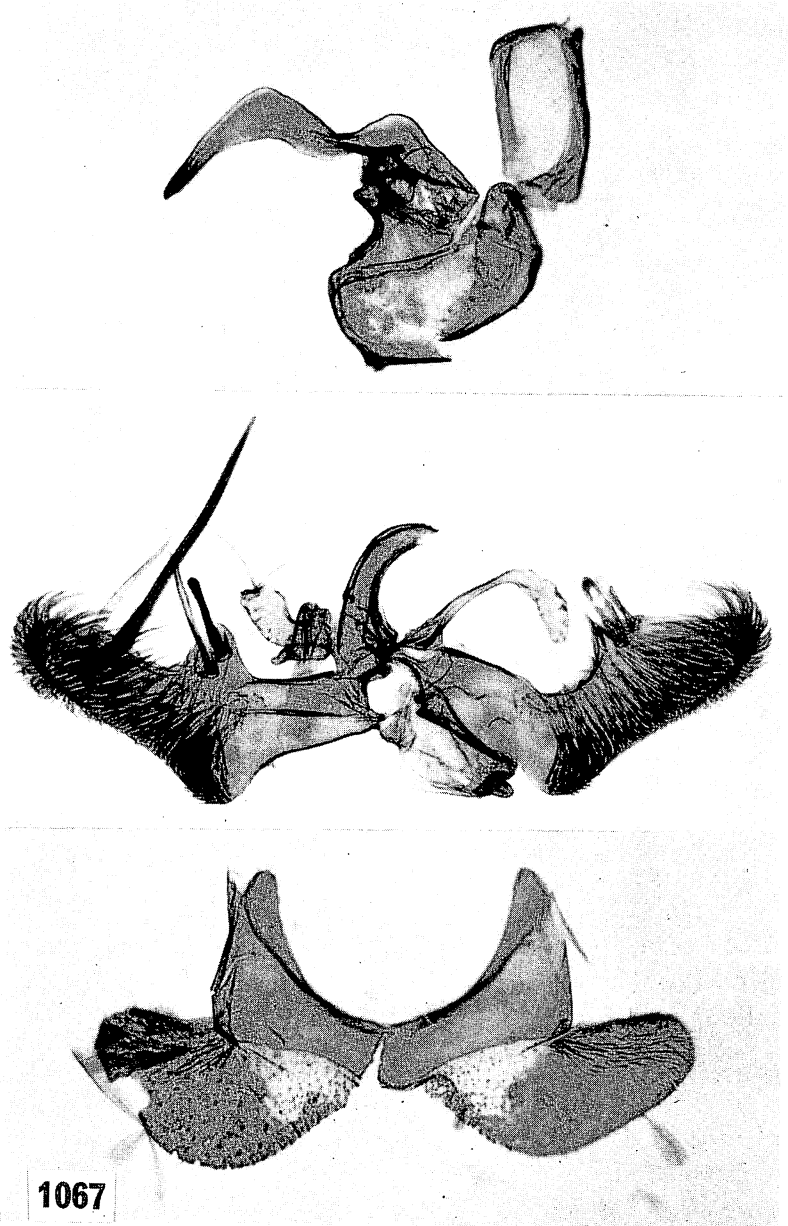


Figure 1067—Male genitalia supposedly of *Hypsmocoma* (*H.*) *domicolens* (Butler), determined by Walsingham (BM slide 7352); Kona, 4,000 feet, Hawaii. The anterior margins of the abdominal sternites are sclerotized. Compare figures 1066, and 1068.

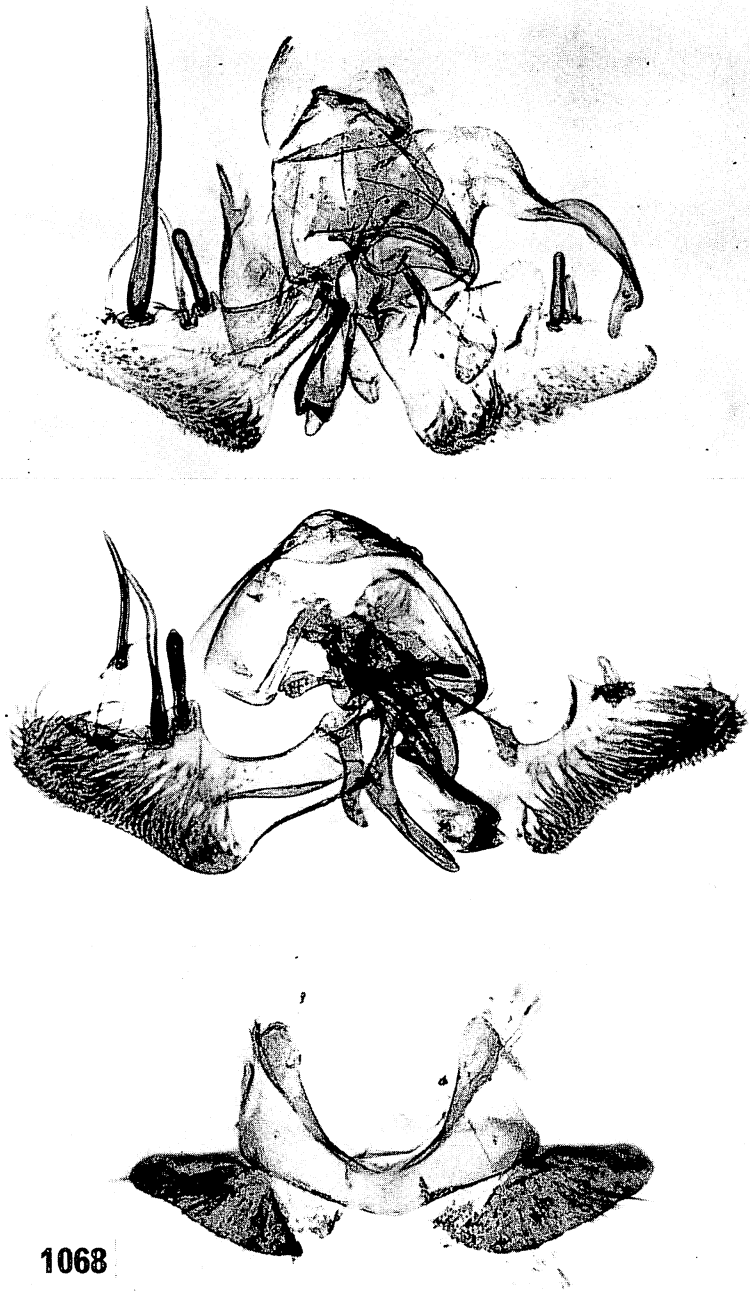
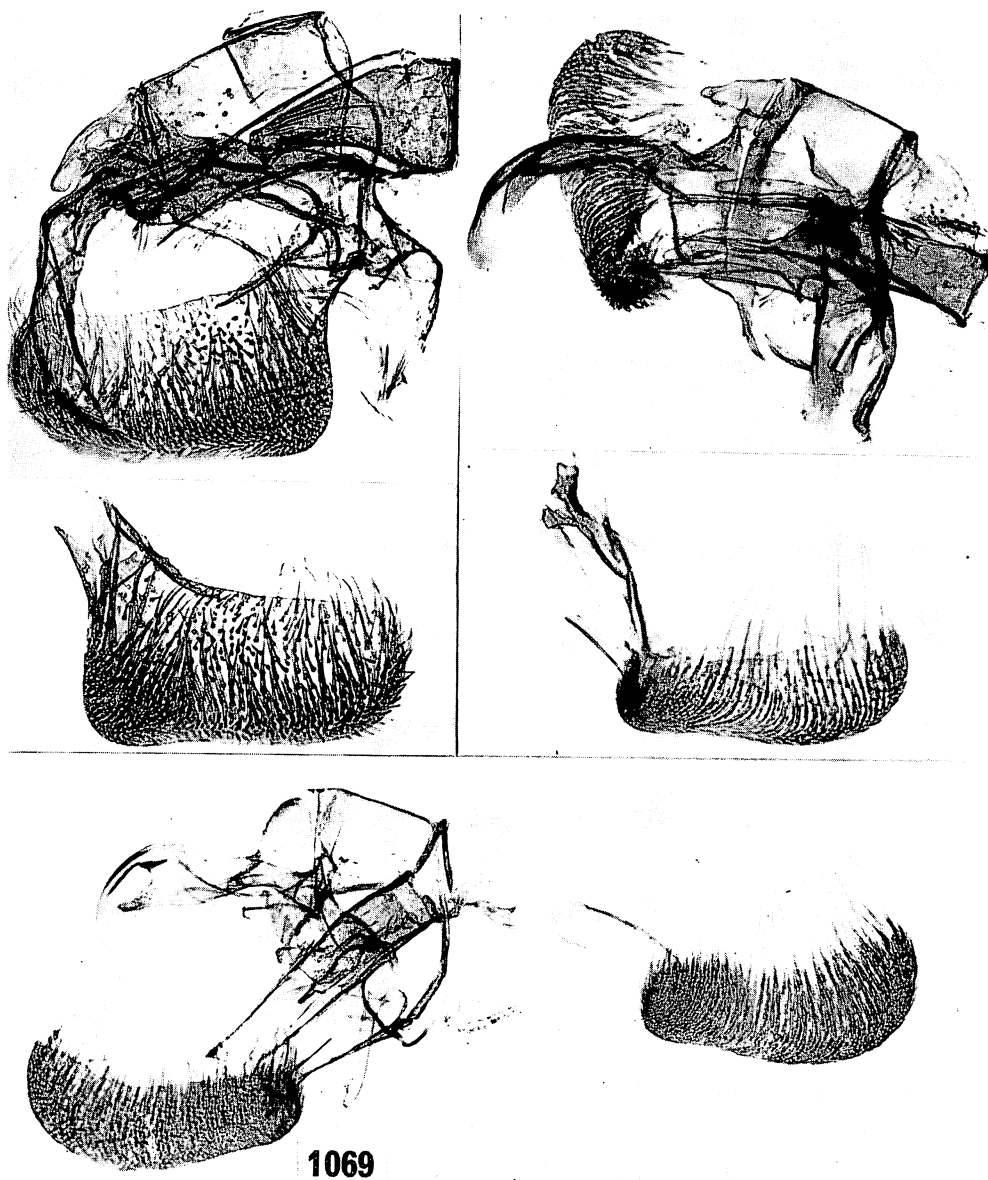


Figure 1068—Male genitalia supposedly of *Hyposmocoma* (*H.*) *domicolens* (Butler), determined by Walsingham. Top, a specimen from Kona, Hawaii (Busck slide 39; Walsingham specimen 25268). Middle and bottom, specimen from Lanai, 2,000 feet; (BM slide 7351). Note the differences in the shapes of the valvae and the aedeagi and the different lengths of the spurs of the specimens from the two localities. Unfortunately, some details are concealed because of the way the preparations are made. Compare figures 1066, 1067 and the *commensella* group.



1069

Figure 1069—Male genitalia of *Hypsoscoma*. Top left and middle left, (*E.*) *dorsella* Walsingham, holotype (BM slide 4331); Waianae Mts., 3,000 feet, Oahu. Top right and middle right, (*E.*) *emendata* Walsingham, holotype (BM slide 4138); Haleakala, 5,000 feet, Maui. Bottom, left and right, (*E.*) *ensifer* Walsingham, holotype (BM slide 4139); Kilauea, Hawaii. Compare *adolescens* and associates.

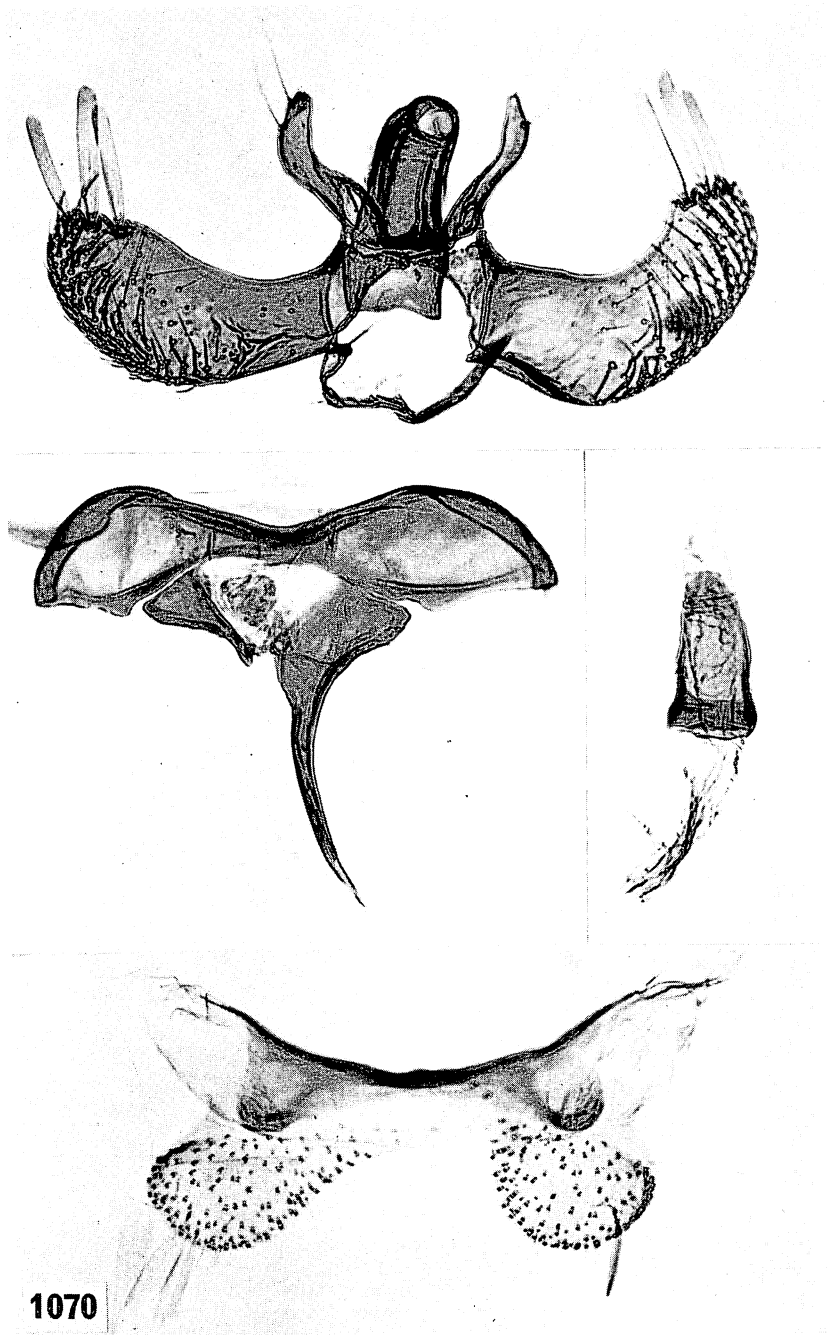


Figure 1070—Male genitalia of *Hyposmocoma* (*H.*) *elegantula* (Swezey) ("*Petrochroa*"), paratype (slide Z-XII-31-65); Koko Head, Oahu. The internal part of the aedeagus (apex of the ejaculatory duct) is shown separately at middle right. This is closely related to *neckerensis* (Swezey); compare figure 1135.

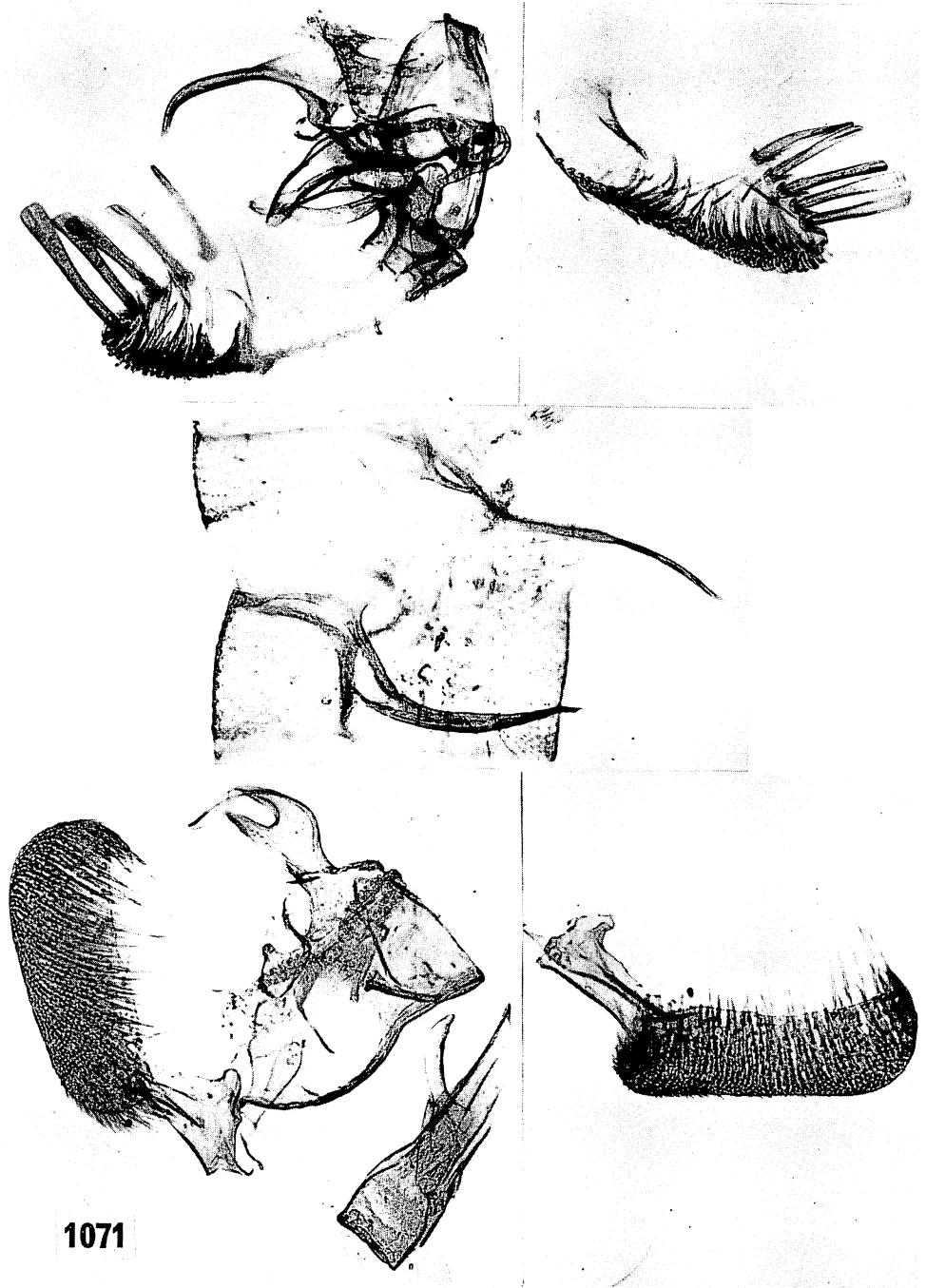
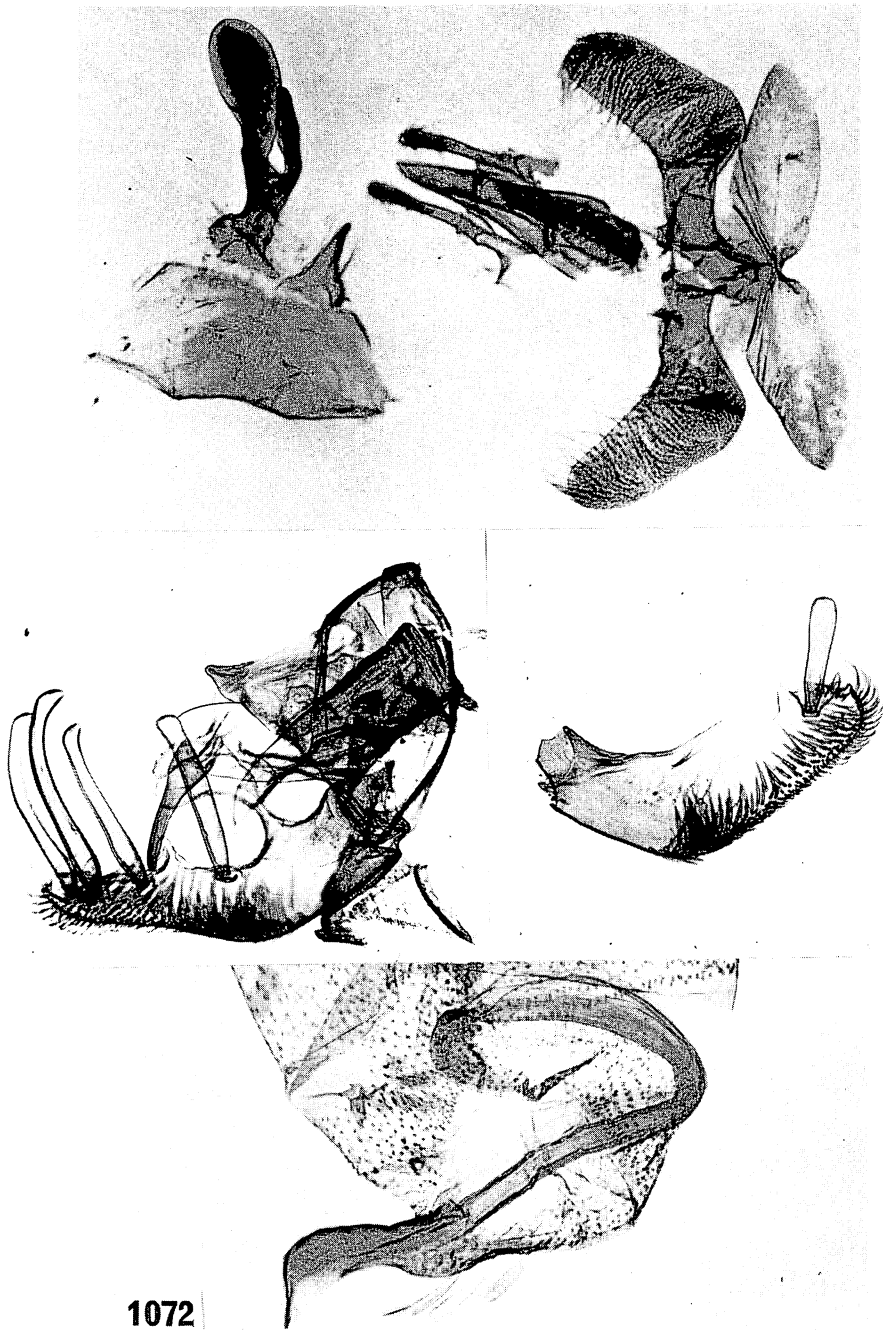


Figure 1071—Male genitalia of *Hypsmocoma*. Top and middle, (*H.*) *empedola* Meyrick, paratype (BM slide 5462); Honolulu. The middle figure illustrates the pseuduncuslike processes on abdominal segments 6 and 7; see text for discussion. Bottom, (*E.*) *enixa* Walsingham, holotype (BM slide 4134); Kaholuamano, 4,000 feet, Kauai.



1072

Figure 1072—Male genitalia of *Hypsmocoma*. Top, (*E.*) *erismatias* Meyrick, holotype (slide Z-I-22-61-4); Nuuanu, Honolulu. Middle and bottom, (*H.*) *evanescens* Walsingham, holotype (BM slide 4113); Haleakala, 5,000 feet, Maui. Note the extraordinary process from the costa of the left valva. Compare *haleakalae* and *lacertella*; although the genitalia of these species appear similar, the moths are very different. Compare the *blackburnii* group.



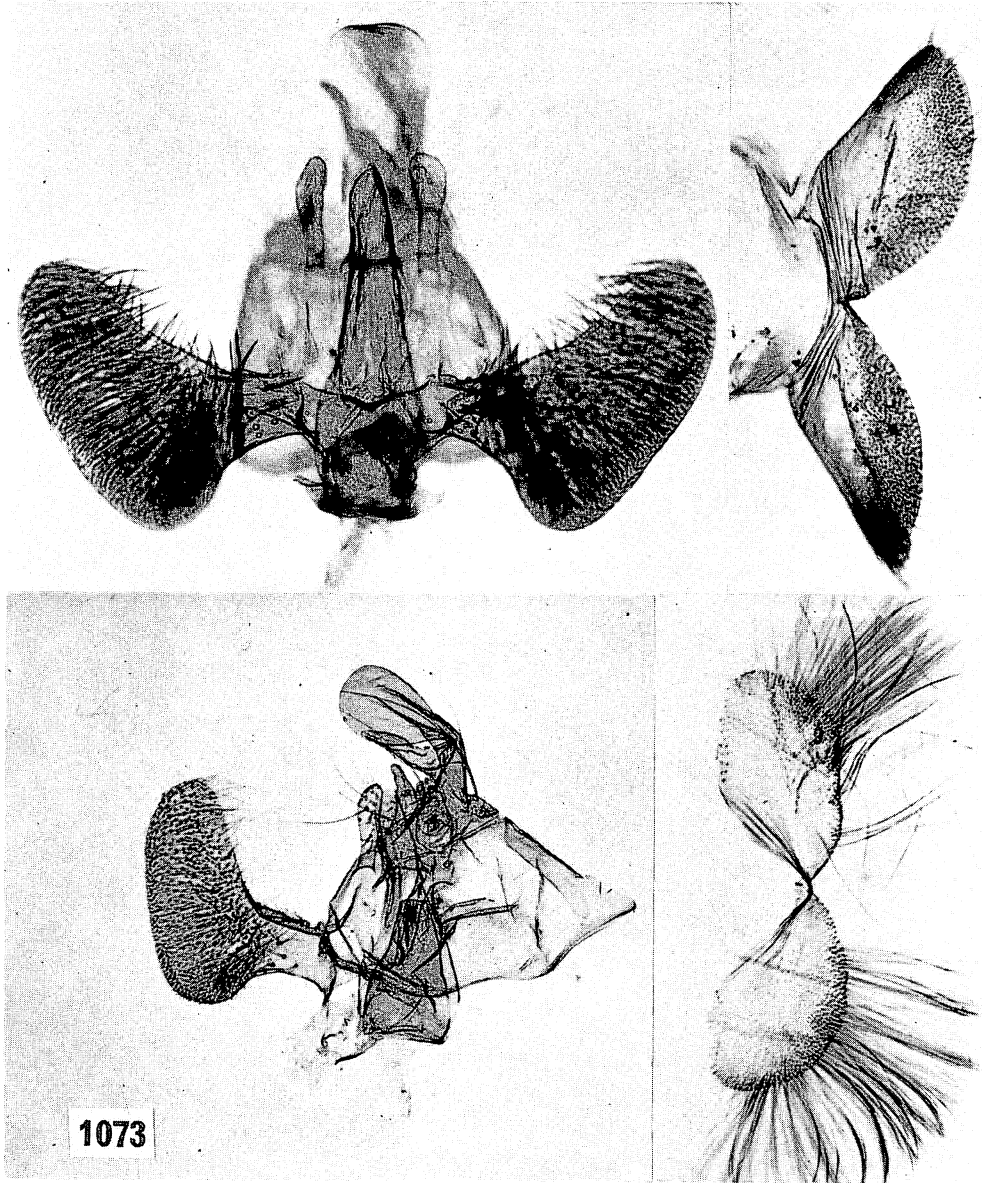


Figure 1073—Male genitalia of *Hypsoscoma*. Top, (*E.*) *exornata* Walsingham, holotype (BM slide 5556); Kona, 4,000 feet, Hawaii. Bottom, (*E.*) *flavicosta* (Walsingham), formerly considered a form of *exornata*, holotype (BM slide 4079); Kilauea, Hawaii.

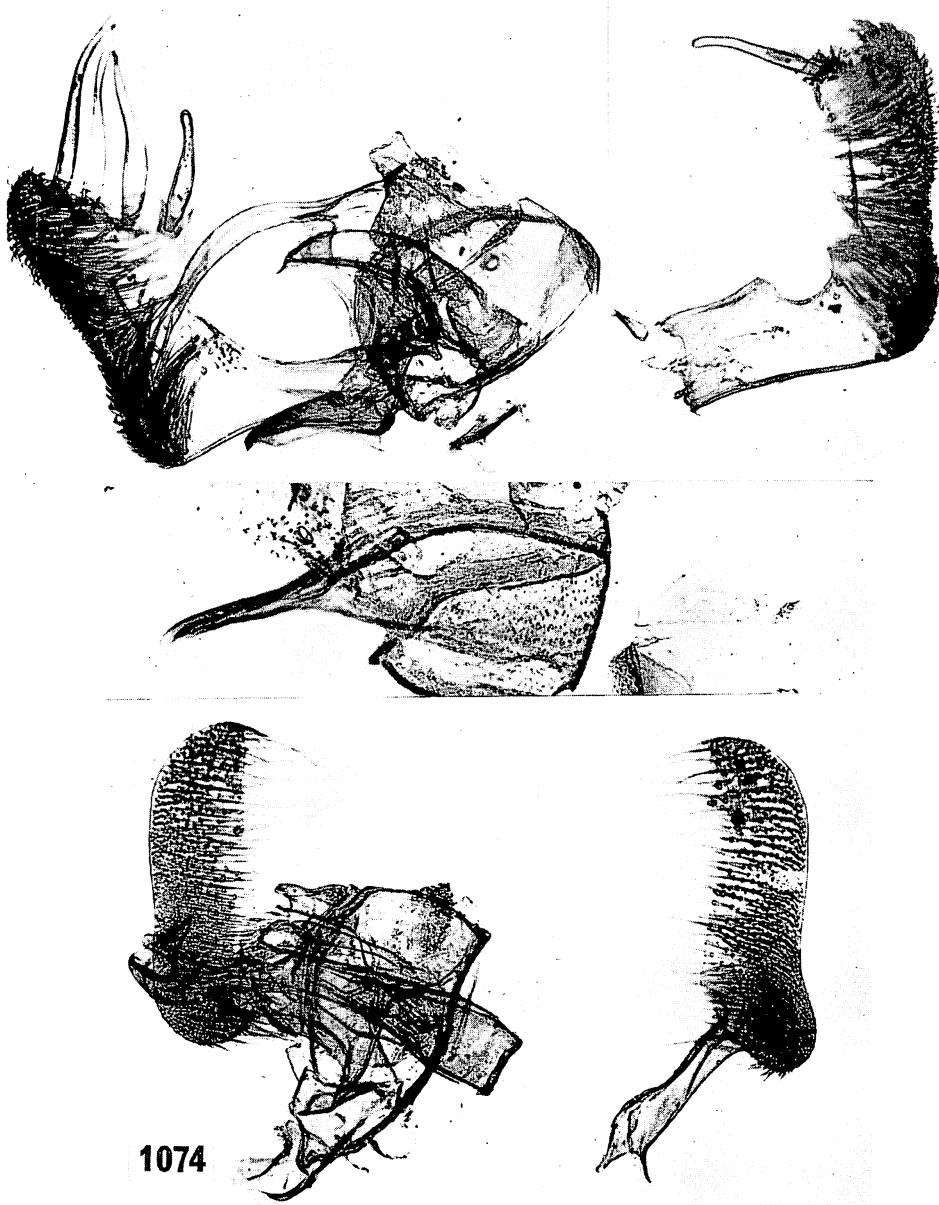


Figure 1074—Male genitalia of *Hypsoscoma*. Top and middle, (*H. fallacella* Walsingham, holotype (BM slide 4332); Kauai, 3,000 to 4,000 feet). Bottom, (*E. falsimella* Walsingham, holotype (BM slide 4333); Haleakala, over 5,000 feet, Maui; the right lobe of the right brachium appears artificially bent across the left lobe. Compare the *adolescens* group. Although these species belong to different subgenera and are not close associates, Walsingham treated them as close allies.

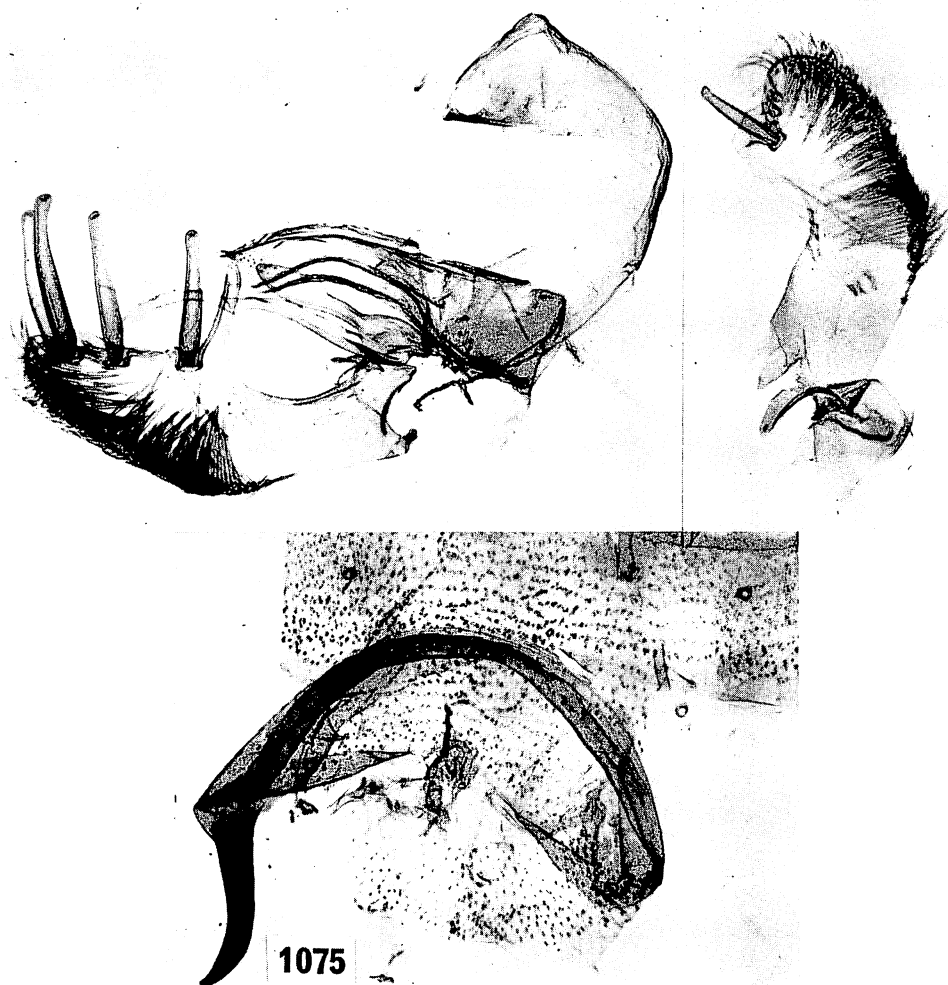


Figure 1075—Male genitalia of *Hyposmocoma* (*H.*) *fractinubella* Walsingham, holotype (BM slide 4146); Olinda, 4,000 feet, Maui. Note the slender costal process on the left valva and the long, slender left anellar lobe. Compare the *blackburnii* group.

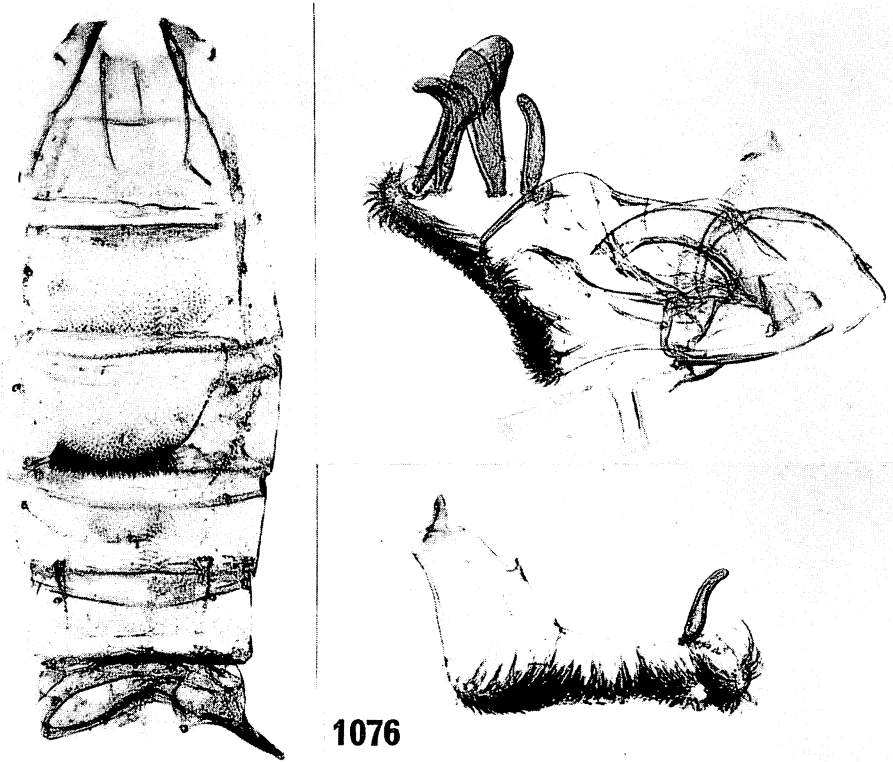


Figure 1076—Male genitalia and abdominal pelt of *Hypsmocoma (H.) fractistriata* Walsingham, allotype (BM slide 4496); Waianae Mts., Oahu. Note the unusual setal comb on the fourth tergum and the pseuduncus and associated sclerotization on the seventh abdominal segment. Compare *commensella* and allies. Compare figure 1077.

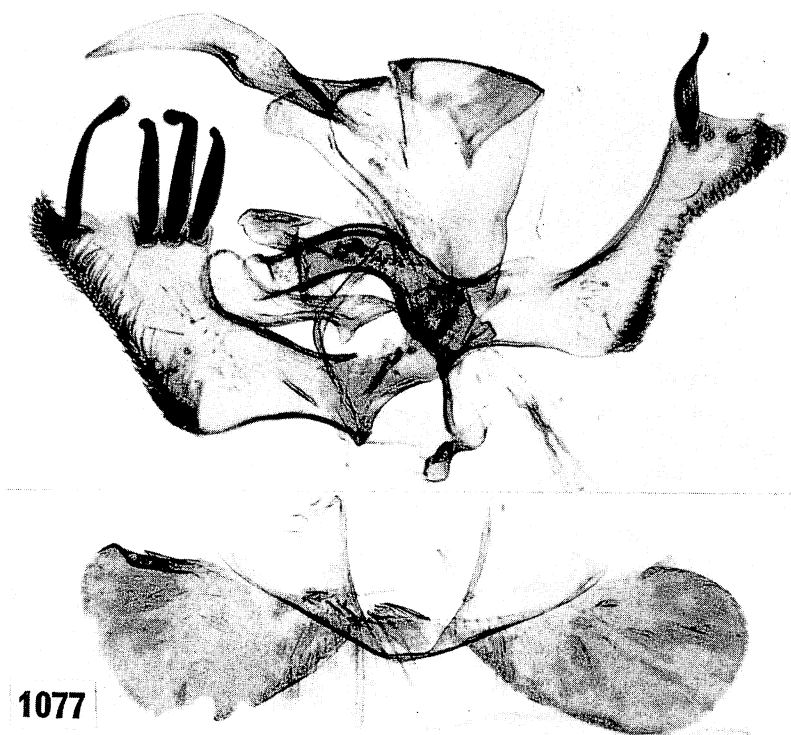


Figure 1077—Male genitalia of *Hypsmocoma* (*H.*) new species 13, formerly confused as a paratype of *fractistriata* (BM slide 7599); Lanai. The abdomen of this species lacks the dorsal setal comb on the fourth abdominal segment; it also lacks a pseuduncus. Compare figure 1076.

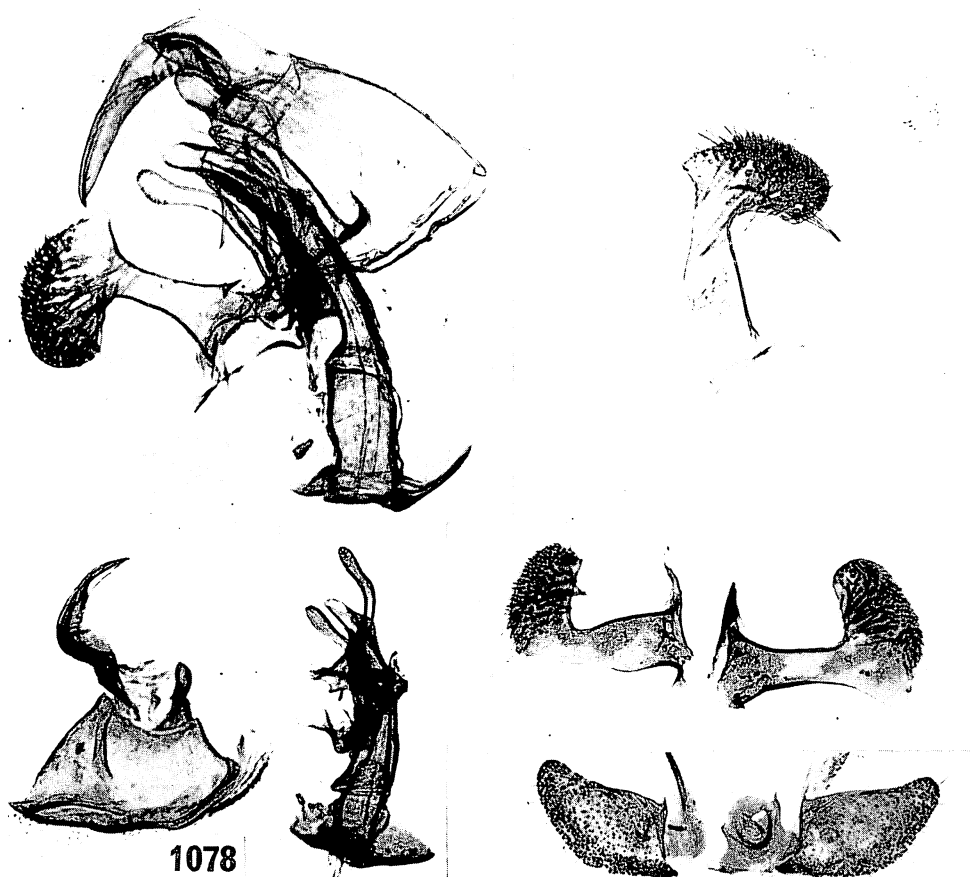


Figure 1078—Male genitalia of *Hypsmocoma* (*E.*) *fulvida* Walsingham. Top, holotype (BM slide 4337); Molokai, between 3,000 and 4,000 feet. The two setae extending from the apex of the right valva are only bent out of position—they are not differentiated. Bottom, a paratype (BM slide 7328); Kauai, 3,000 to 4,000 feet. See figure 1079. Compare *latiflua*, *obscura*, *ochreovittella*, *sudorella*, and *vicina*.

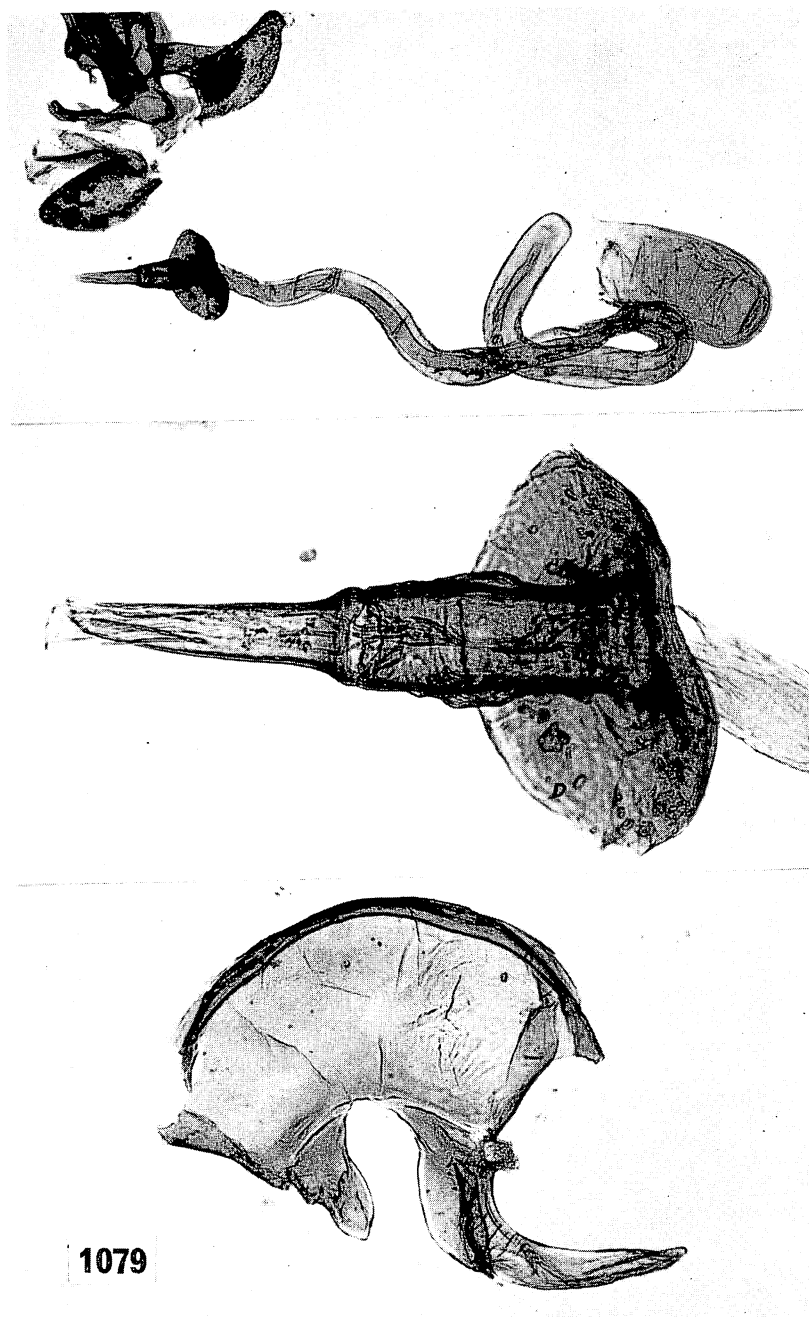
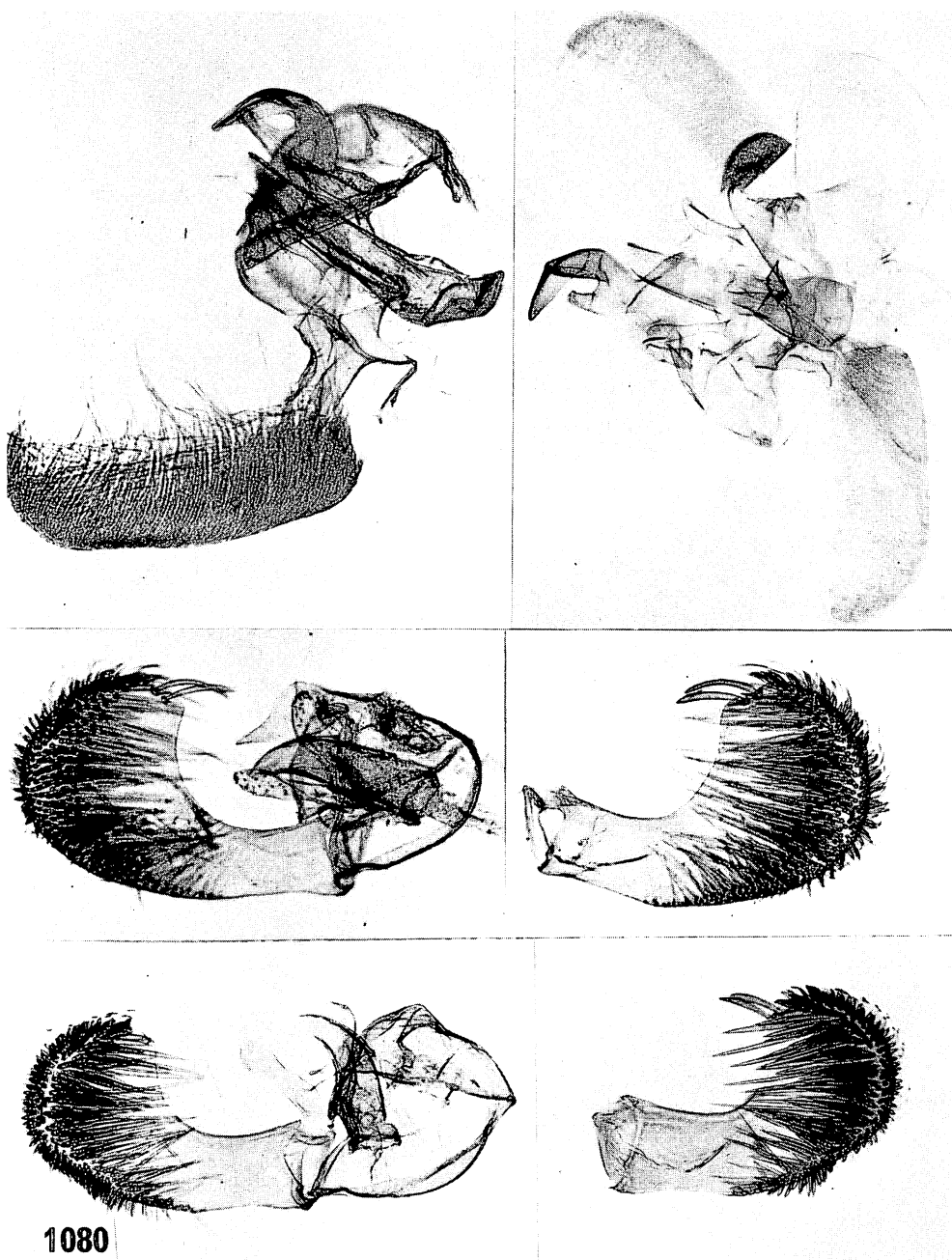


Figure 1079—Male genitalia of *Hypsocoma* (*E.*) *fulvida* Walsingham, paratype (BM slide 5465-A); Kauai, 3,000 to 4,000 feet. Note the sclerotized ejaculatory duct and the enlarged flange which fits against the base of the aedeagus. Compare *latiflua*, *obscura*, *ochreovittella*, *sudorella*, and *vicina*. See figure 1078.



1080

Figure 1080—Male genitalia of *Hypsoscoma*. Top left, (*E.*) *fulvocervina* Walsingham, holotype (BM slide 4342); Kaholuamano, Kauai. Top right, a paratype of the same (Walsingham specimen 27830; Busck slide 73); compare *adolescens*, and allies. Middle, (*H.*) *illuminata* Walsingham, holotype (BM slide 4108); Haleakala, 5,000 feet, Maui. Bottom, (*H.*) *indicella* Walsingham, holotype (BM slide 4117); Haleakala, above 5,000 feet, Maui; the two spurs are broken off the left valva. See also figures 1086 and 1088. Compare *lixiviella*, *mimica*, *parva*, *saliaris*, and *schismatica*. Although the genitalia of *illuminata* and *indicella* appear closely similar, the moths are very different.



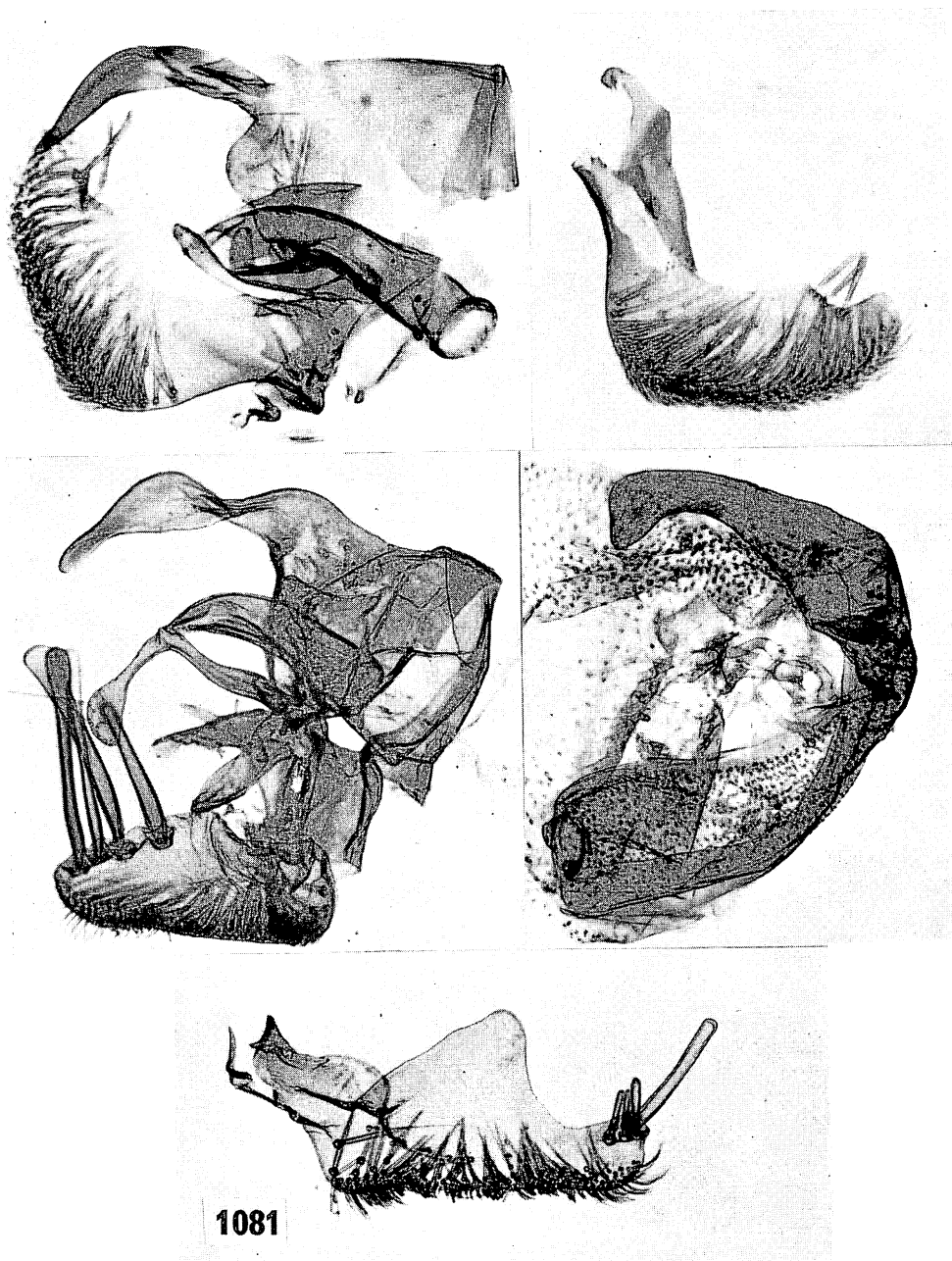


Figure 1081—Male genitalia of *Hyposmocoma*. Top, (*H. fuscopurpurea* Walsingham, holotype (BM slide 4127); Haleakala, 5,000 feet, Maui. Middle and bottom, (*H. geminella* Walsingham, holotype (BM slide 4147); Halemanu, 4,000 feet, Kauai. Note the extraordinary “L”-shaped anellar lobe and the unusually heavy pseuduncus (middle right). Compare the *picticornis* group.

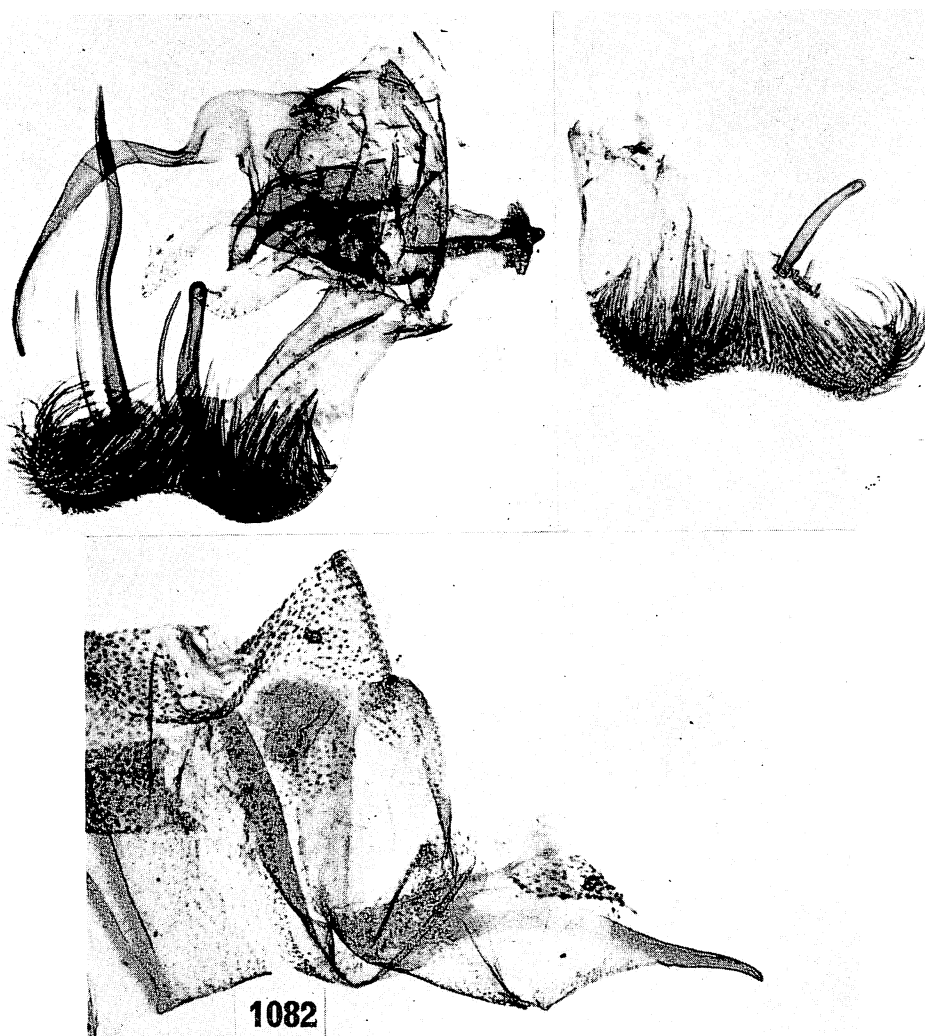


Figure 1082—Male genitalia of *Hypsmocoma* (*H.*) *genialis* Walsingham, holotype (BM slide 4145); Olinda, 4,000 feet, Maui. Note the unusual costal positions of the spurs on the valvae, especially the submedial position on the right valva. Compare the terminal positions of those of *hygroscopa*, *lebetella* (figures 1085, 1095), and others, for example. Compare the *commensella* group.

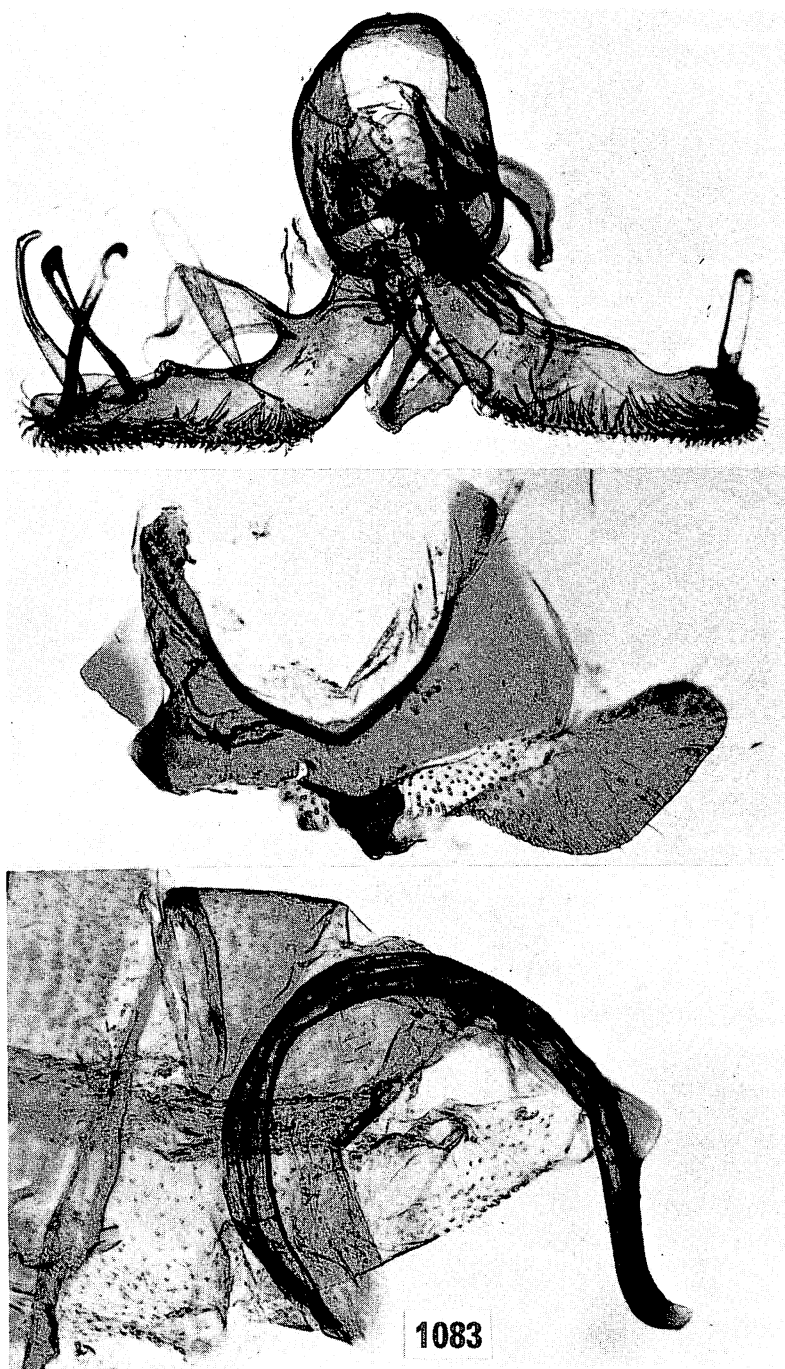


Figure 1083—Male genitalia of *Hypsoscocoma* (*H.*) *haleakalae* (Butler), "cenotype" (BM slide 6467); Haleakala, 5,000 feet, Maui. Note the broad, sclerotized costal process on the left valva. Compare *evanescens*, *lacertella*, and the *blackburnii* group.

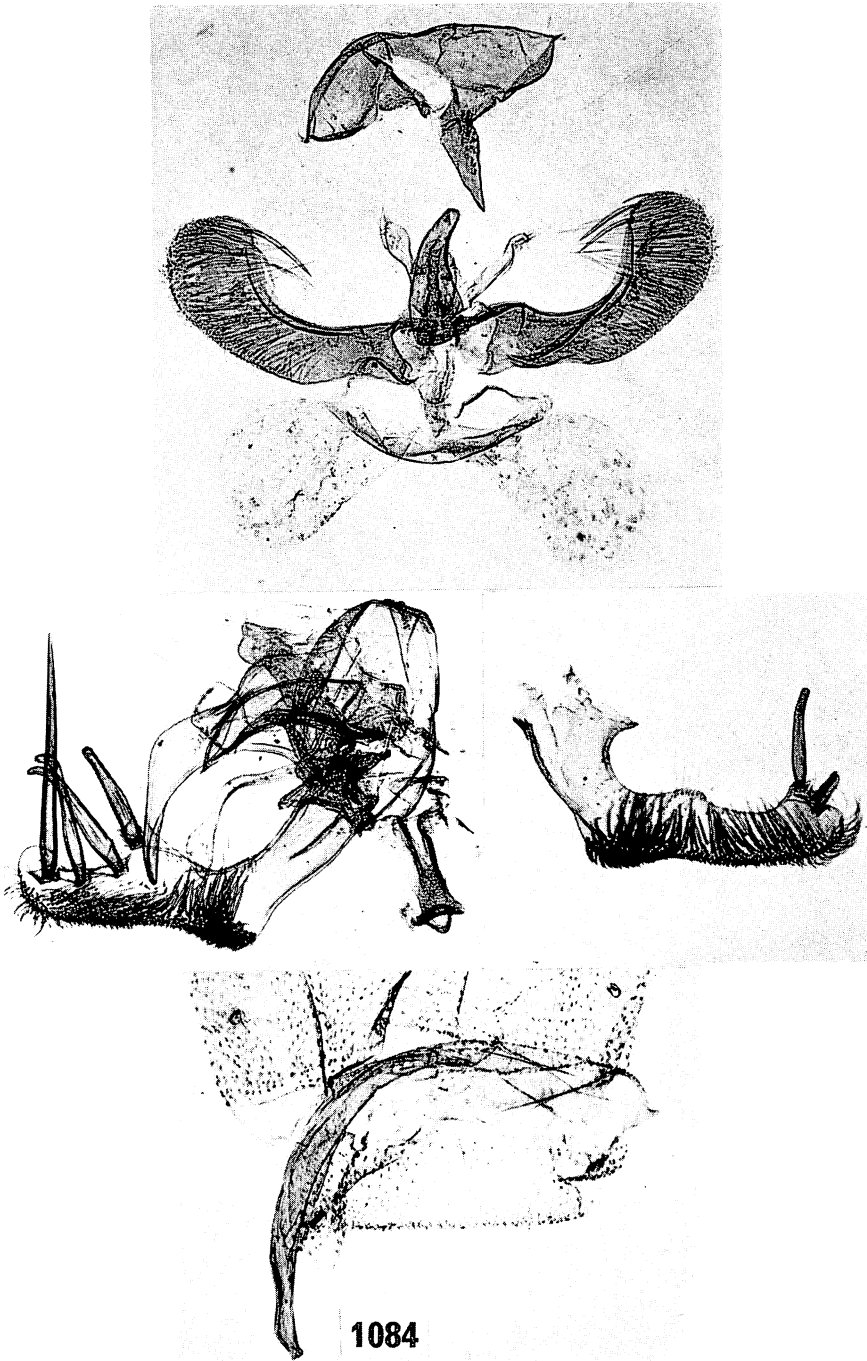


Figure 1084—Male genitalia of *Hyposmocoma*. Top, (*H.*) *hemicasis* Meyrick, paratype (slide Z-I-23-61-3); Pacific Heights, Oahu. Compare the *illuminata* group. Middle and bottom, (*H.*) *humero vittella* Walsingham, holotype (BM slide 4101); Waianae Mts., 3,000 feet.



Figure 1085—Male genitalia of *Hypsoscopa (H.) hygroscopa* Meyrick, holotype (slide Z-I-22-61-1); Halemanu, Kauai. Note the terminal positions of the spurs on the valvae (the spurs from the right valva are seen detached and scattered). Compare the *admiratoris* group.

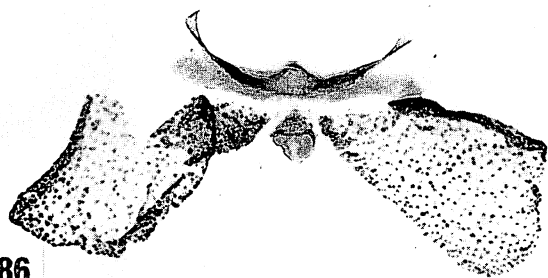
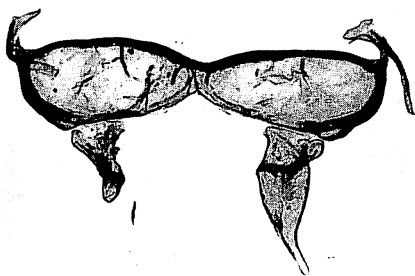
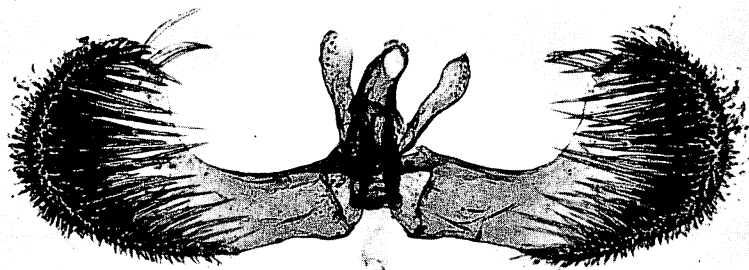
**1086**

Figure 1086—Male genitalia of *Hypsmocoma (H.) illuminata* Meyrick, paratype (BM slide 7886); Haleakala, 5,000 feet, Maui. Compare the genitalia of the type on figure 1080. These genitalia are similar to those of *indecella* (figure 1088), but the moths are distinctively colored. Compare *canella*, *cinereosparsa*, *communis*, *hemicasis*, *lixiviella*, *mimica*, *nigrescens*, *parva*, and *subflavidella*.

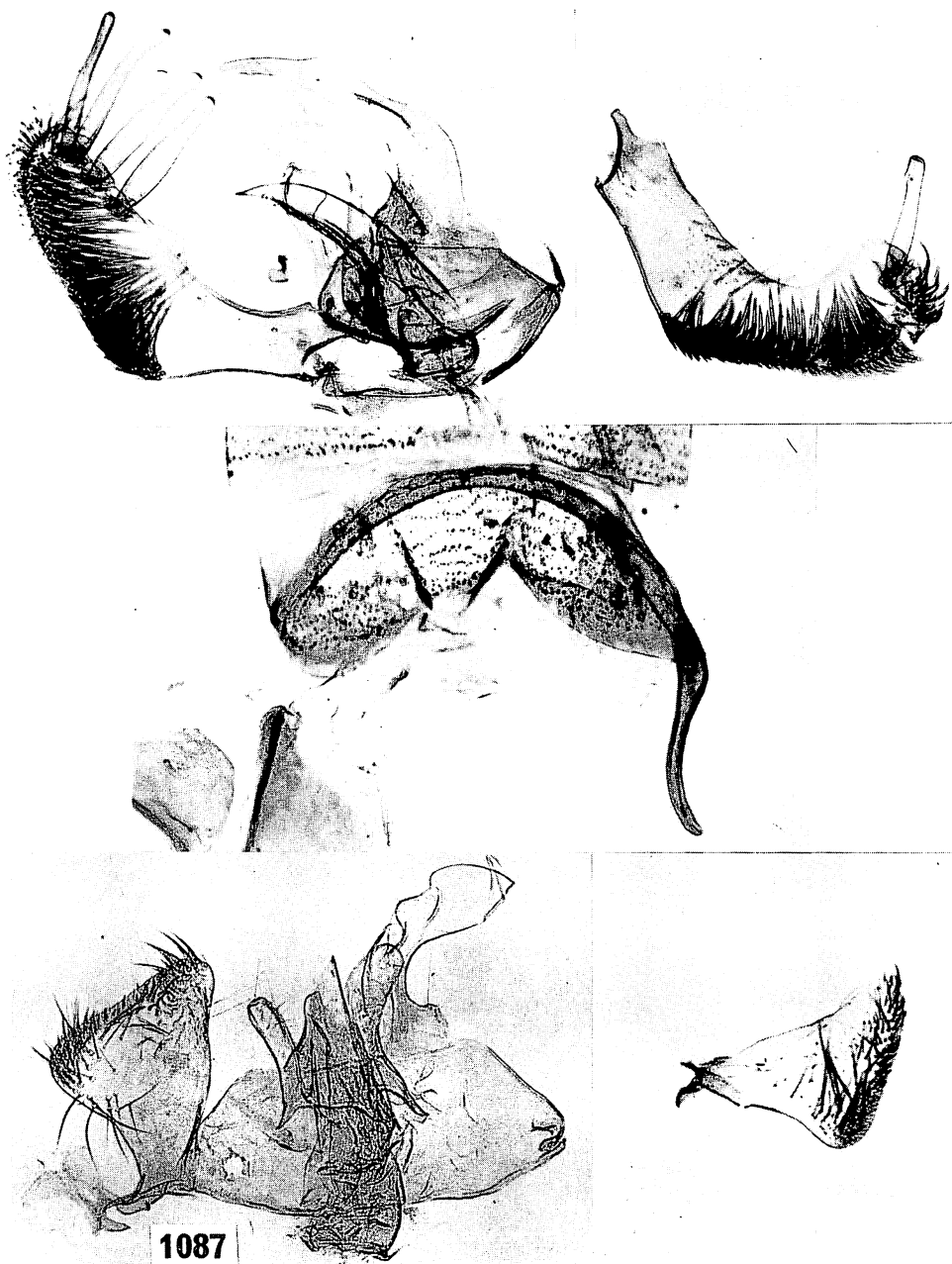


Figure 1087—Male genitalia of *Hyposmocoma*. Top and middle, (*H. impunctata* Walsingham, holotype (BM slide 4114); Kilauea, Hawaii. There are rudimentary spurs near the base of the long spur on the right valva. Bottom, (*E. inflexa* Walsingham, holotype (BM slide 4493); Haleakala, 4,000 feet, Maui. Note the great reduction of the valvae and compare ("*Aphthonetus*") *empetra* and allies.

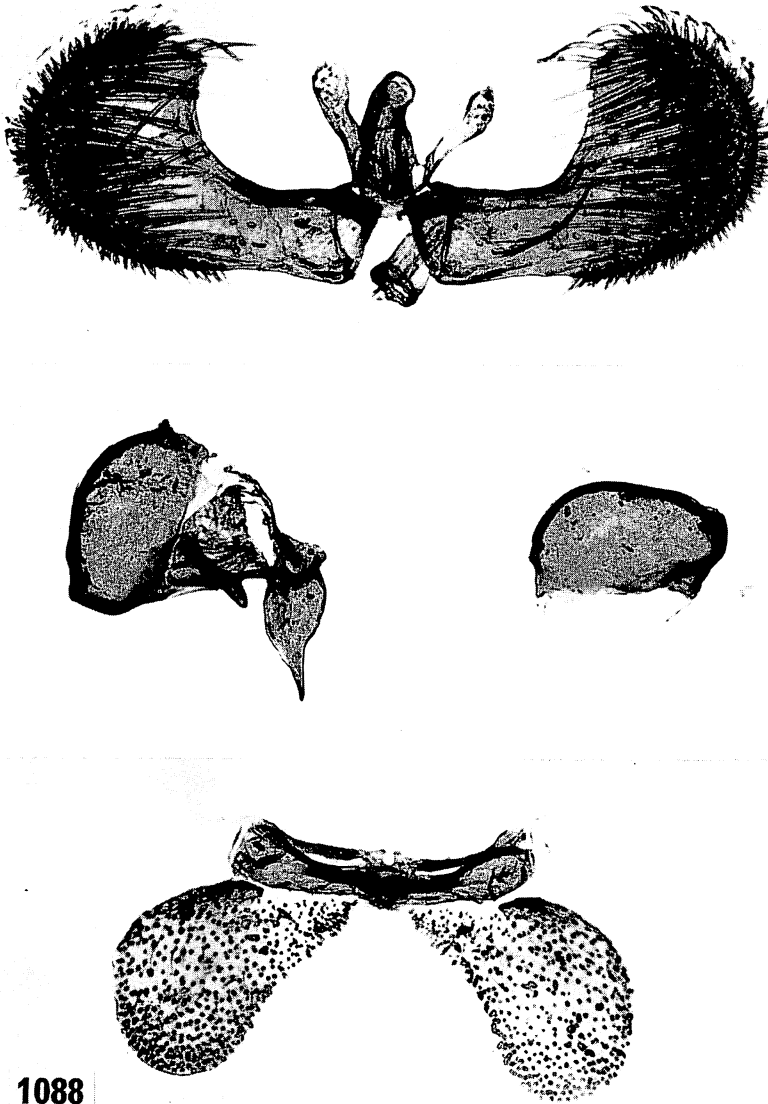
**1088**

Figure 1088—Male genitalia of *Hypsmocoma* (*H.*) *indecella* Walsingham, paratype (BM slide 8459); Haleakala, 5,000 feet, Maui. See the genitalia of the holotype in figure 1080 and the commentary in the legend to that figure.



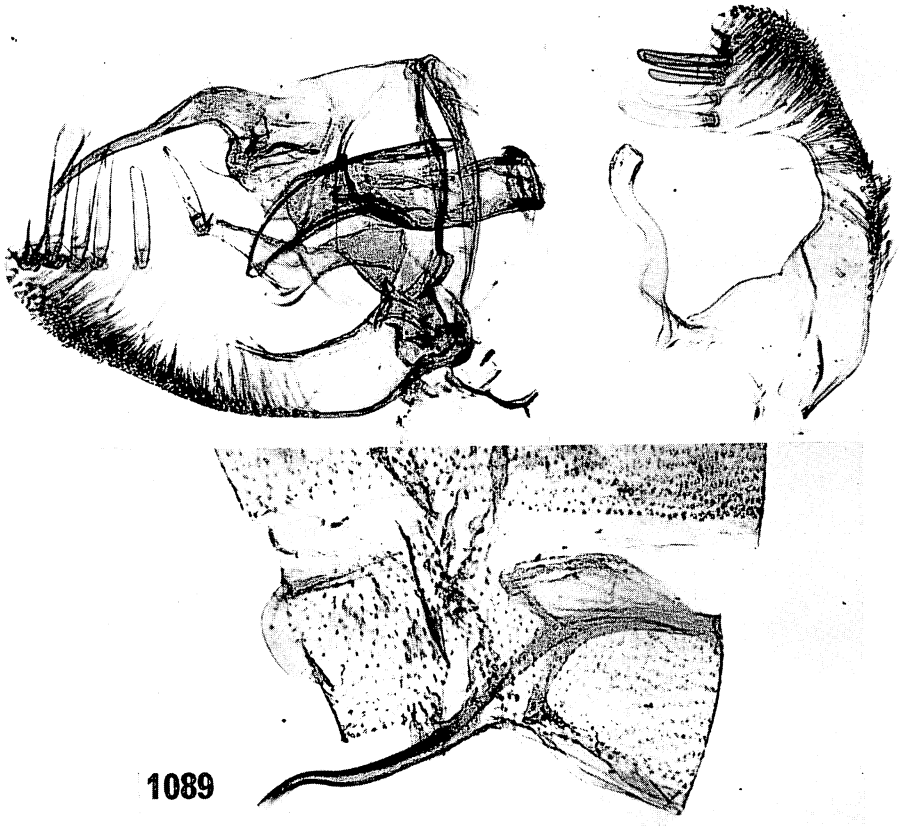


Figure 1089—Male genitalia of *Hypsomocoma* (*H.*) *iodes* Walsingham, holotype (BM slide 4477); Molokai, above 3,000 feet. Compare *alliterata*, *conditella*, *liturata*, *nebulifera*, *nigralbida*, *ochreociliata*, *paradoxa*, *quinquemaculata*, *sideritis*, *syrrhaptus*, *tarsimaculata*, and *triptila*.

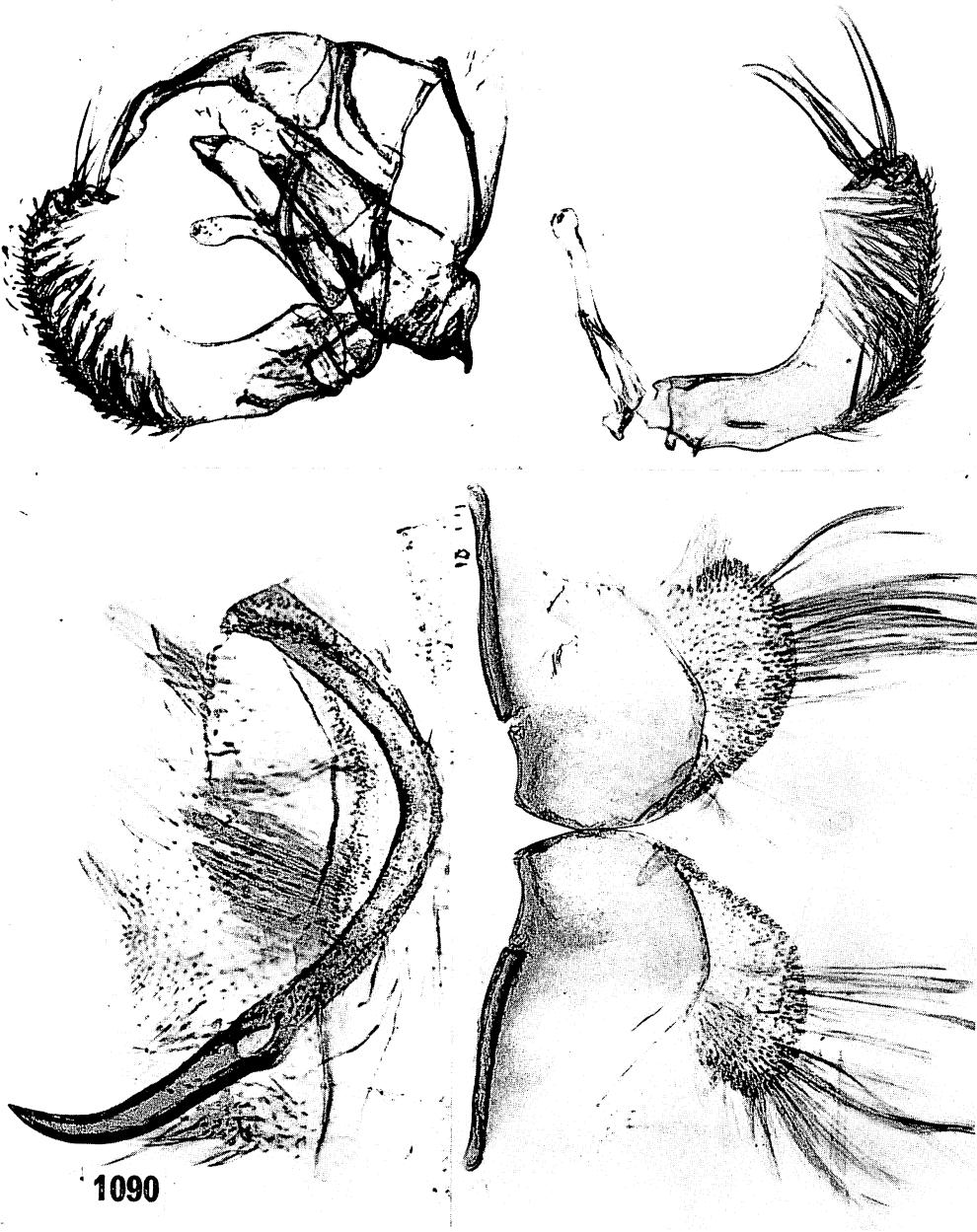


Figure 1090—Male genitalia of *Hyposmocoma* (*H.*) *irregularis* Walsingham, holotype (BM slide 4484); Kauai, 3,000 to 4,000 feet. The bottom figures are in greater enlargement. Compare *admirationis* and similar forms.

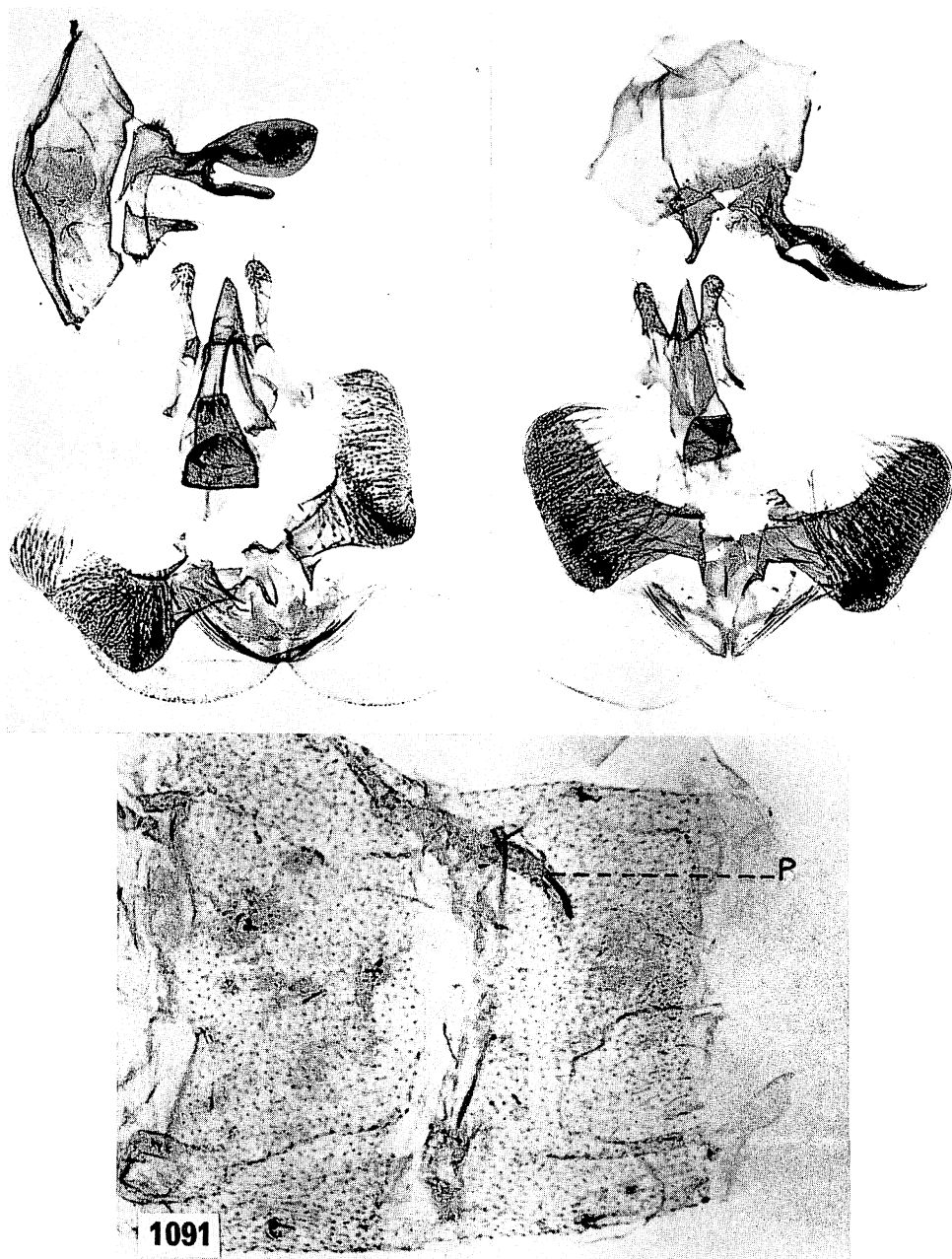


Figure 1091—Male genitalia of *Hypsoscoma*. Top left and bottom, (*E.*) *insinuatix* Meyrick, holotype (slide Z-I-22-61-2); Kainalu, 2,000 to 3,000 feet, Molokai. The bottom figure is a ventral view of the sixth and seventh abdominal segments. The apparent sclerotized process ("P") is not a pseuduncus; it may be an abnormality. Top right, (*E.*) *jugifera* Meyrick, holotype (slide Z-I-20-61-3); Mt. Tantalus, Oahu. Note the differences in the anellar lobes in these species.

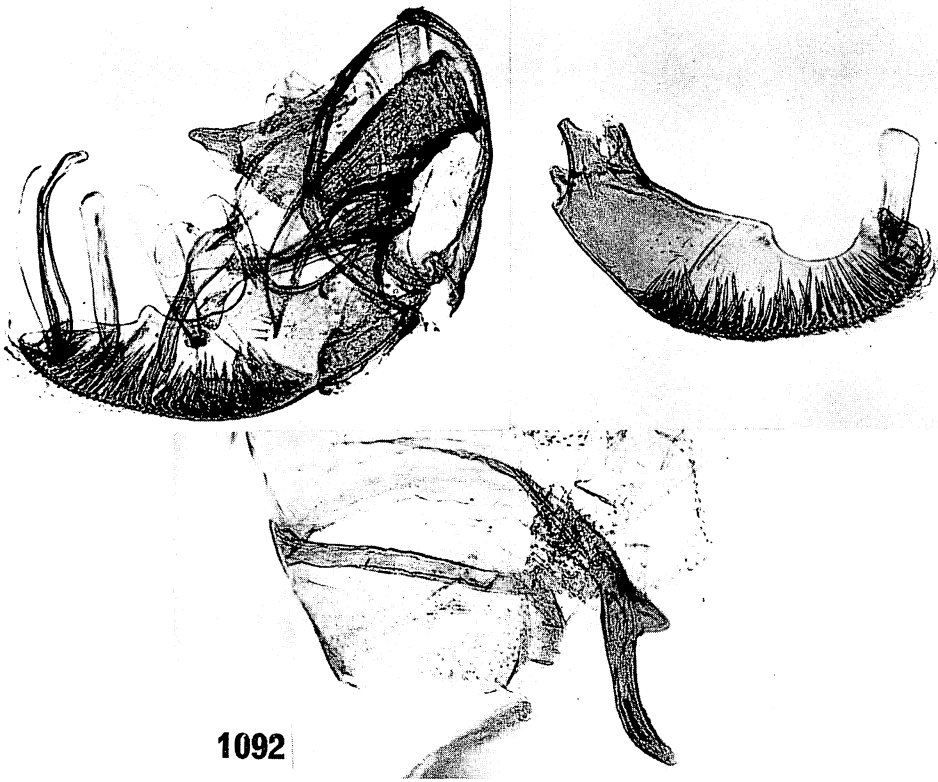


Figure 1092—Male genitalia of *Hypsoscoma (H.) lacertella* Walsingham, allotype (BM slide 4129); Haleakala, 5,000 feet, Maui. Note the broad process on the costa of the left valva. Compare *evanescens*, *haleakalae*, and the *blackburnii* group.

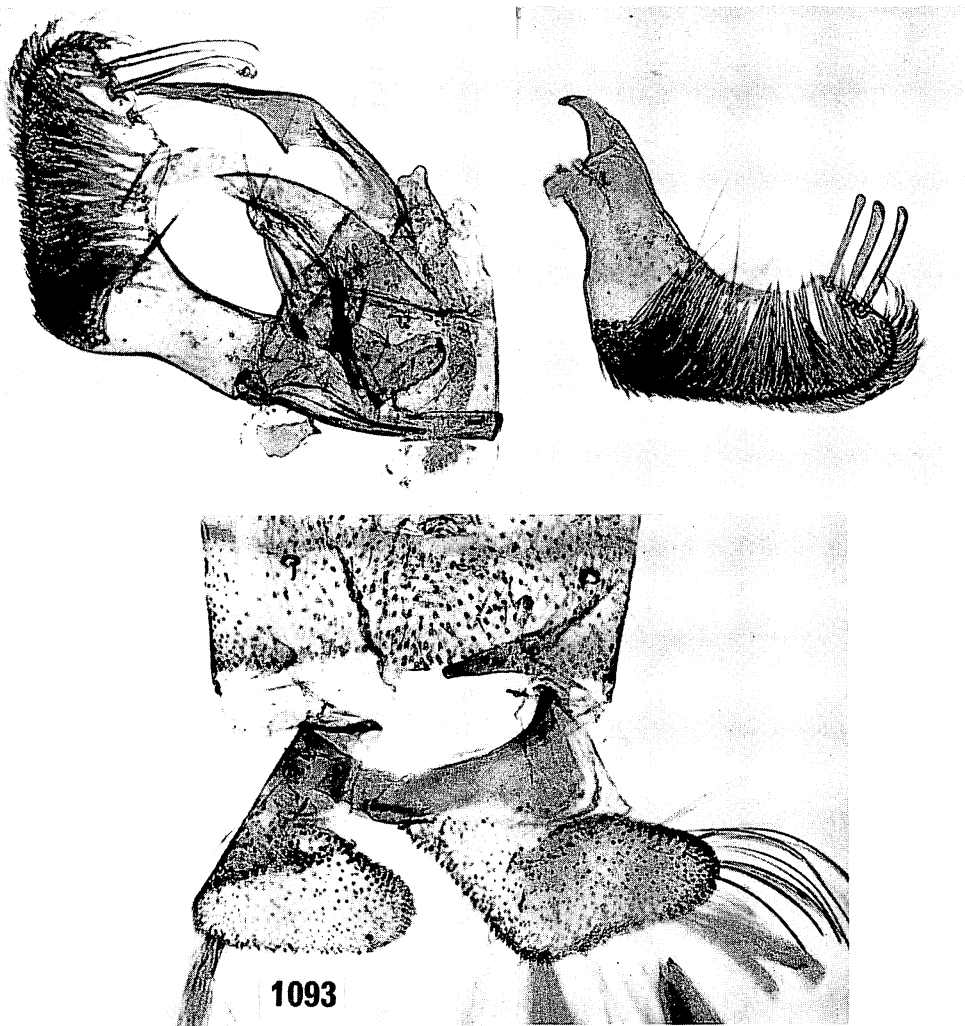
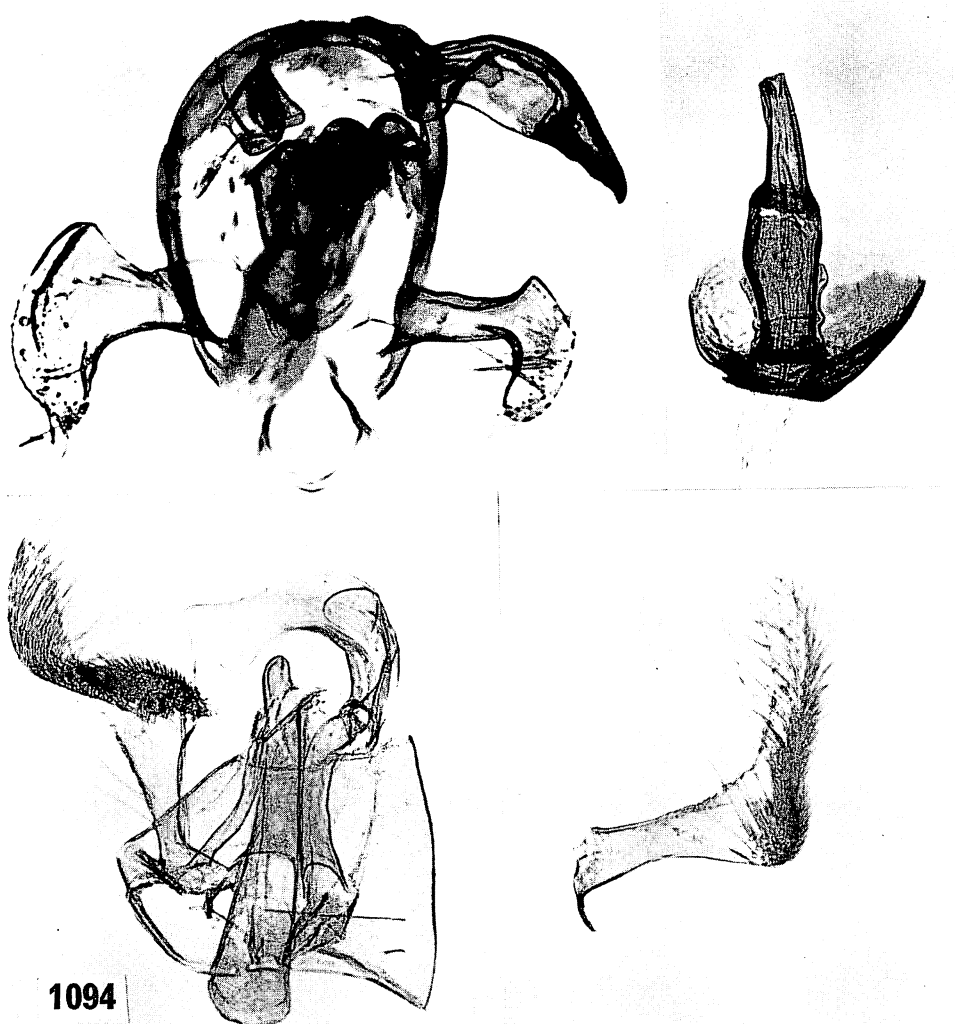


Figure 1093—Male genitalia of *Hypsoscopia* (*H.*) *lactea* Walsingham, holotype (BM slide 4318); Halemanu, 4,000 feet, Kauai. Compare *albifrontella*.



1094

Figure 1094—Male genitalia of *Hypsmocoma*. Top, (*E.*) *latiflua* Meyrick, holotype (BM slide 9558 Clarke); Koolau Mts., above Honolulu. Note the enlarged flange at the base of the distal intra-aedeagal part of the ejaculatory duct. Compare the *fulvida* group. Bottom, (*E.*) *lugens* Walsingham, holotype (BM slide 4135); Haleakala, 5,000 feet, Maui; left valva artificially folded. Although Meyrick described *lugens* as a typical *Hypsmocoma*, the genitalia reveal that it is a member of the *Neelysia* group; compare ("*Neelysia*") *incongrua*, for example. Compare the *fulvida* group.

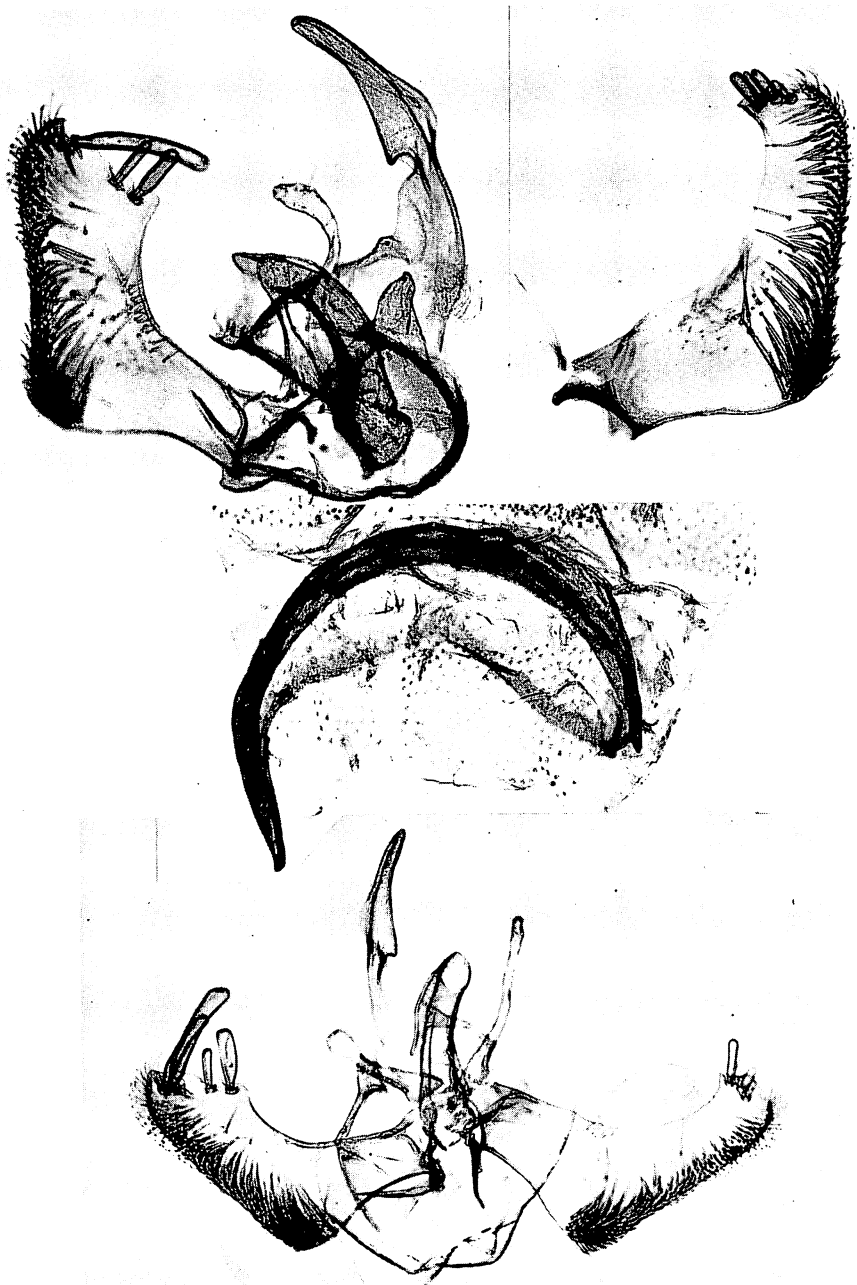
**1095**

Figure 1095—Male genitalia of *Hypsoscoma* (*H.*) *lebetella* Walsingham. Top and middle, holotype (BM slide 4094); Olinda, 4,000 feet, Maui; outer spur lost from left valva. Bottom, a paratype (BM slide 2013) from the same locality. Compare *albifrontella* and *leporella*.

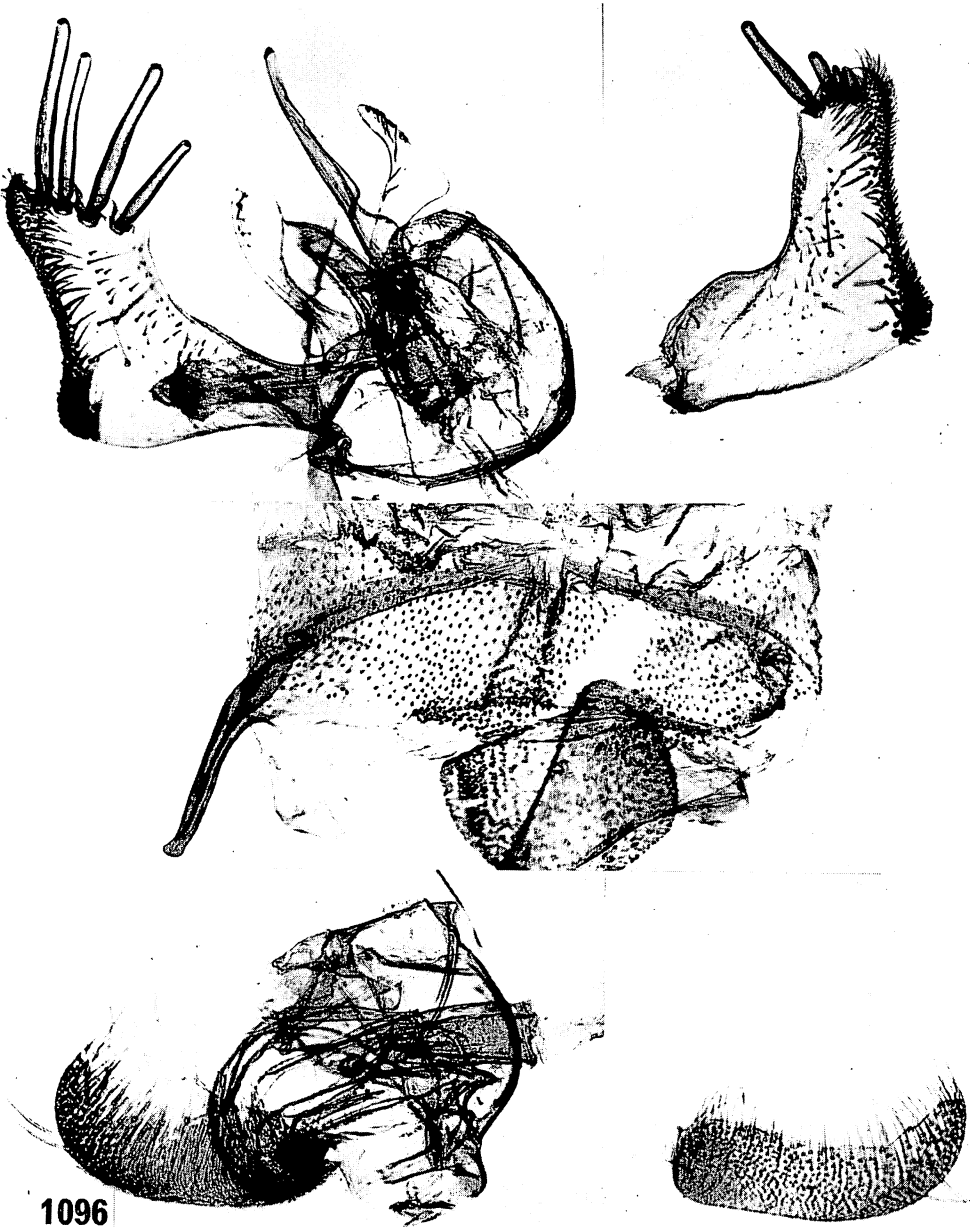


Figure 1096—Male genitalia of *Hypsmocoma*. Top and middle, (*H.*) *leporella* Walsingham, holotype (BM slide 4087); Kauai, 3,000 to 4,000 feet. Compare *albifrontella* and *lebetella*. Bottom, (*E.*) *limata* Walsingham, holotype (BM slide 4105); Kilauea, Hawaii.



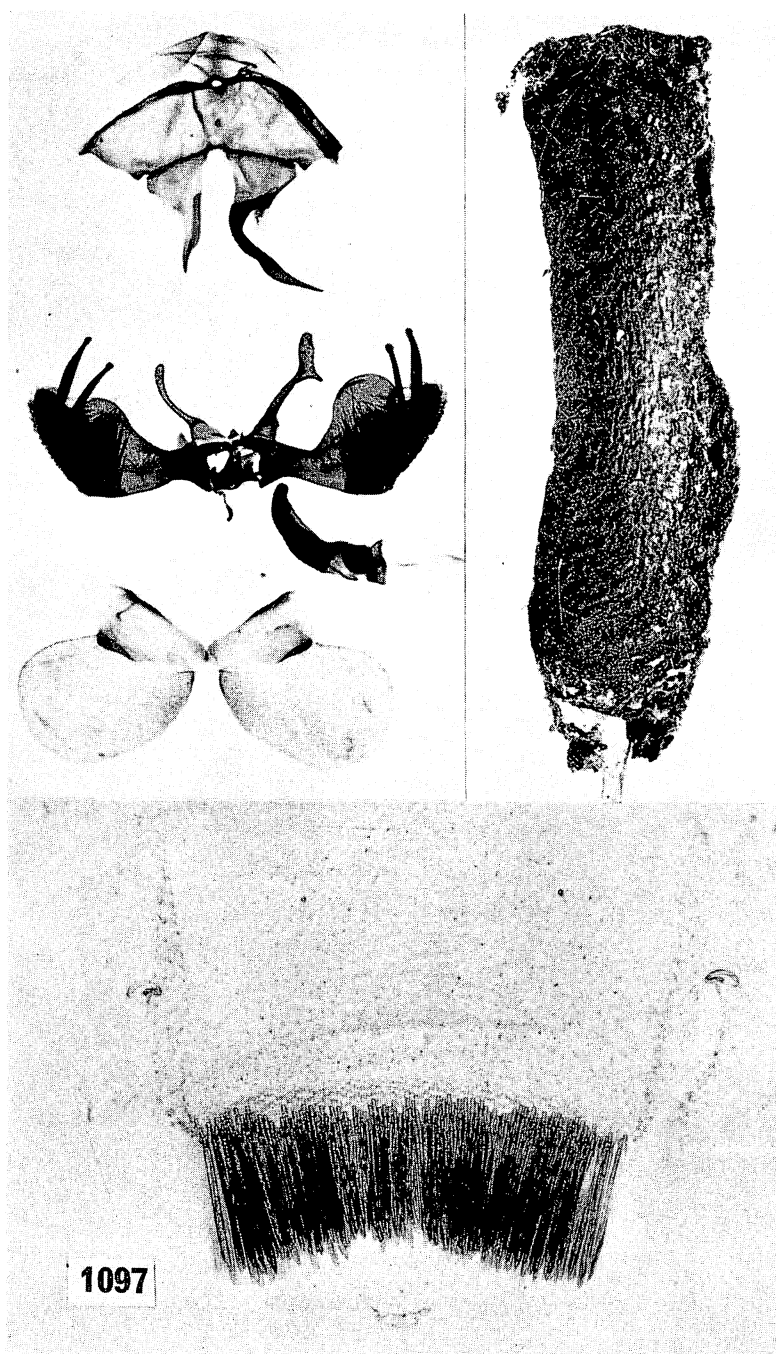


Figure 1097—Details of *Hypsmocoma* (*H.*) *lignivora* (Butler) ("Diplosara"). Top left, male genitalia, and bottom, the comb of setiform squamae on the seventh abdominal tergum (slide I-18-61-1); Palolo, Oahu. Top right, larval case of a female (genitalia on slide Z-XII-62-3; see figure 1225) as determined by Dr. Swezey; Lanihuli, Oahu. See figures 1098, 1099. This larval case appears to be different from that in figure 803.

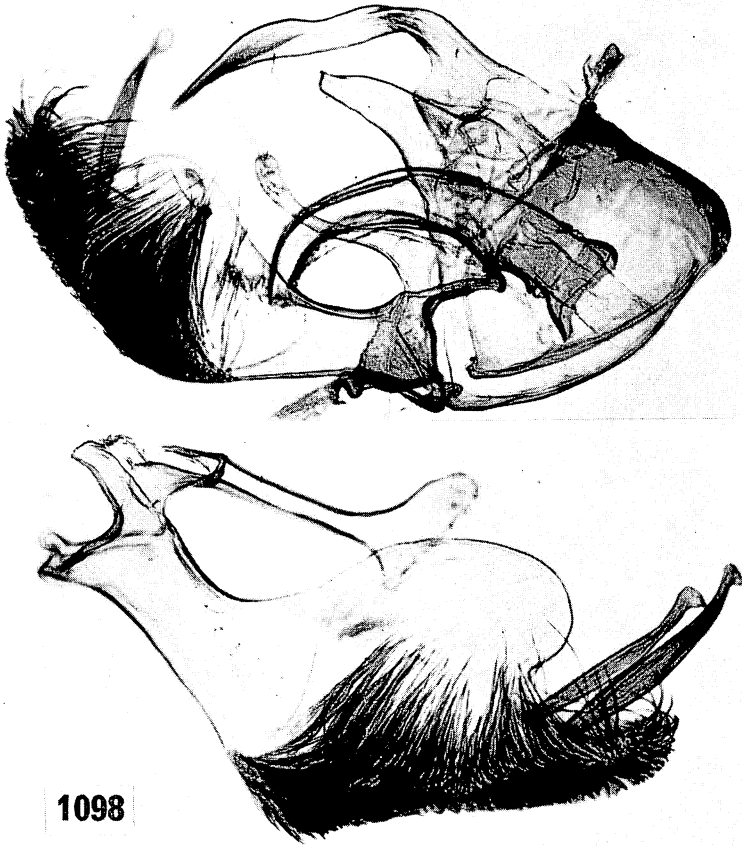


Figure 1098—Male genitalia of *Hypsoscoma* (*H.*) *lignivora* (Butler) ("*Diplosara*") (BM slide 5521); Mt. Tantalus, Oahu; ex *Pisonia*. One of the spurs has been lost from the left valva, and the apex of the left brachium has been broken off. Compare figures 1097, 1099.

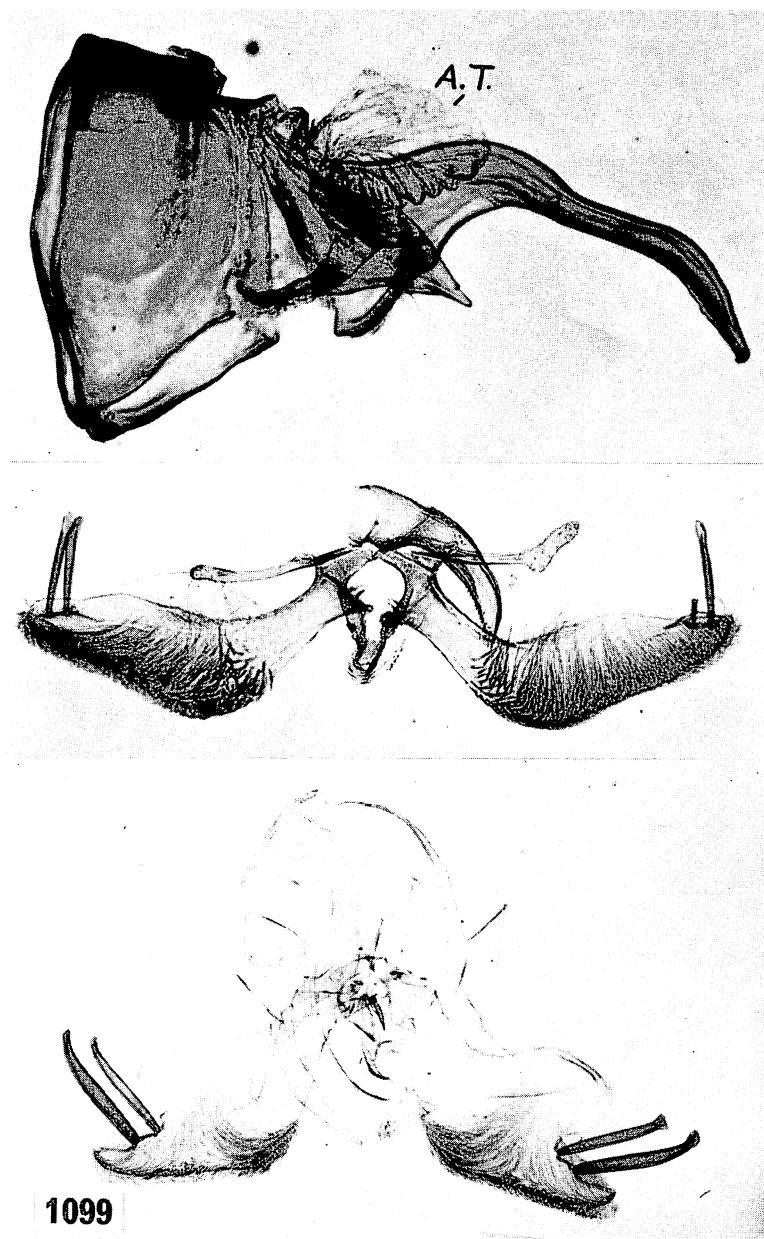
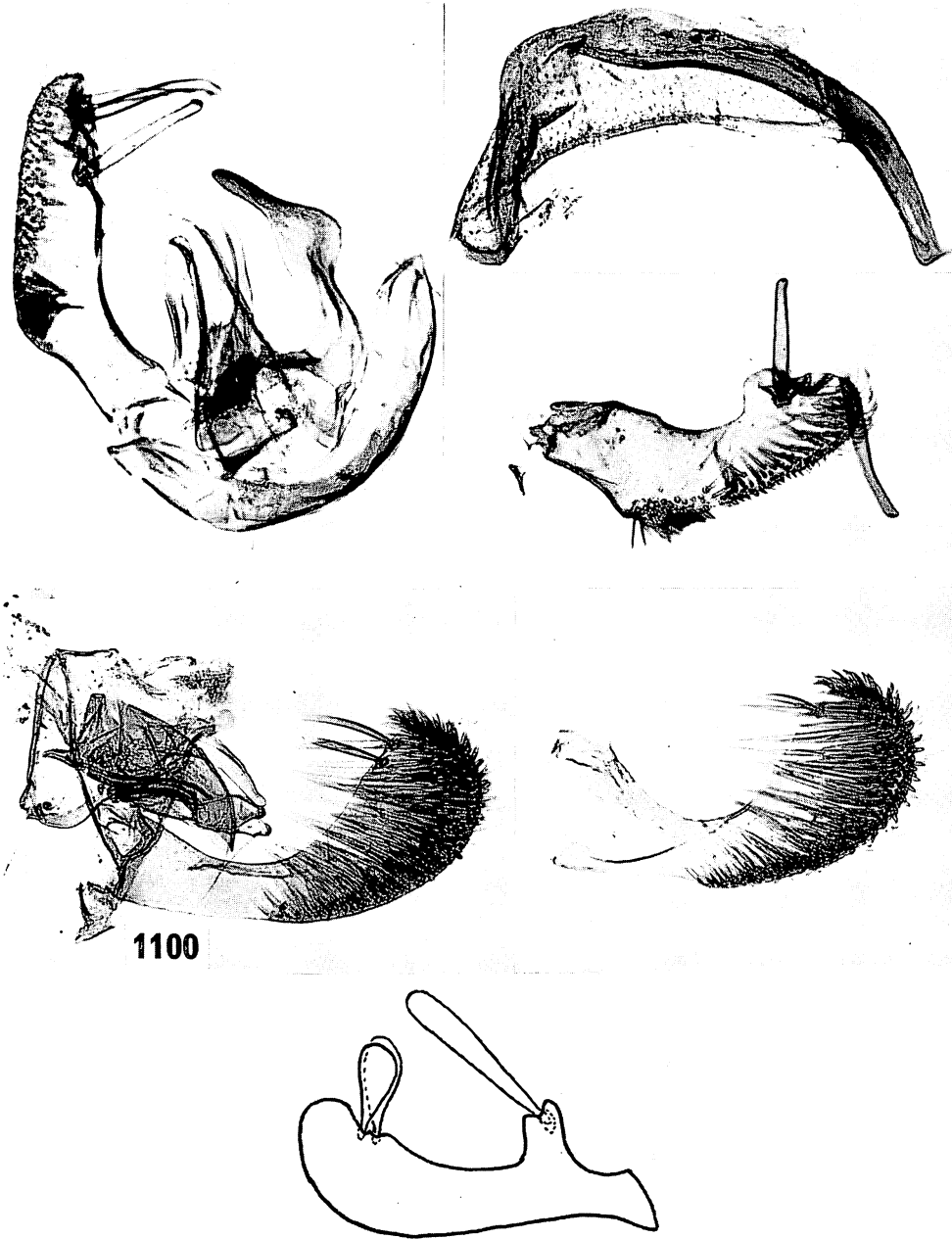


Figure 1099—Male genitalia of *Hypsoscocoma*. Top and middle, (*H.*) new species 17, formerly confused as *lignivora* (BM slide 2004); Kilauea, Hawaii. The proximal spur on the right valva has been broken. Bottom, an example of another species from Molokai (Busck slide 54; Walsingham specimen 25173). Note the unusual shape of the costa of the left valva. If this is not an abnormal *lignivora*, then it represents another new species. Compare figures 1097, 1098.



1100

Figure 1100—Male genitalia of *Hyposmocoma*. Top three figures, (*H.*) *lineata* Walsingham, holotype (BM slide 4122); Haleakala, 5,000 feet, Maui; the distal spur on the right valva has been broken out of its base and has drifted in the mount. Compare *ludificata*. Middle, (*H.*) *lixiviella* Walsingham, allotype (BM slide 4480); Kauai, 3,000 to 4,000 feet. The left figure shows the ectal face of the left valva; at the right, the right valva is seen from the ectal face. There is only one spur on the right valva, and there are no additional sockets. Compare *illuminata*, *indicella*, *lixiviella*, *mimica*, *illuminata*, and *parda*. Bottom, a sketch of the left male genital valva of (*H.*) new species 19 (BM slide 5473-b); Kauai, 3,000 to 4,000 feet. Compare *numida* in the *mimema* group.

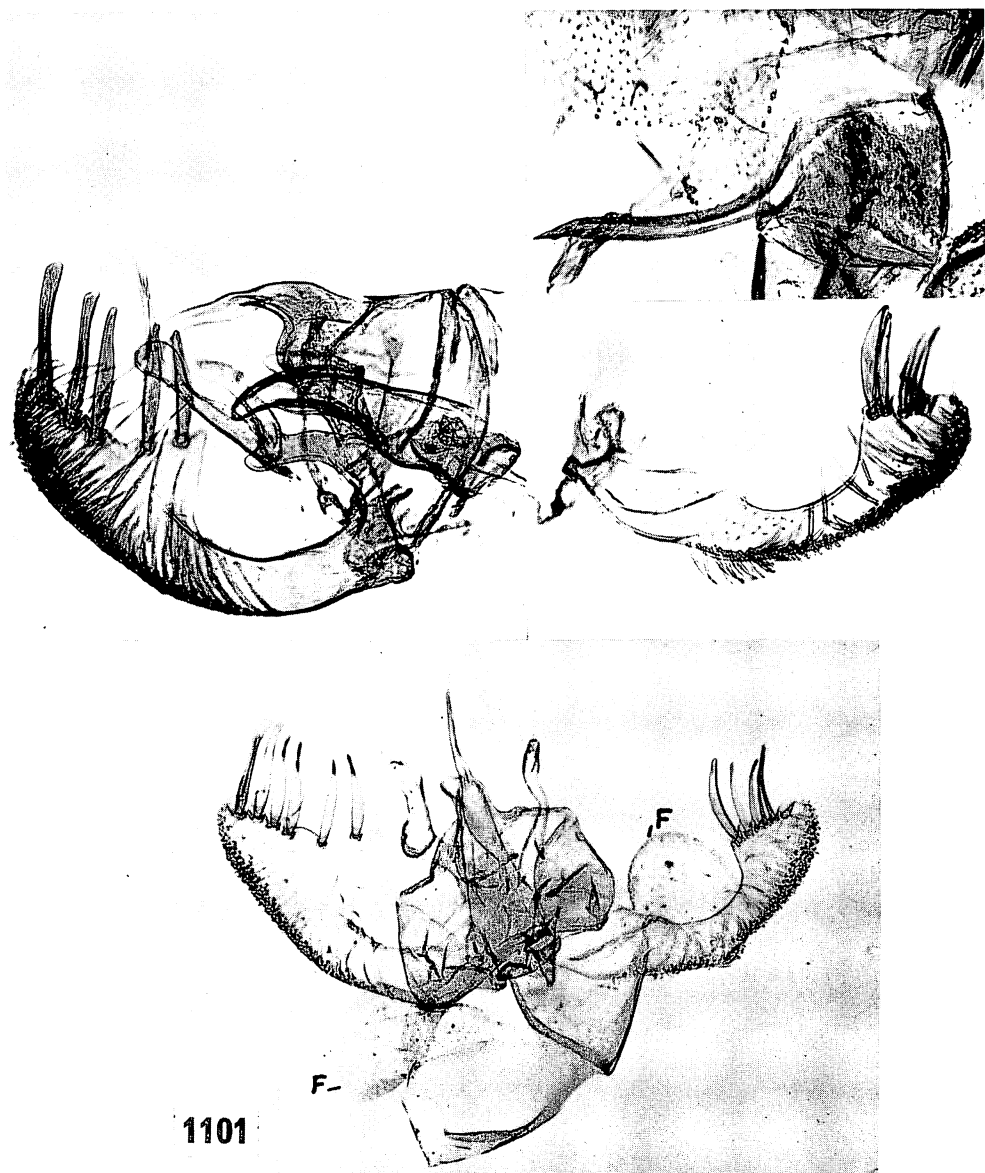


Figure 1101—Male genitalia of *Hypsoscyma* (*H.*) *literata* Walsingham. Top three figures, holotype (BM slide 4478); Kona, 4,000 feet, Hawaii. The pseuduncus is viewed on edge; its apex is expanded on the other face. There are five spurs on each valva. Bottom, the same species, paratype (Busck slide 74; Walsingham specimen 25293); Hawaii. Do not confuse the right genital flap ("F"), which has been displaced, with an expansion of the right valva. Note that on this specimen there are six spurs on each valva instead of the five on the holotype (the ectal one has been lost from the right valva). Compare the *iodes* group.

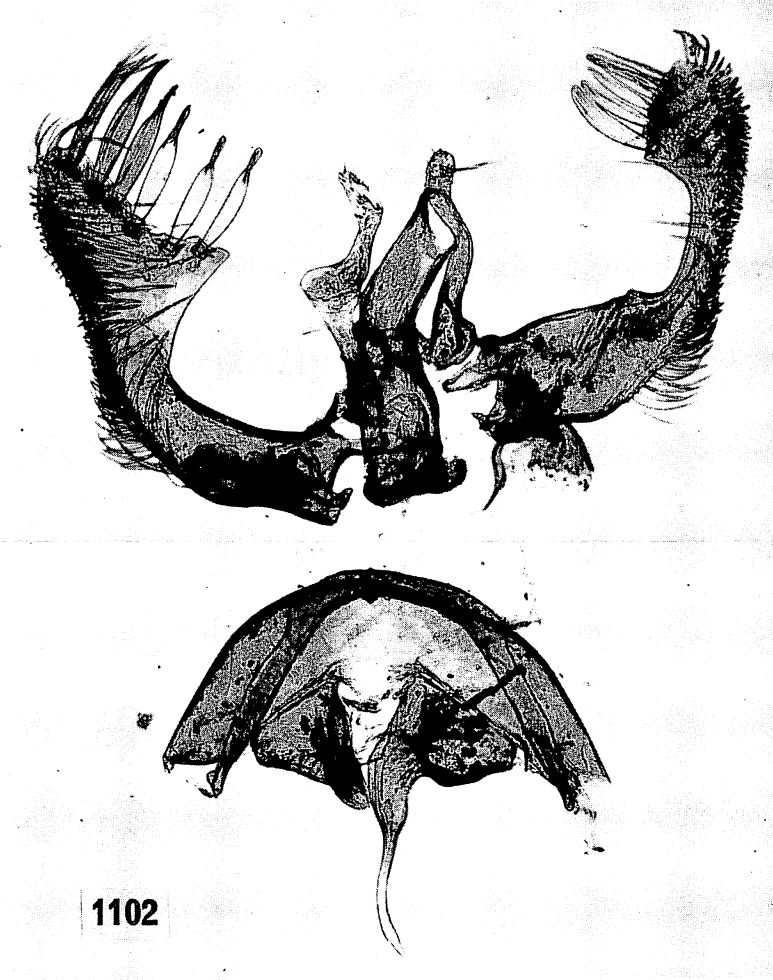


Figure 1102—Male genitalia of *Hypsmocoma (H.) literata* Walsingham from a specimen determined by Dr. Swezey (BM slide 14297); Kalihi, Honolulu. See figure 1103 for other parts.

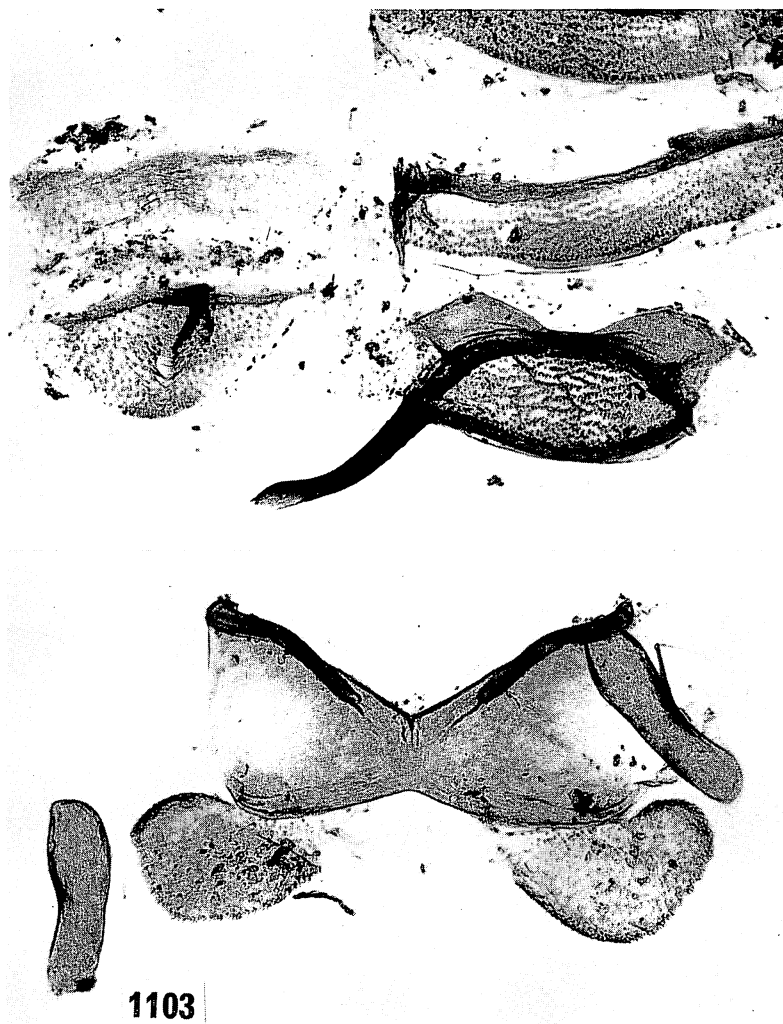


Figure 1103—Parts of the male abdomen of *Hyposmocoma* (*H.*) *literata* Walsingham determined by Dr. Swezey (BM slide 14297). See figure 1102 for other parts.

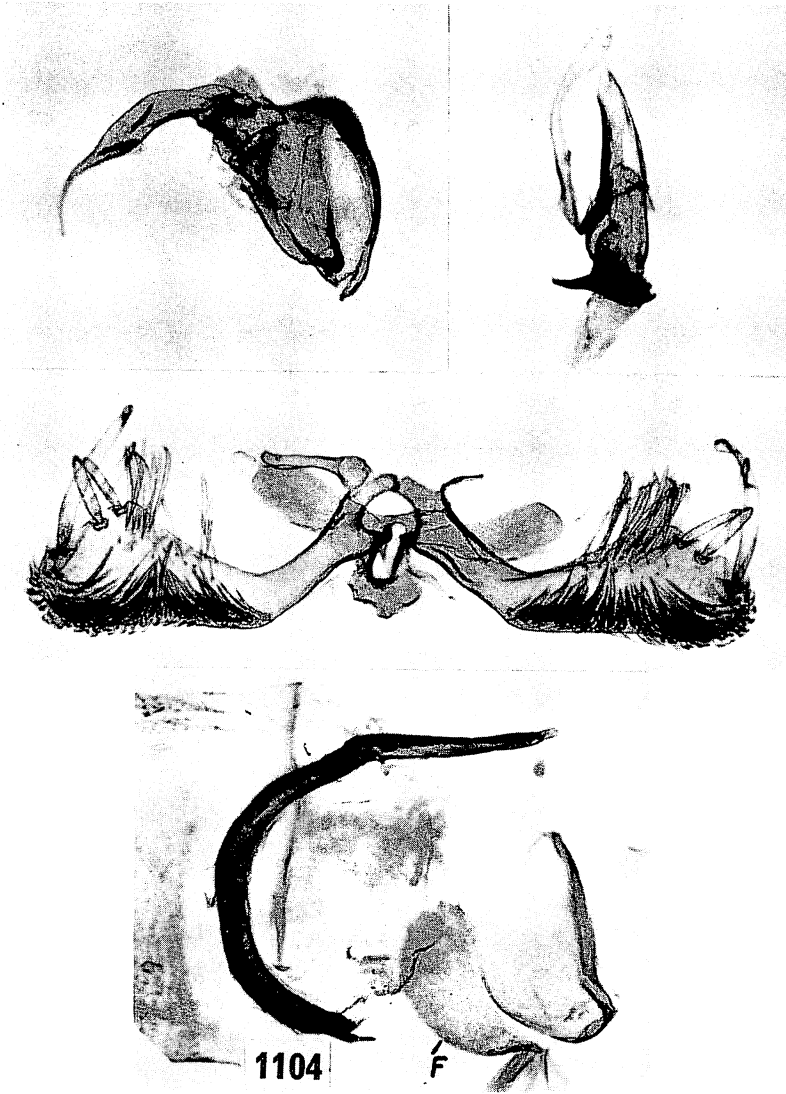


Figure 1104—Male genitalia of *Hyposmocoma* (*H.*) new species 18, formerly confused as a paratype of *literata* Walsingham (BM slide 7501); Molokai, above 4,000 feet. The left anellar lobe adheres to the base of the left valva and the right lobe is attached to the aedeagus. A genital flap is marked by "F". The pseuduncus is seen in dorsal aspect; note how strongly developed it is across the entire sternum.



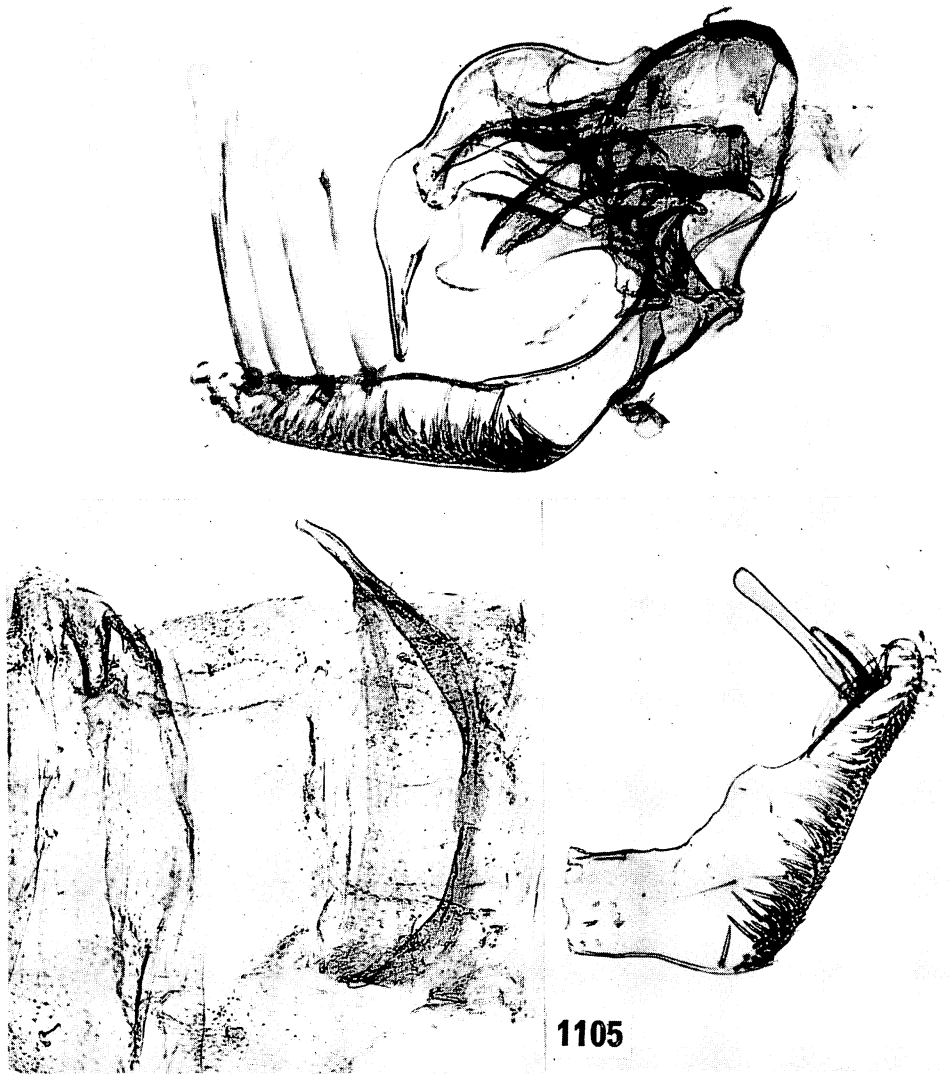
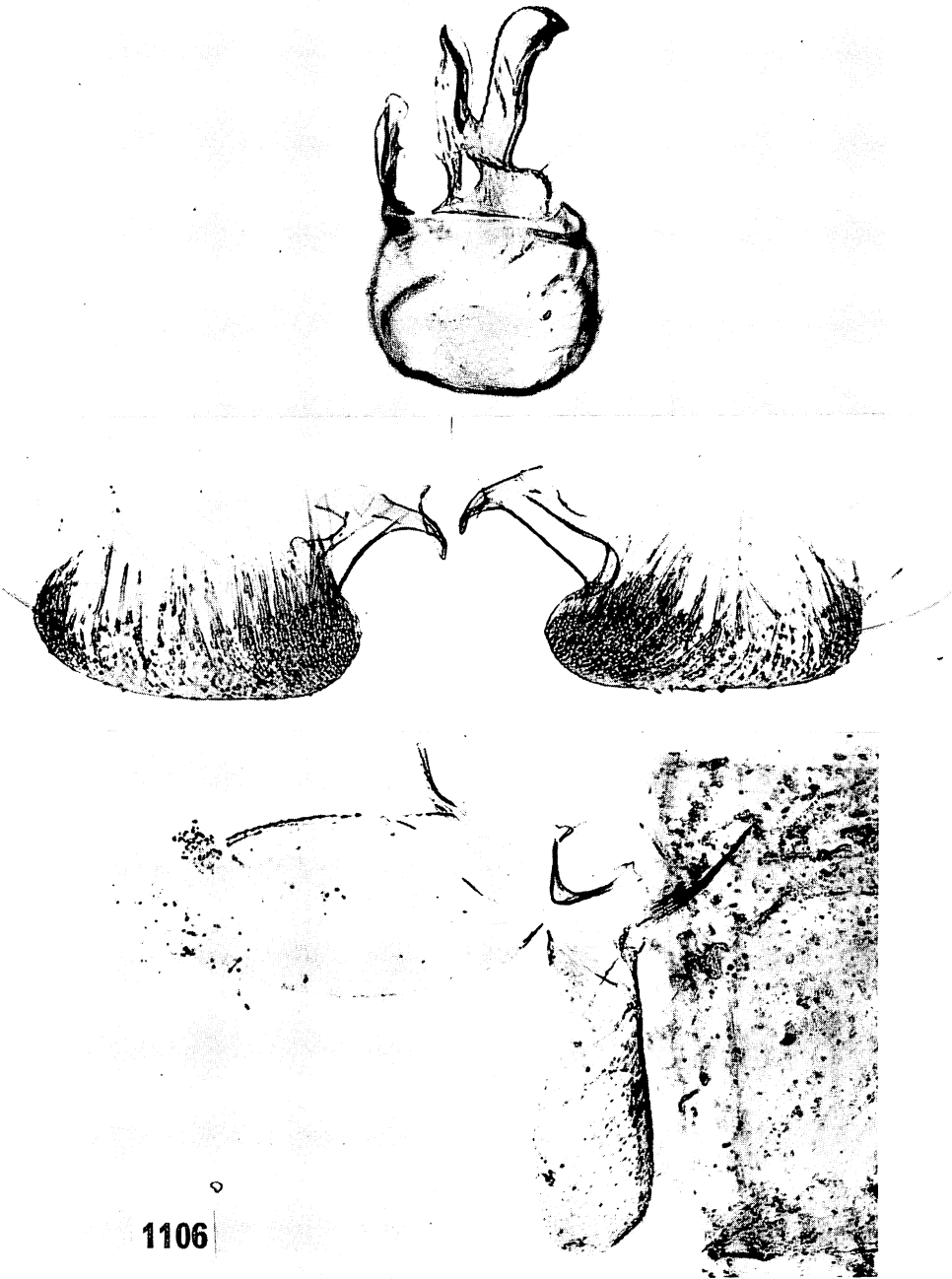


Figure 1105—Male genitalia of *Hypsmocoma* (*H.*) new species 20, formerly confused as a paratype of *longitudinalis* Walsingham (BM slide 5437); Waialua Beach, Oahu. Another supposed male paratype (BM slide 8490; see wing venation on figure 842) from Halemanu, Oahu, has similar genitalia. Note that this species belongs to *Hypsmocoma*, whereas the male paratype illustrated in figures 789 and 1106 belongs to *Euperissus*, the two major divisions of *Hypsmocoma*. Compare *lineata* and *ludificata*.



1106

Figure 1106—Male genitalia of *Hypsoscocoma* (E.) new species 21, formerly confused as a paratype of *longitudinalis* Walsingham (BM slide 5436); Molokai, above 3,000 feet. The tegumen and brachia are shown in ventral aspect. The aedeagus and anellar lobes were unfortunately not photographed. Note the strong, single, distal seta on each valva. Compare the drawings on figure 789.

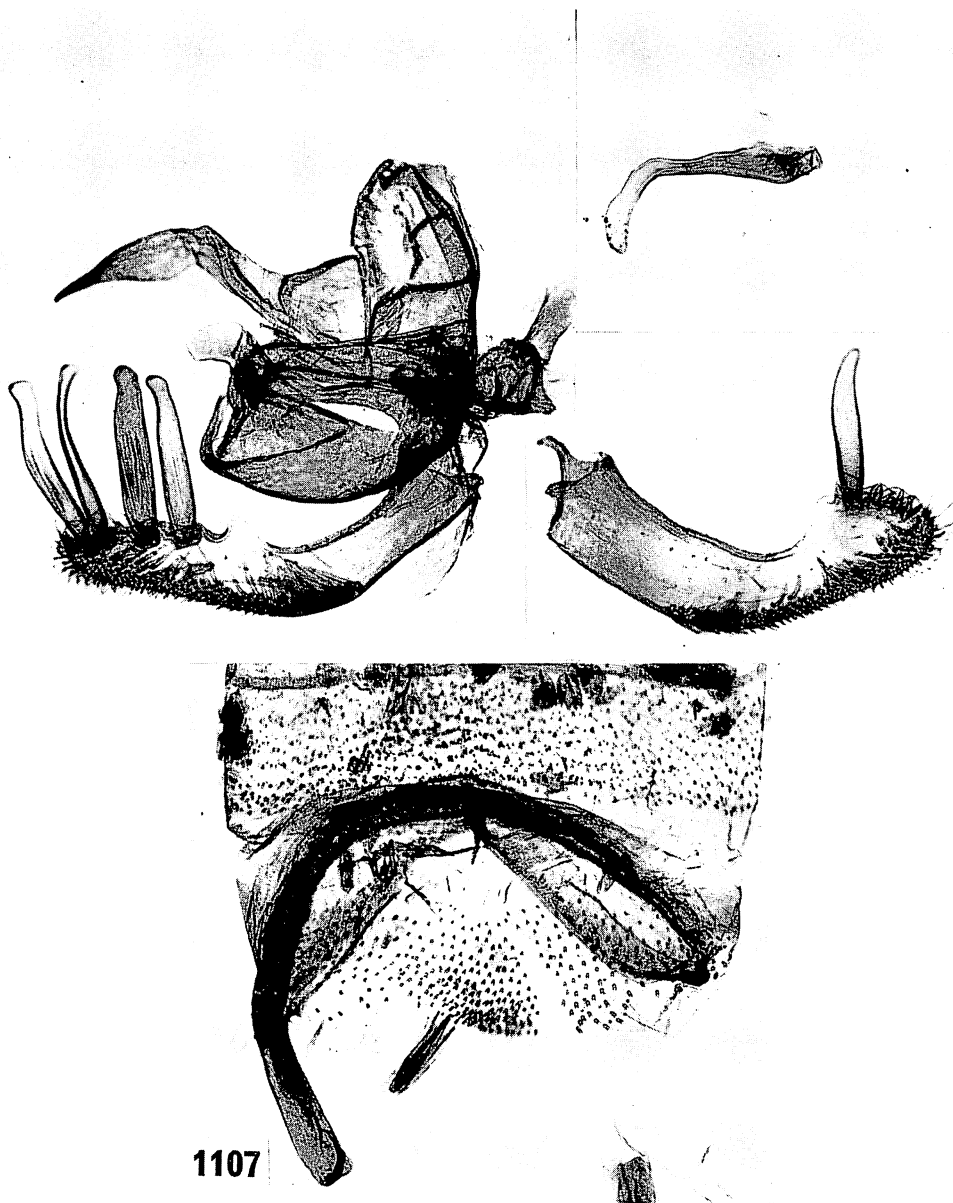


Figure 1107—Male genitalia of *Hypsmocoma* (*H.*) *ludificata* Walsingham, holotype (BM slide 4121); Haleakala, 5,000 feet, Maui. The upper right figure is the right anellar lobe. Note the rudimentary spurs adjacent to the single large spur on the right valva. Compare *lineata* and the *lupella* group.

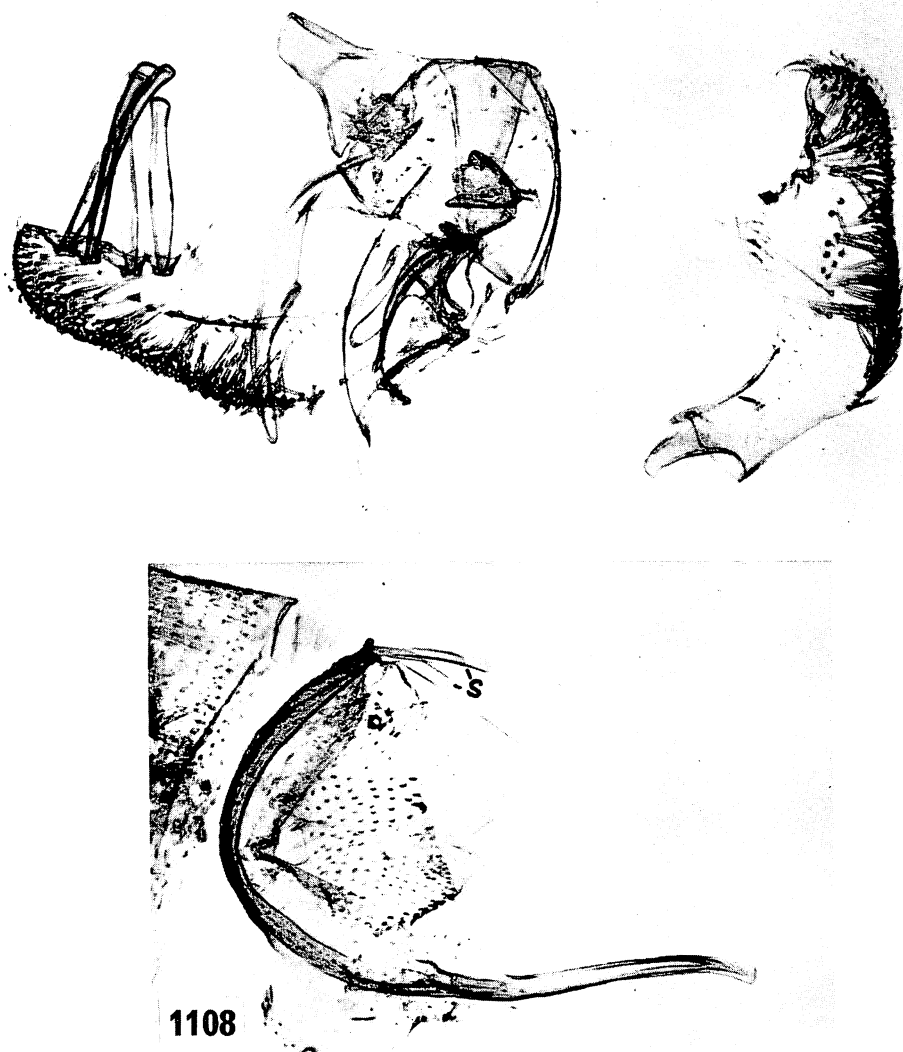


Figure 1108—Male genitalia of *Hyposmocoma* (*H.*) *lupella* Walsingham, holotype (BM slide 4097); Kaholuamano, 4,000 feet, Kauai. Note the gently arcuate aedeagus, the broad left brachium, and the long slender anellar lobe. The long ental spur has been broken off the right valva, and the three ectal spurs are aborted. In the lower figure, several squamae ("S") adhere to the side of the pseuduncus; these should not be confused with sclerotizations.

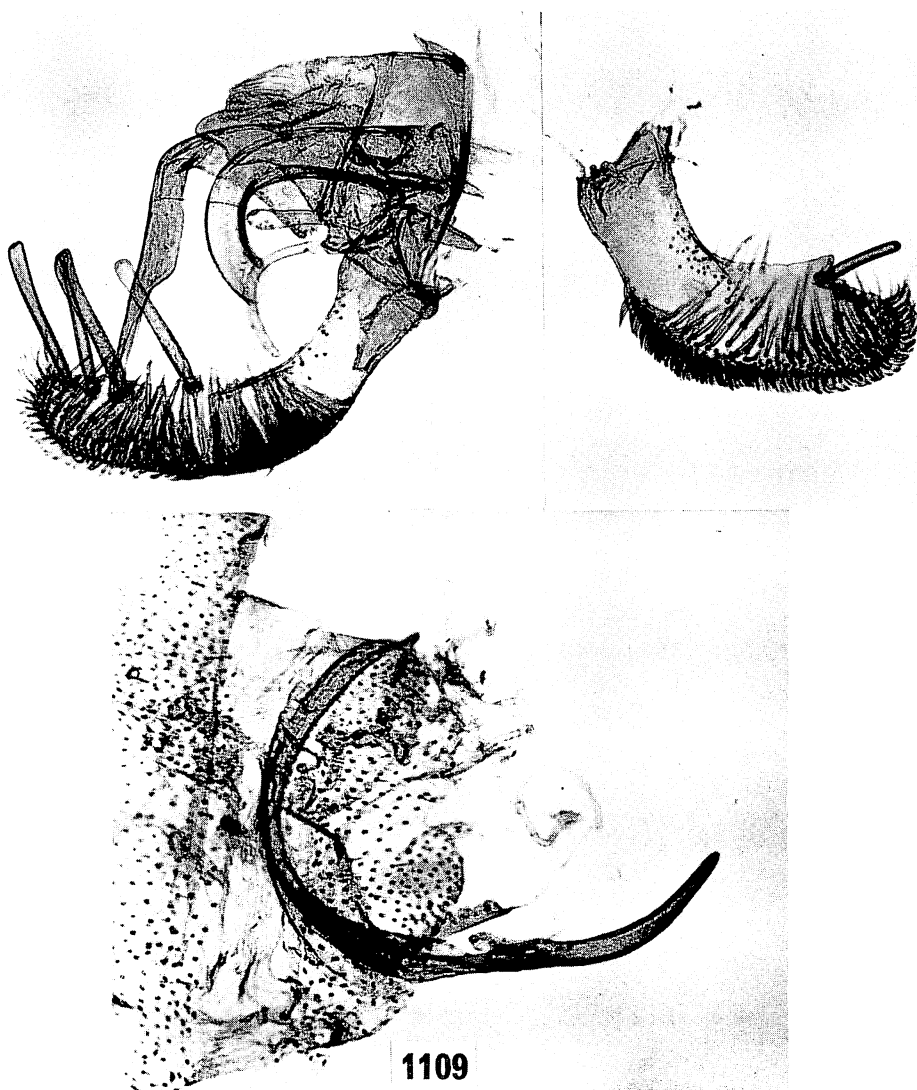


Figure 1109—Male genitalia of *Hypsocoma* (*H.*) *candidella* (Walsingham) (formerly considered a form of *lupella*), holotype (BM slide 4360); Kona, 4,000 feet, Hawaii. Note the strongly arcuate aedeagus and compare the gently arcuate aedeagus of the holotype of *lupella* as shown in figure 1108. There are three minute rudiments of ectal spurs on the right valva.

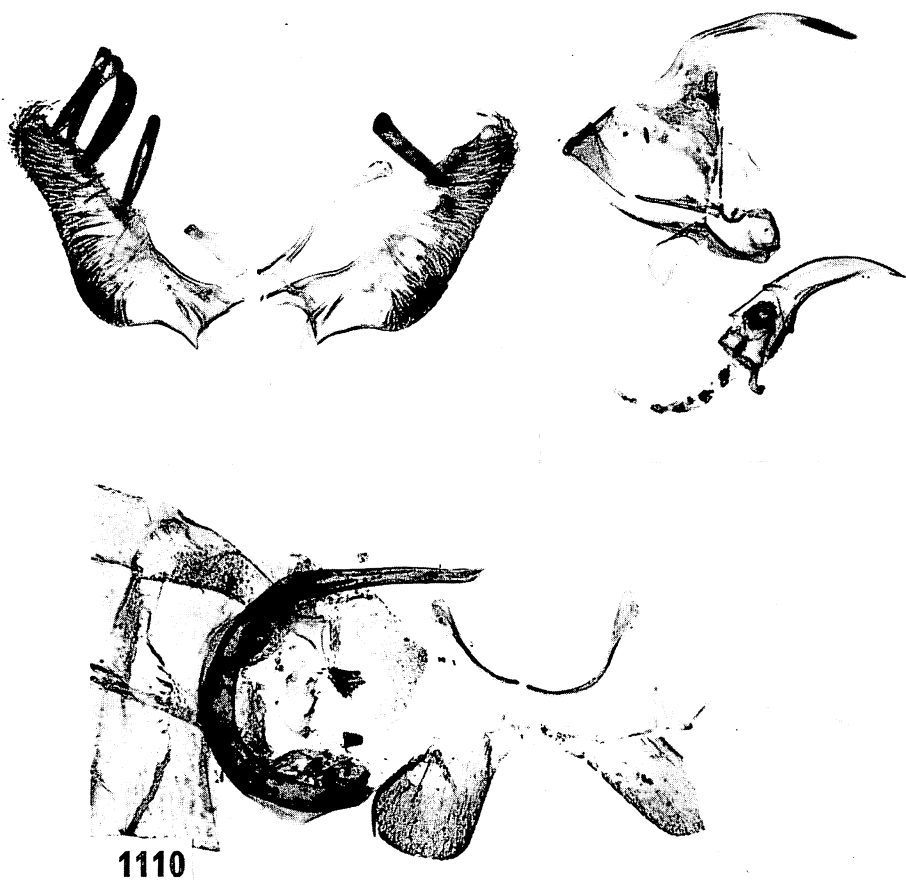


Figure 1110—Male genitalia of *Hyposmocoma* (*H.*) new species 8, formerly confused as a paratype of *lupella candidella* Walsingham (BM slide 7338); Kauai, 3,000 to 4,000 feet. The aedeagus and anellar lobes are conspicuously different from the holotype of *candidella*; see figure 1109.

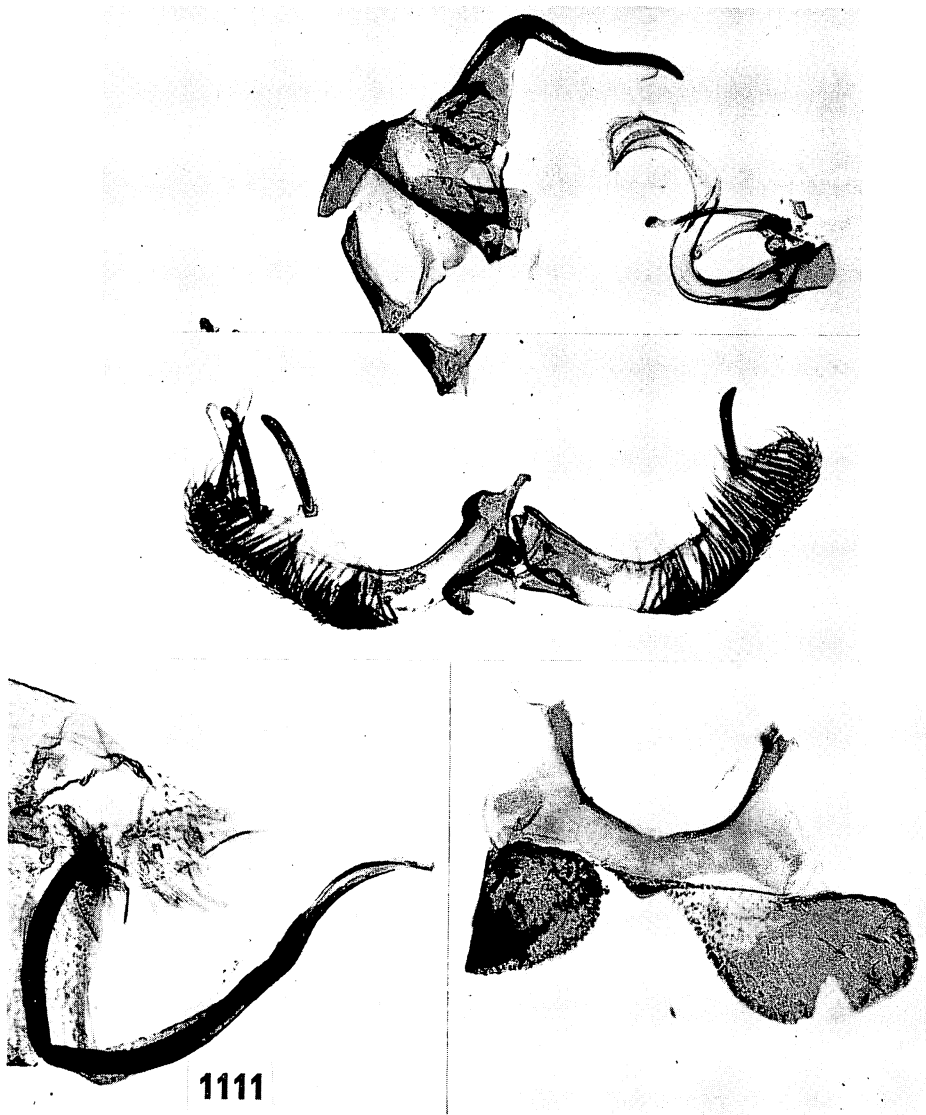


Figure 1111—Male genitalia of *Hypsoscopia* (*H.*) new species 9, formerly confused as a paratype of *lupella candidella* Walsingham (BM slide 7337); Molokai, over 3,000 feet. Note the extraordinary, sinuous aedeagus and the slender anellar lobes, and compare figures 1109, 1110. The photographs are not all to the same scale. The ectal spurs on the right valva are vestigial.



Figure 1112—Male genitalia of *Hyposmocoma* (*H.*) new species 10, formerly confused as a paratype of *lupella candidella* Walsingham (BM slide 7336); Lanai, 2,000 feet. The three ectal spurs on the right valva are vestigial. The middle figure at top shows the brachia. At top right is the aedeagus (somewhat less enlarged) with an adherent anellar lobe; note the unusual subapical, ventral, dentiform process. The pseuduncus, shown in dorsal aspect, is more greatly enlarged. Compare figures 1109, 1110, 1111.



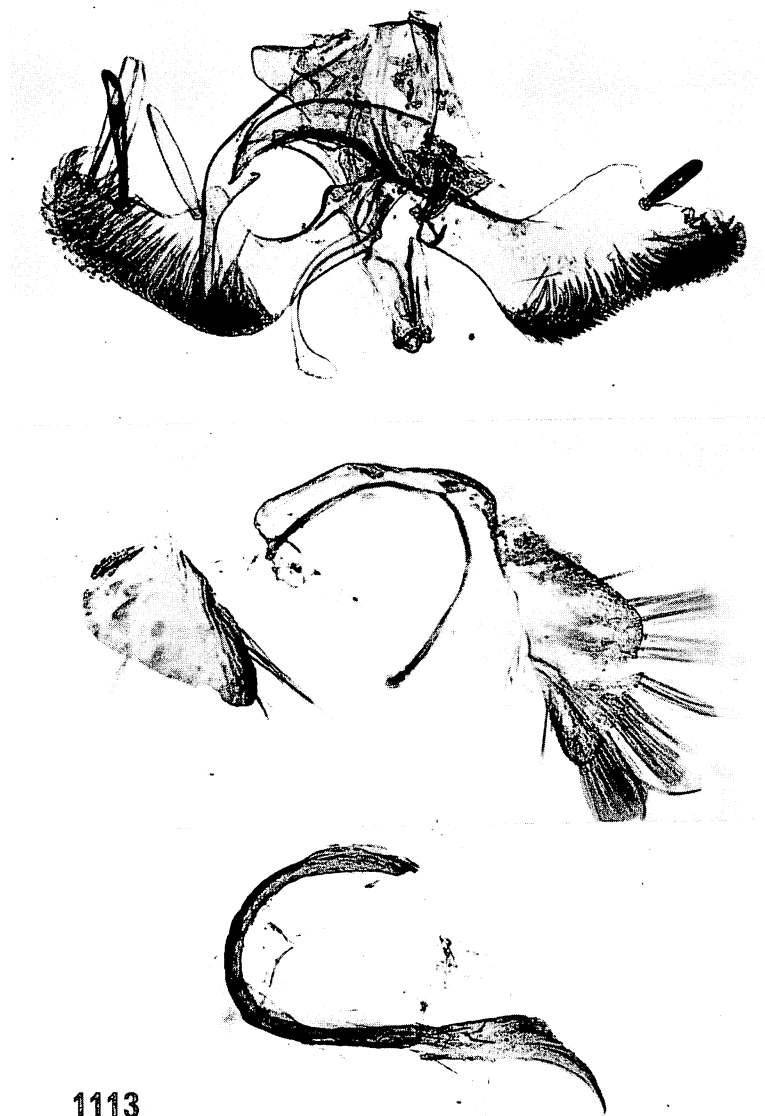
**1113**

Figure 1113—Male genitalia of *Hypsmocoma (H.) suffusella* (Walsingham), formerly considered a form of *lupella*, holotype (BM slide 6468); Molokai, over 3,000 feet. The ectal spurs on the right valva are rudimentary. Compare figure 1114.

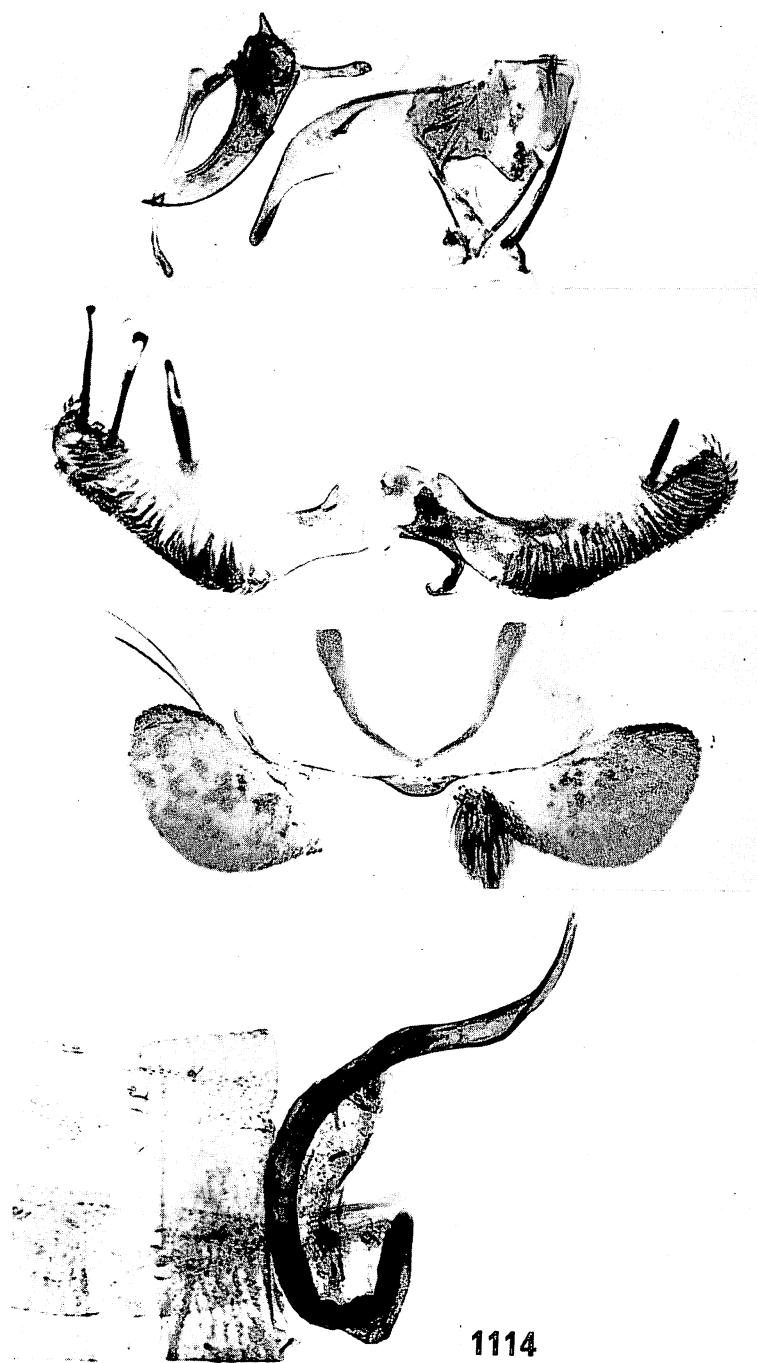


Figure 1114—Male genitalia of *Hypsocoma* (*H.*) *suffusella* (Walsingham), formerly considered a form of *lupella*, paratype (BM slide 7333); Haleakala, 5,000 feet, Maui. Compare figure 1113 of the genitalia of the holotype.

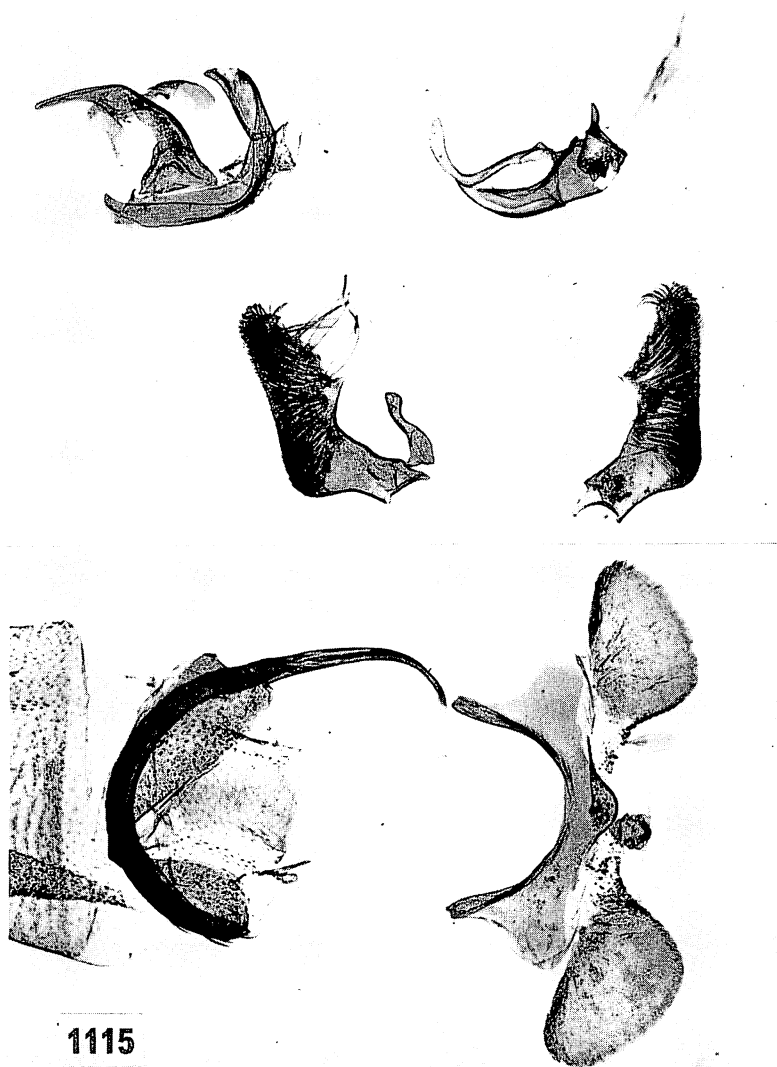


Figure 1115—Male genitalia of *Hypsmocoma* (*H.*) new species 30, formerly considered a paratype of *suffusella* Walsingham (BM slide 7335); Kaholuamano, 4,000 feet, Kauai. The left anellar lobe is at the base of the left valva, and the right lobe is attached to the aedeagus. Note the angles of the areas bearing the spurs on the valvae and compare figures 1113 and 1116.

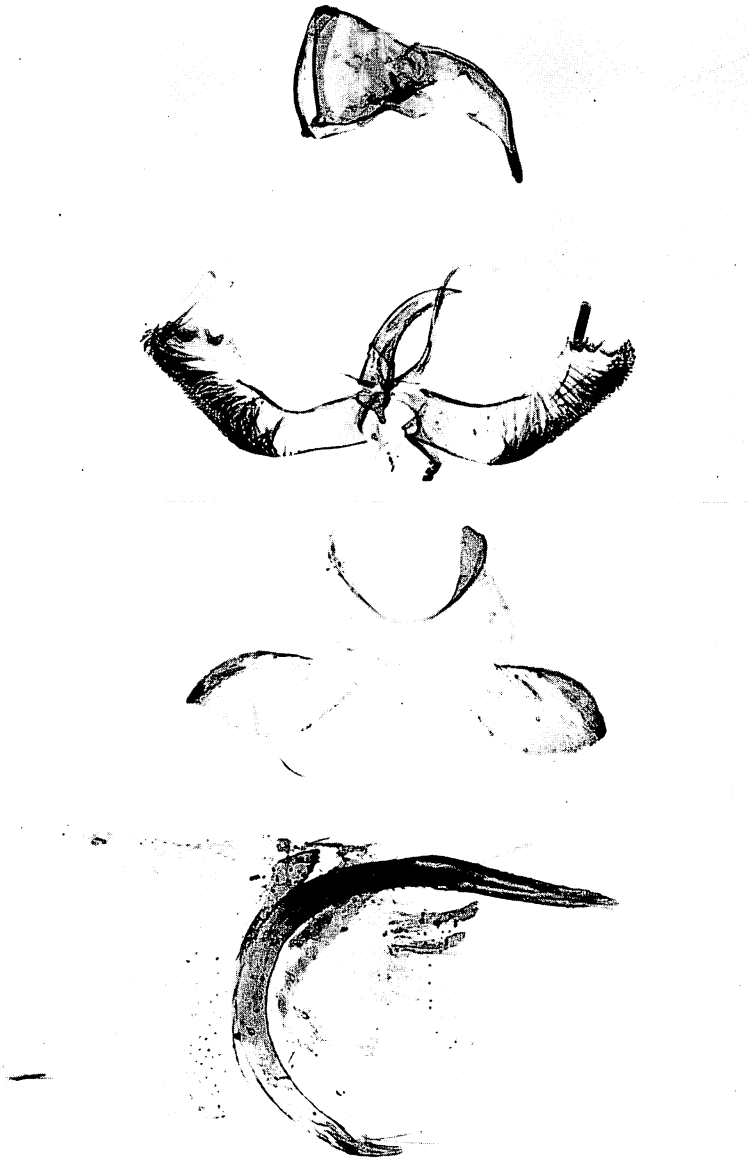
**1116**

Figure 1116—Male genitalia of *Hyposmocoma* (*H.*) new species 31, formerly confused as a paratype of *effusella* Walsingham (BM slide 7334); Waianae Mts., about 2,000 feet, Oahu. Note the placement of the purs at the apices of the valvae; compare figures 1113, 1115

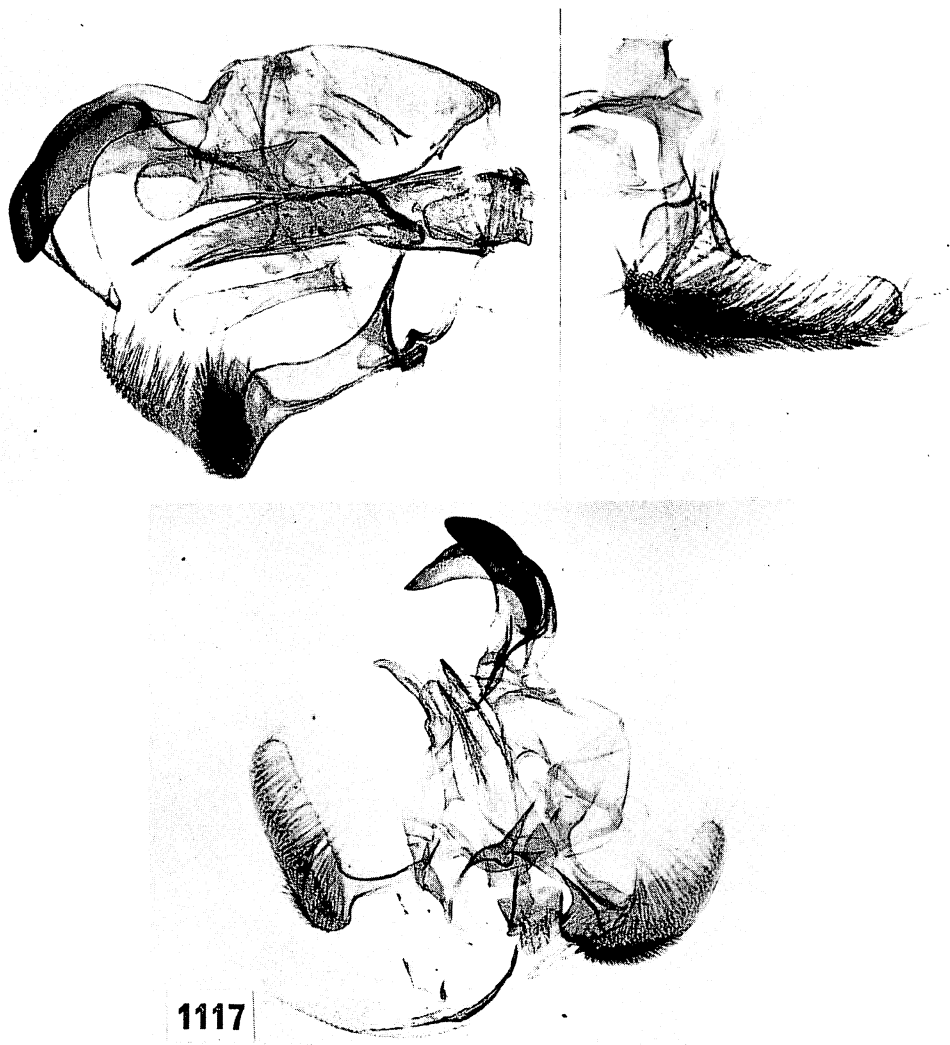


Figure 1117—Male genitalia of *Hypsoscoma* (*E.*) *maestella* Walsingham. Top, the holotype (BM slide 4341); Kaholuamano, 4,000 feet, Kauai. Bottom, the same from a paratype from Kauai (Busck slide 71; Walsingham specimen 27839). Compare *scandens*.

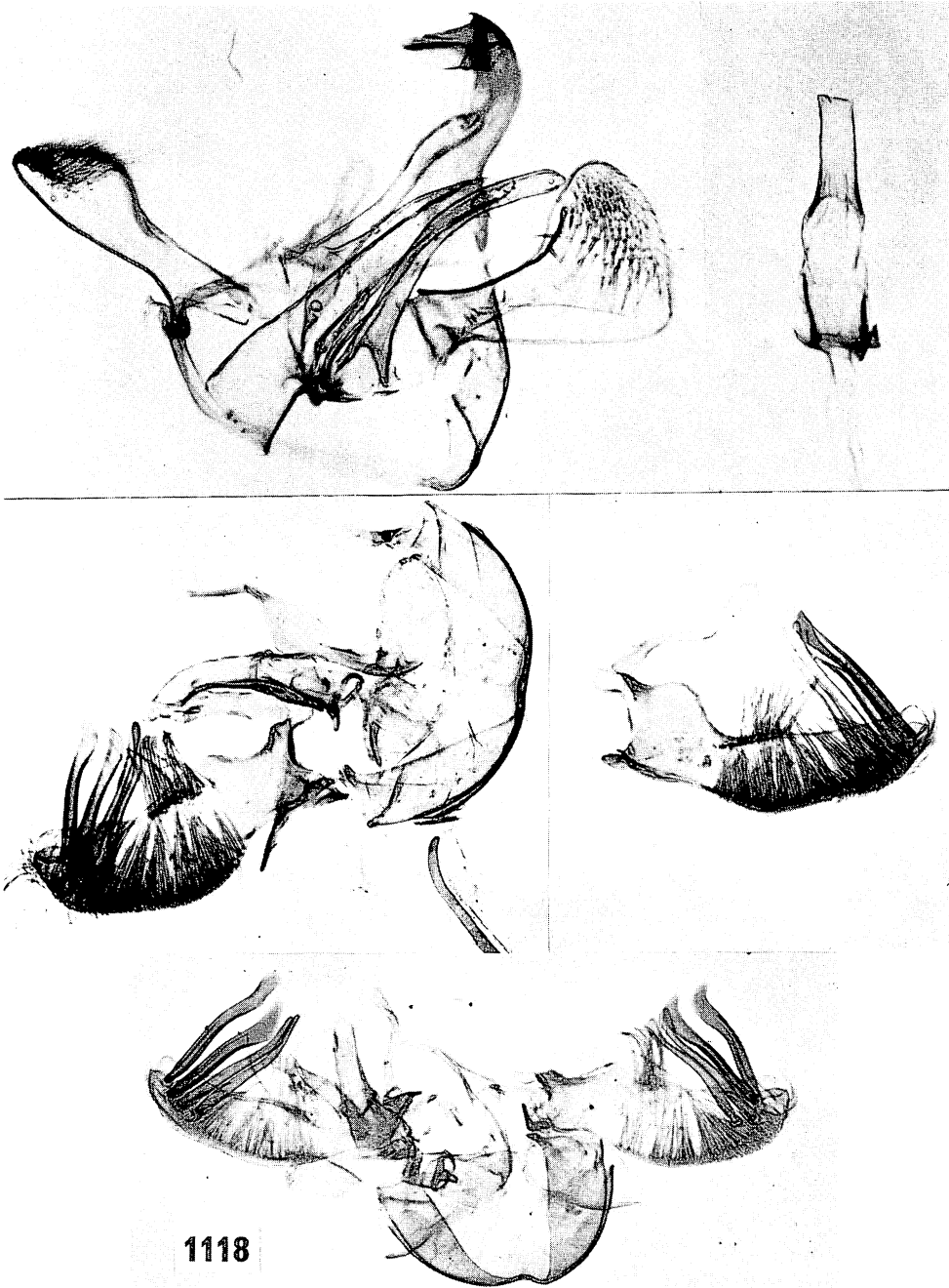


Figure 1118—Male genitalia of *Hypsmocoma*. Top, (*E.*) *malacopa* Meyrick, lectotype (BM slide 9568 Clarke); Koolau Mts., Oahu. The left valva is optically distorted. At right is the end of the ejaculatory duct (lining of the aedeagus). Compare the ("*Aphthonetus*") *empetra* group. Middle, (*H.*) *marginenotata* Walsingham, holotype (BM slide 4132); Kauai, 3,000 to 4,000 feet. Bottom, same, from a paratype (Busck slide 36; Walsingham specimen 27666); Kauai. There is no pseuduncus. Compare *vermiculata*.

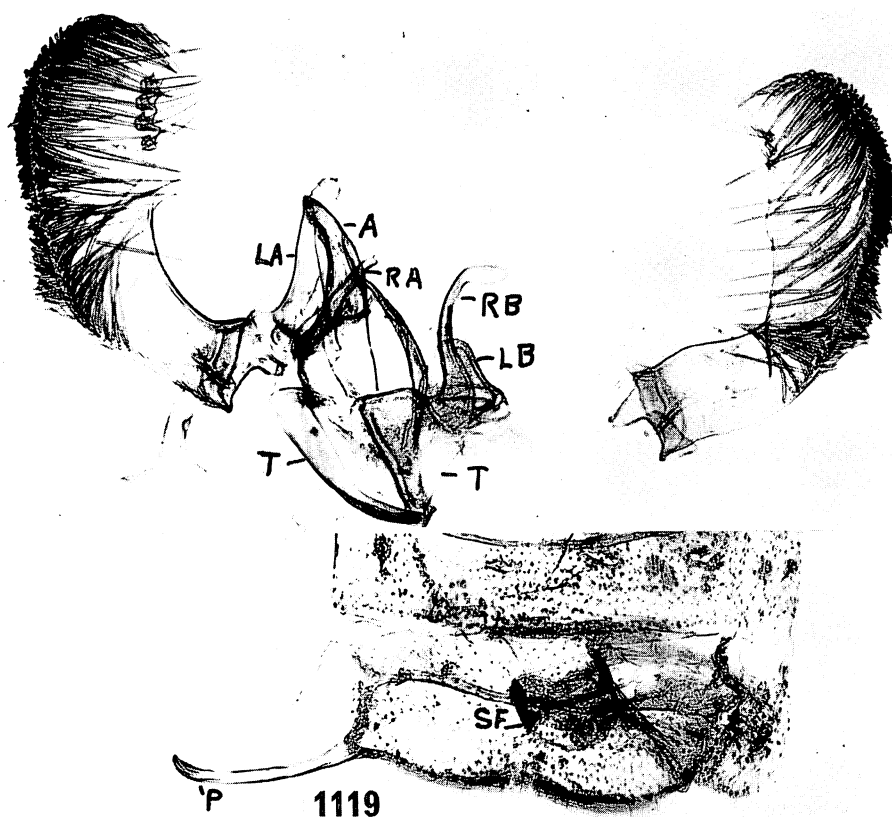


Figure 1119—Male genitalia of *Hypsmocoma* (*H.*) *malornata* Walsingham, holotype (BM slide 4358); Olinda, Maui. The end of the abdomen is viewed from beneath. The pseuduncus ("P") is viewed from the edge, and it is expanded at the apex when viewed from the broad side. The submedian sclerotized flange ("SF") is somewhat distorted here. See also figures 1120 to 1125. Compare the *corvina*, *partita*, and *similis* groups. See also *nividorSELLa*. A, aedeagus; LA, left anellar lobe; LB, left brachium; RA, right anellar lobe (apex broken off) RB, right brachium; T, tegumen.

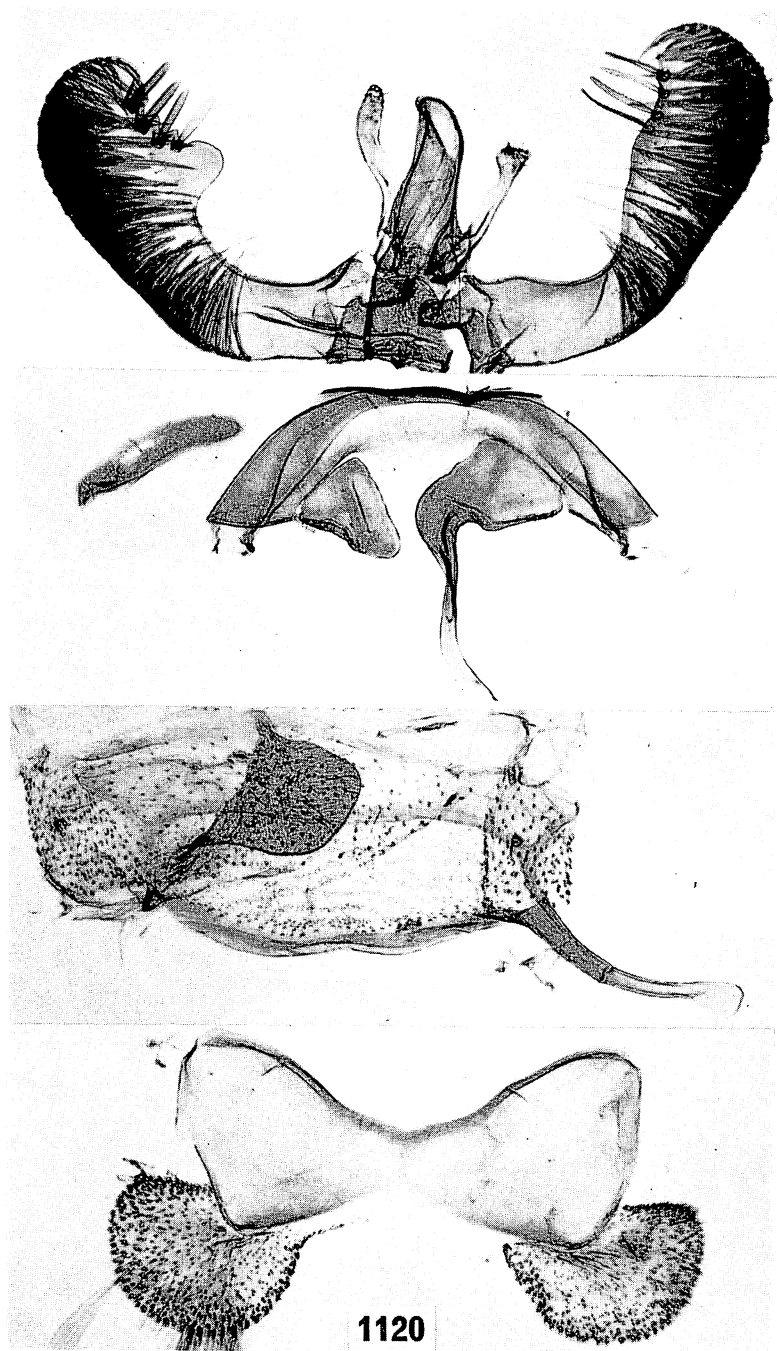


Figure 1120—Male genitalia of *Hypsoscyma* (*H.*) *malornata* Walsingham (slide Z-III-7-65-A); Nihoa Island; J. W. Beardsley, 1964. Compare figure 1119 of the holotype, and see figure 1125 for another specimen from Nihoa.



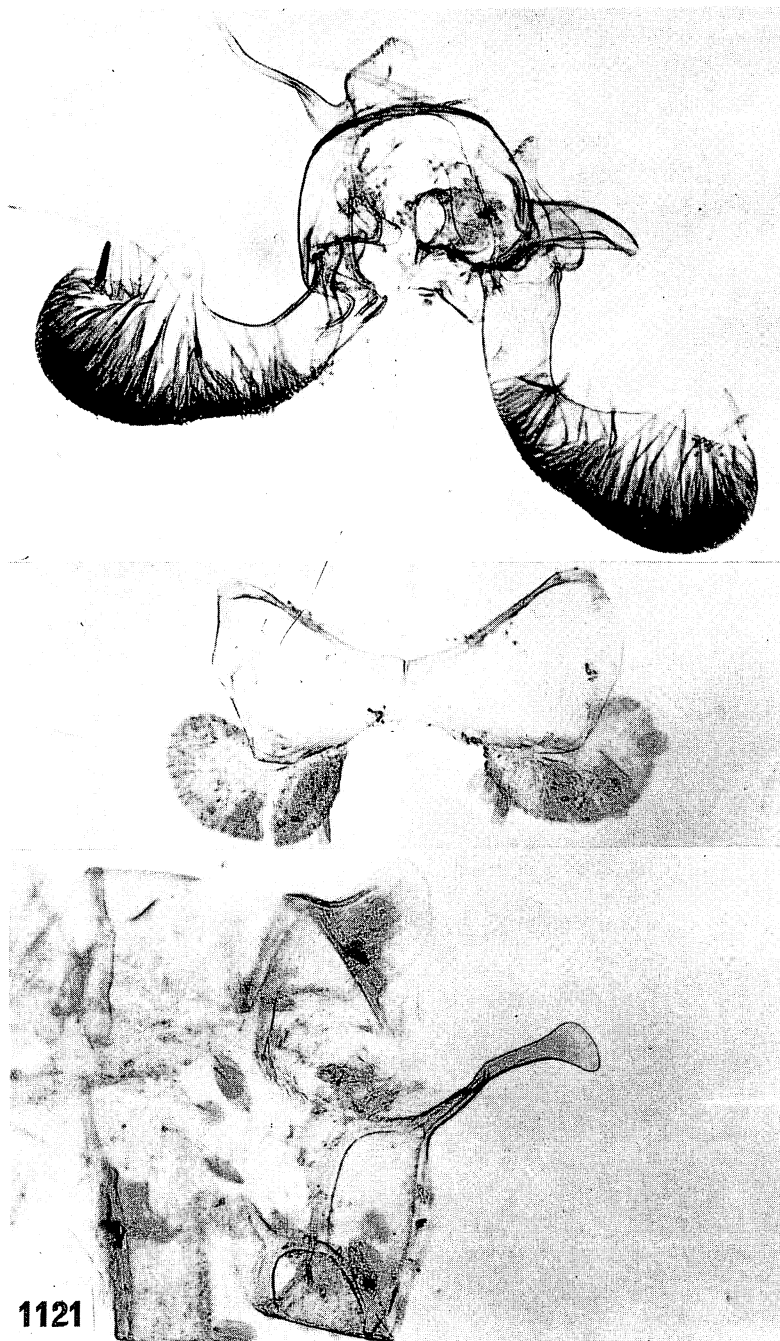


Figure 1121—Male genitalia of *Hypsoscoma (H.) malornata* Walsingham from a paratype from Molokai, above 3,000 feet (BM slide 7504). Compare figures 1119, 1120.



1122

Figure 1122—Male genitalia of *Hypsoscyma* (*H.*) *malornata* Walsingham, paratype (BM slide 7506); Olaa, Hawaii. There are only three spurs on the left valva instead of the usual four. The abdomen is partly decomposed, and the genital flaps are mostly torn away from the hulllike eighth sternum. *A*, aedeagus; *RA*, right anellar lobe; *RB*, right brachium.

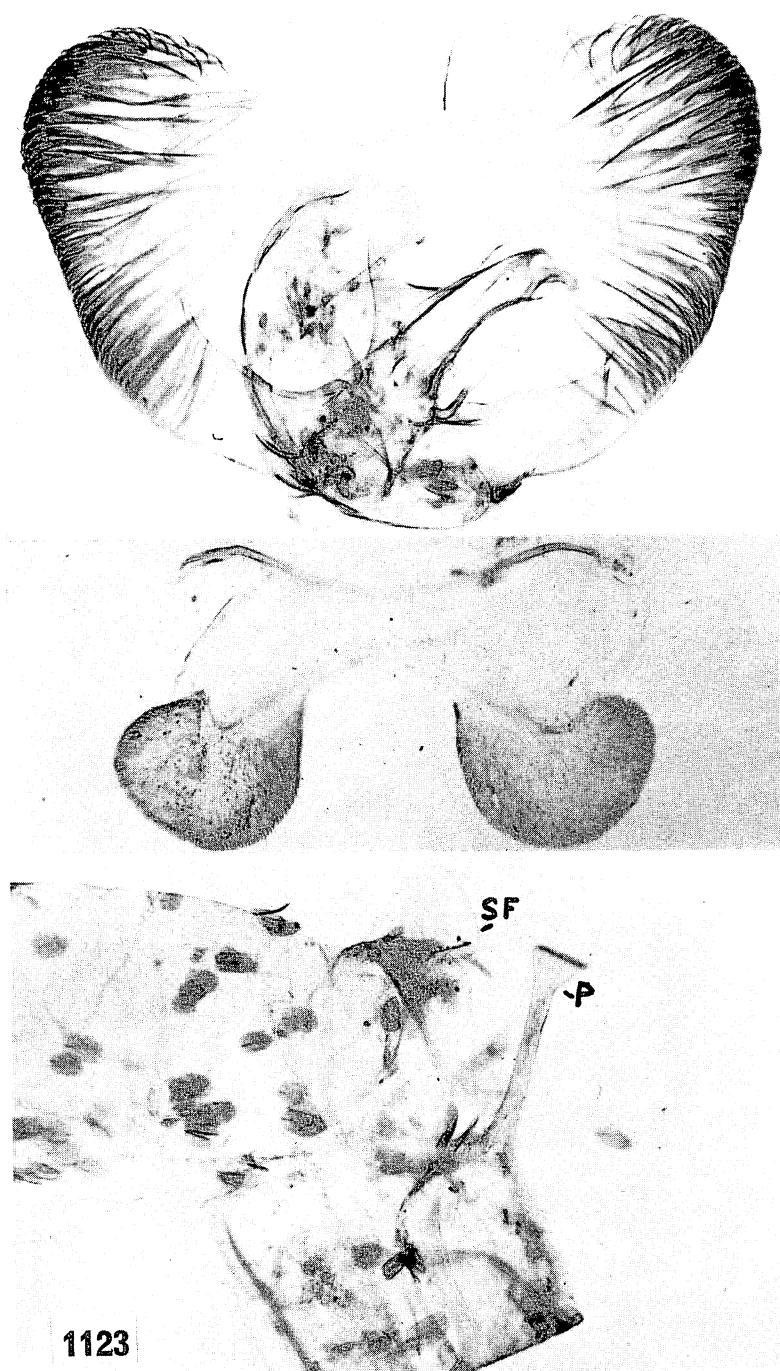


Figure 1123—Male genitalia of a *Hypsmocoma* (*H.*) species that is *malornata* Walsingham or is closely related to it and formerly confused as a paratype of *metrosiderella* Walsingham (BM slide 7508); Waianae Mts., Oahu. *SF*, sclerotized flange; *P*, pseuduncus. The wing venation of this specimen is shown in figure 845.



Figure 1124—Male genitalia of *Hypsoscoma* (*H.*) new species 22, formerly confused as a "homotype" of *malornata* by Walsingham; Kauai, 3,000 to 4,000 feet (BM slide 7503).

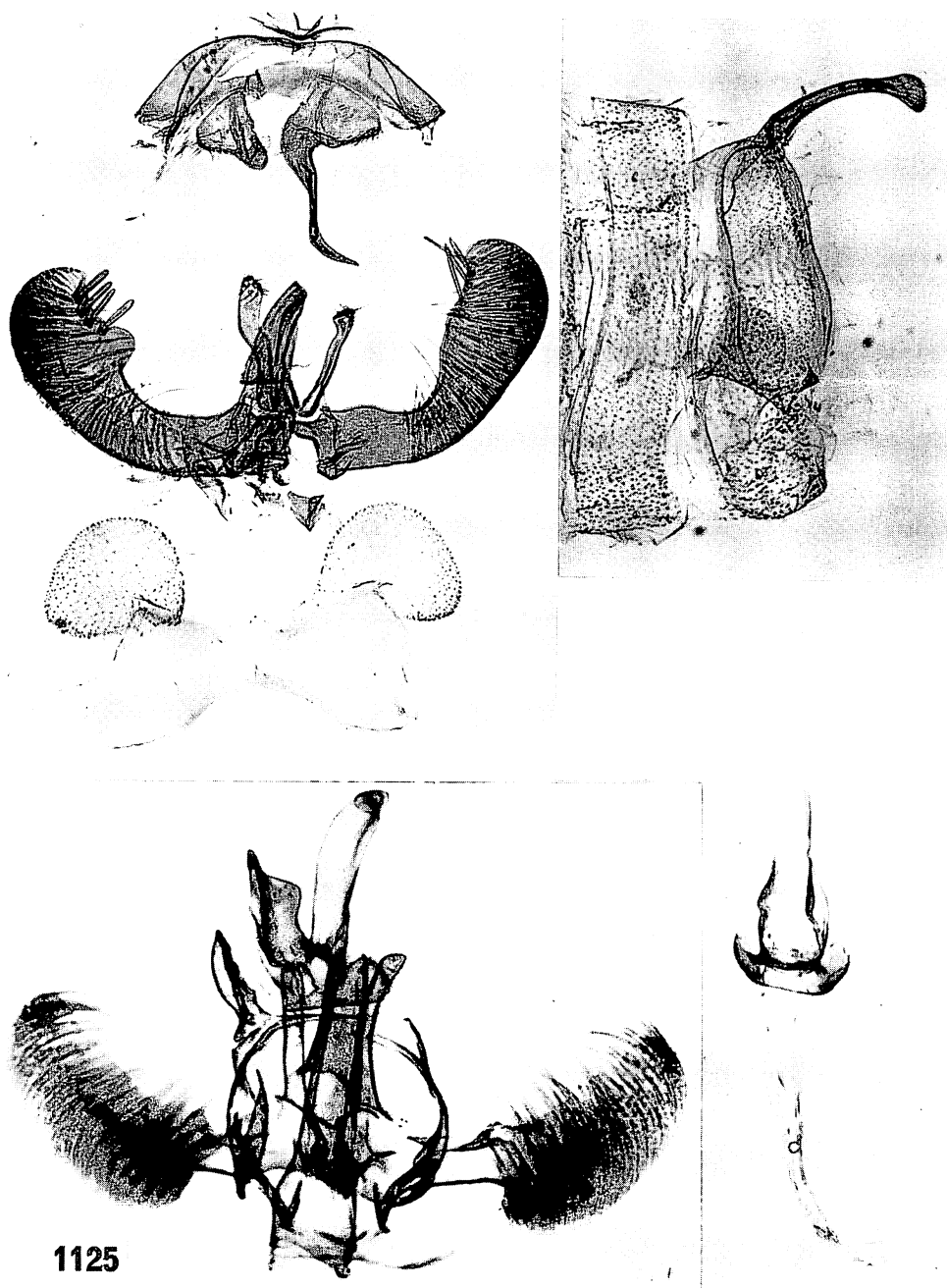


Figure 1125—Male genitalia of *Hyposmocoma*. Top, (*H. malornata* Walsingham from a specimen collected by E. H. Bryan, Jr. on Nihoa Island, 1923 (slide Z-I-24-61-1). Compare figures 1119 to 1123. Bottom, (*E. mystodoxa* Meyrick, lectotype (BM slide 9557 Clarke); Koolau Mts., near Honolulu At right is the apical part of the ejaculatory duct pulled out of the aedeagus.

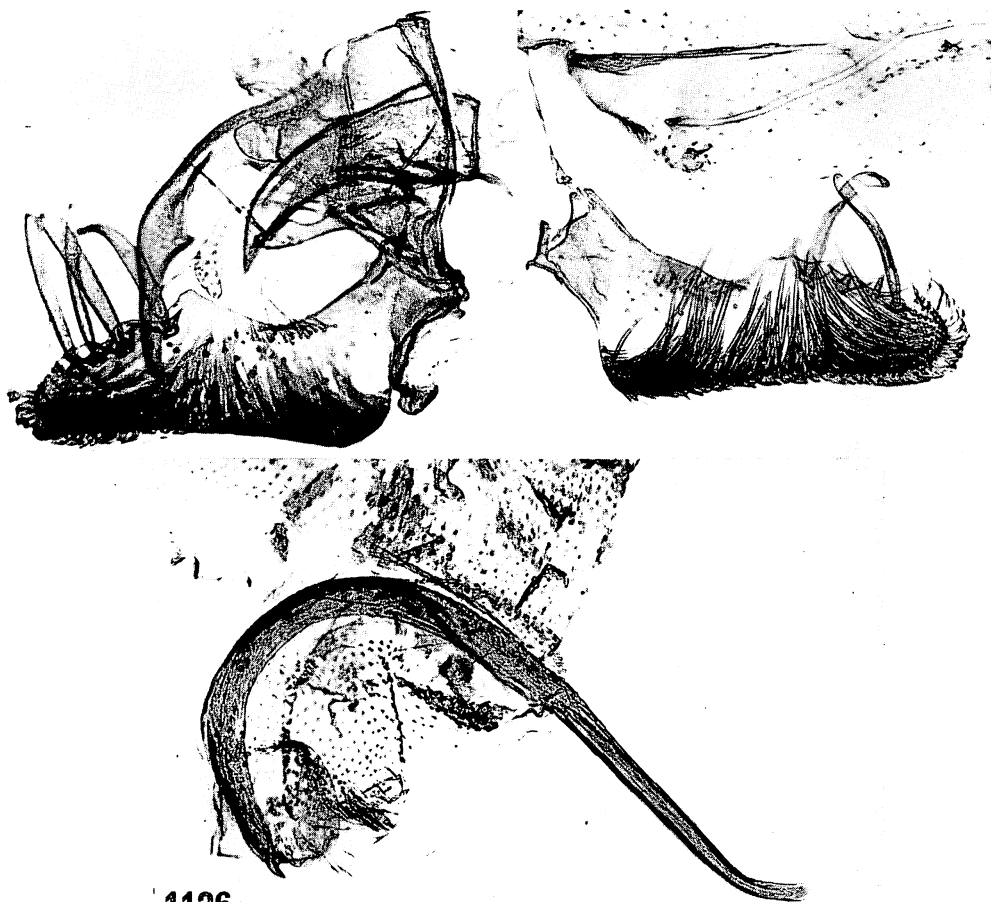


Figure 1126—Male genitalia of *Hypsoscoma* (*H.*) *mediella* Walsingham, allotype (BM slide 4098); Waianae Mts., Oahu. Note the two rudimentary spurs on the right valva.

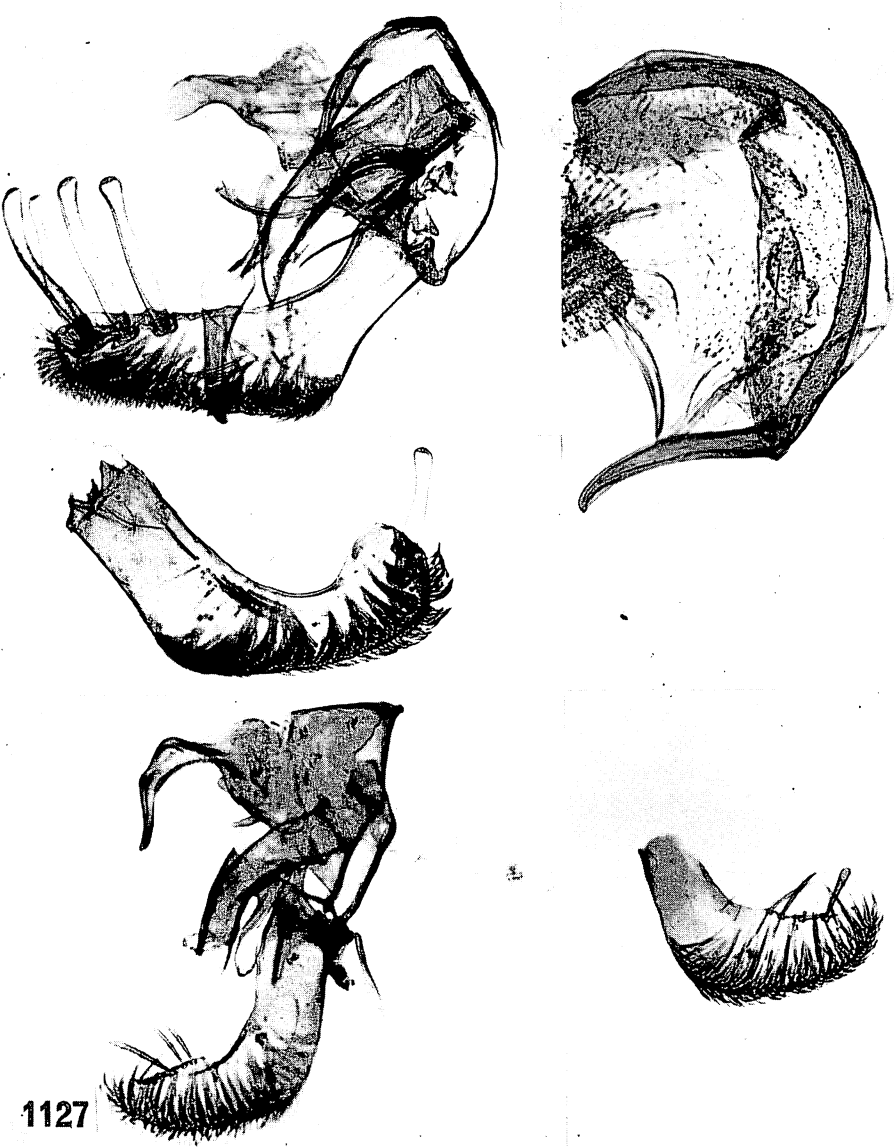


Figure 1127—Male genitalia of *Hypsoscymoma*. Top three figures, (*H.*) *mediospurcata* Walsingham, holotype (BM slide 4102); Kilauea, Hawaii. Bottom, (*H.*) *metallica* Walsingham, holotype (BM slide 4116); Kona, about 5,000 feet, Hawaii.



Figure 1128—Male genitalia of *Hypsoscoma* (*H.*) *mesorectis* Meyrick, holotype (BM slide 9569 Clarke; remounted); Koolau Mts., near Honolulu. At top right is the apical part of the ejaculatory duct withdrawn from the aedeagus.



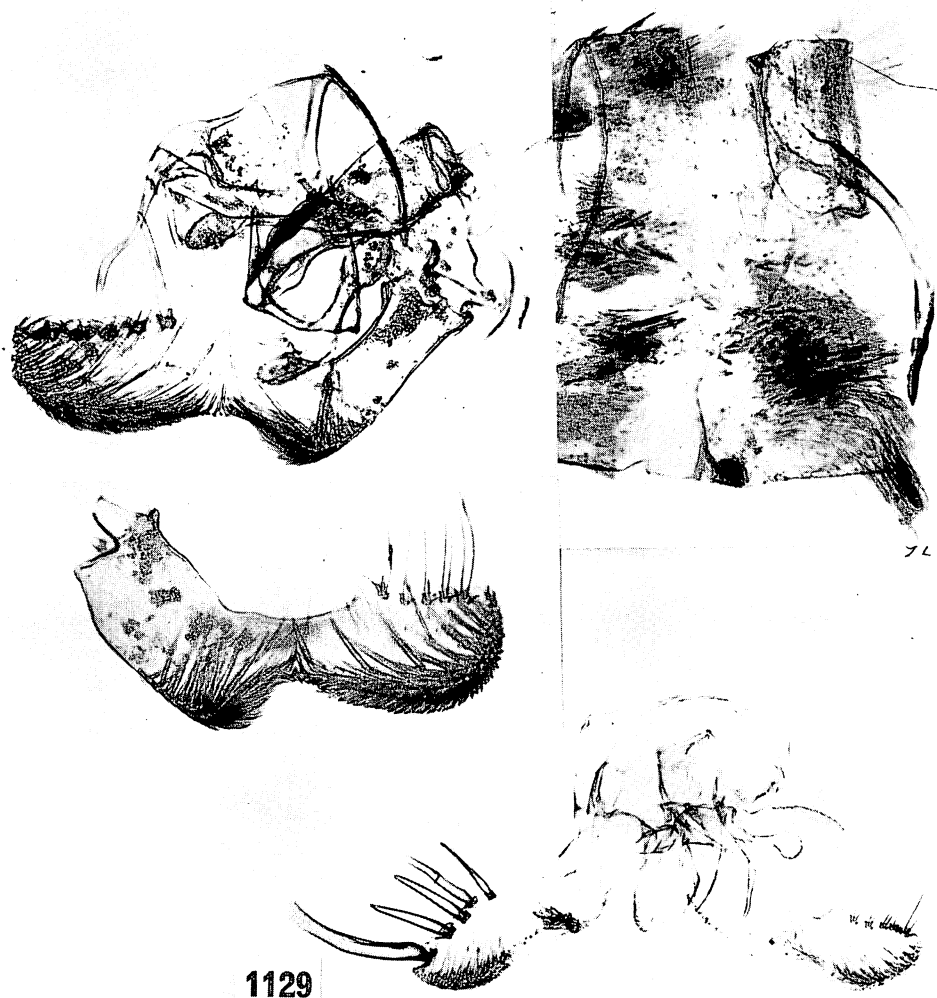
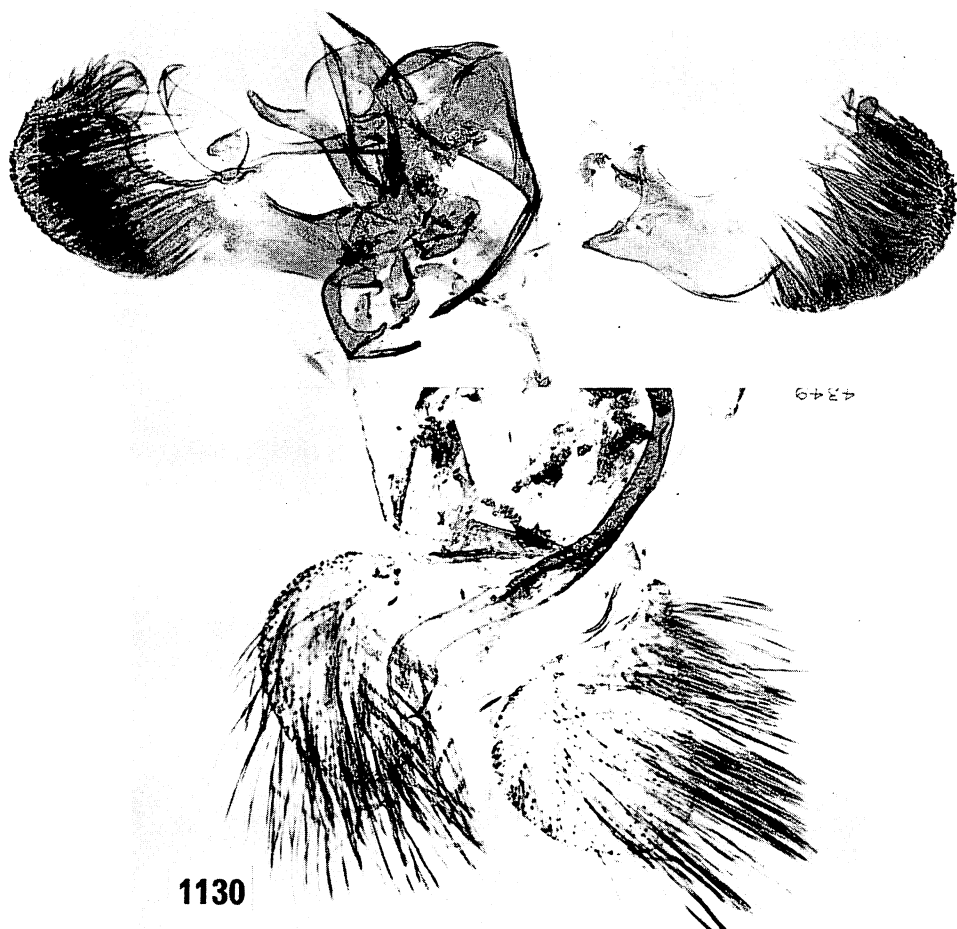


Figure 1129—Male genitalia of *Hypsmocoma* (*H.*) *metrosiderella* Walsingham. Top and middle, holotype (BM slide 4354); Halemanu and Kaholuamano, 4,000 feet, Kauai. Four spurs have been lost from the left valva. The broad apex of the left anellar lobe overlaps the costal margin of the left valva. Bottom, from a Kauai paratype (Busck slide 76; Walsingham specimen 27975); somewhat distorted. Compare *montivolans* and *nebulifera*.

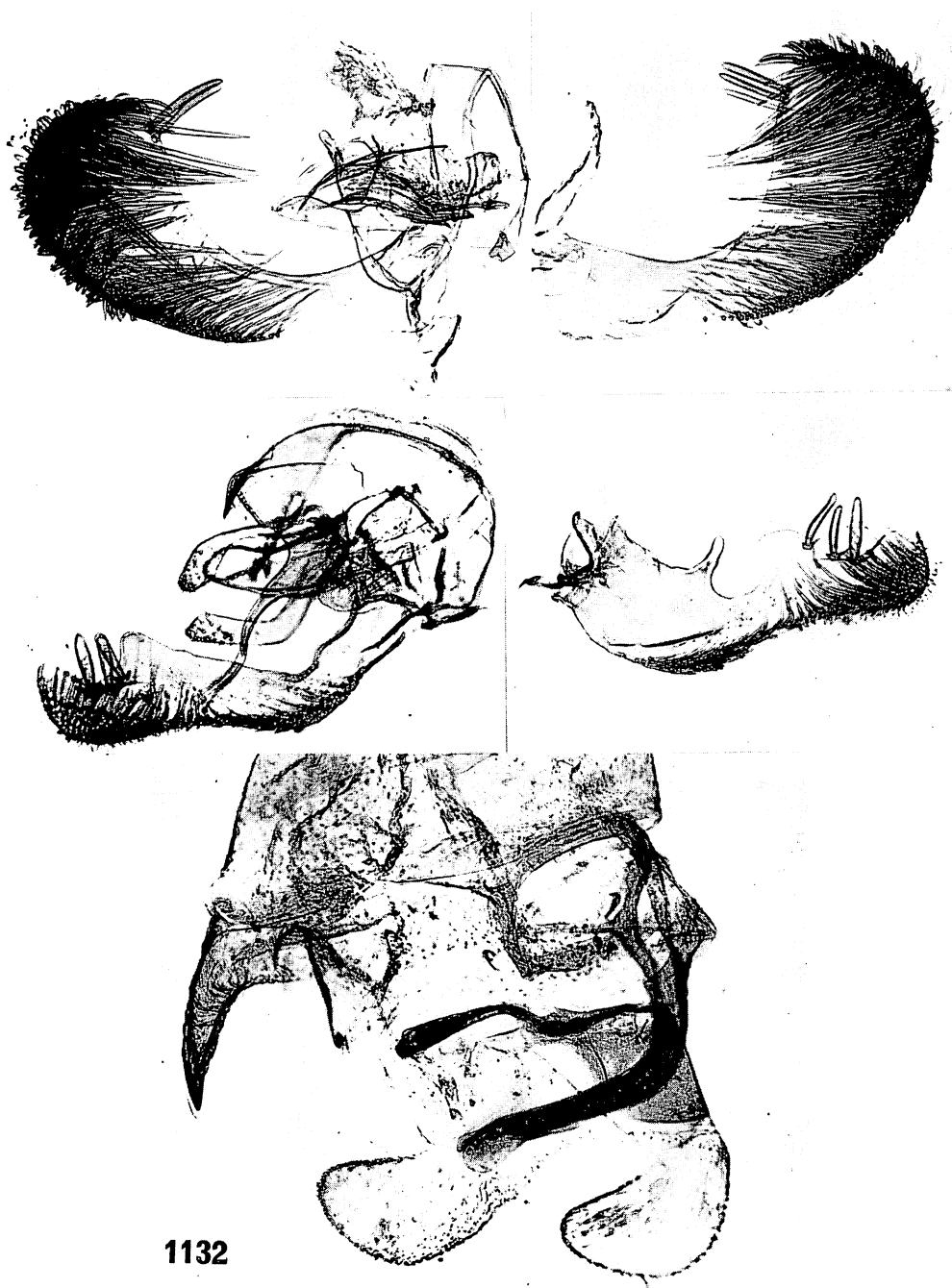


1130

Figure 1130—Male genitalia of *Hyposmocoma* (*H.*) *mimema* Walsingham, holotype (BM slide 4349); Haleakala, below 4,000 to 5,000 feet, Maui. Compare *numida*, *pseudolita*, ("Petrochra") *swezeyi*, *triptila*, and new species 23 (figure 809) from Nihoa, which also have a greatly enlarged and modified spur arising from a process near the middle of the costal margin of the left valva.



Figure 1131—Male genitalia of *Hypsmocoma* (*H.*) new species 23 from Nihoa Island; J. W. Beardsley, 1965 (slide Z-III-9-65). This is a small species (forewing about 3.4 mm. long) belonging to the *mimema* group. See the text for discussion.



1132

Figure 1132—Male genitalia of *Hypsmocoma*. Top, (*H.*) *mimica* Walsingham, holotype (BM slide 4479); Molokai, above 3,000 feet. Compare the *illuminata*, *indicella*, *lixiviella* group. Middle and bottom, (*H.*) *modesta* Walsingham, holotype (BM slide 4330); Kauai, 3,000 to 4,000 feet. Note the unusual right valva and the strong process at the left of the pseuduncus-bearing seventh abdominal segment. The eighth sternite with its genital flaps is attached.

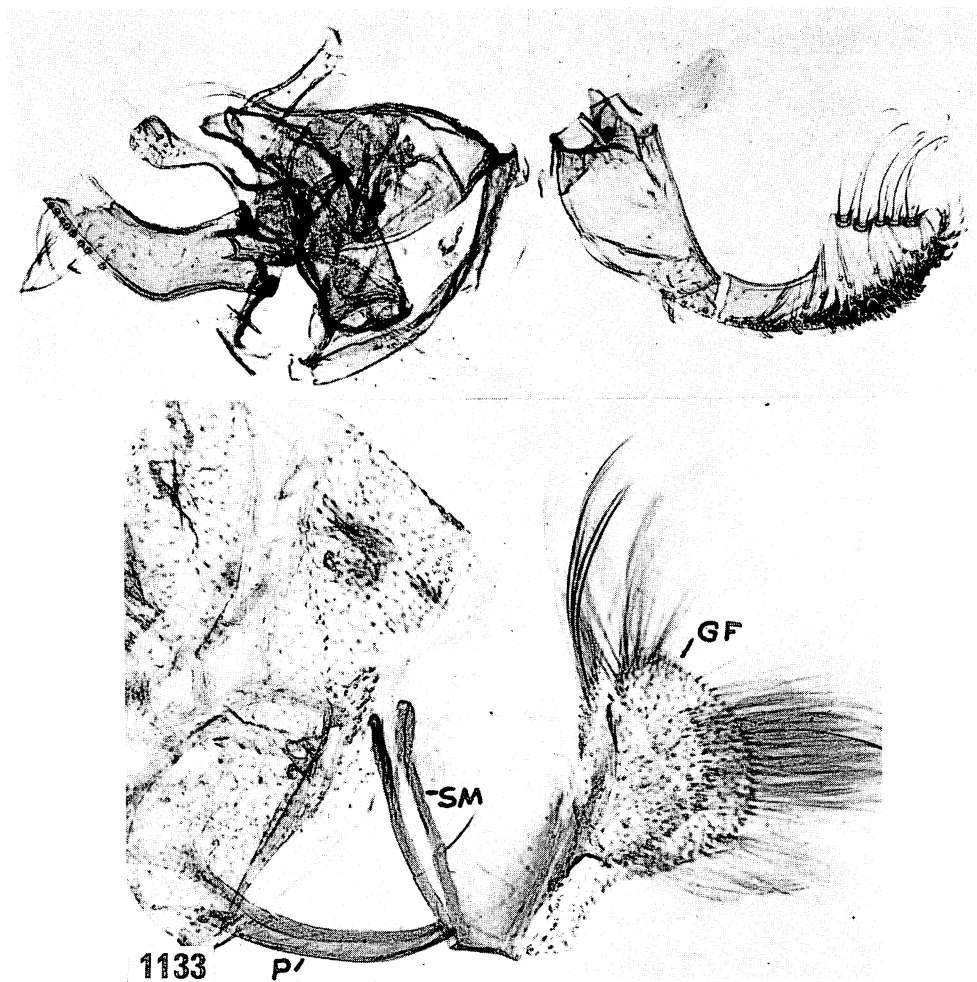


Figure 1133—Male genitalia of *Hypsmocoma* (*H.*) *montivolans* (Butler), holotype (BM slide 4476); mountains near Honolulu. The genitalia are damaged, and the distal part of the left valva has been lost. *GF*, genital flap; *P*, pseuduncus; *SM*, sclerotized margin of eighth sternite. Compare *alliterata*, *metrosiderella*, *nebulifera*, and similar species.

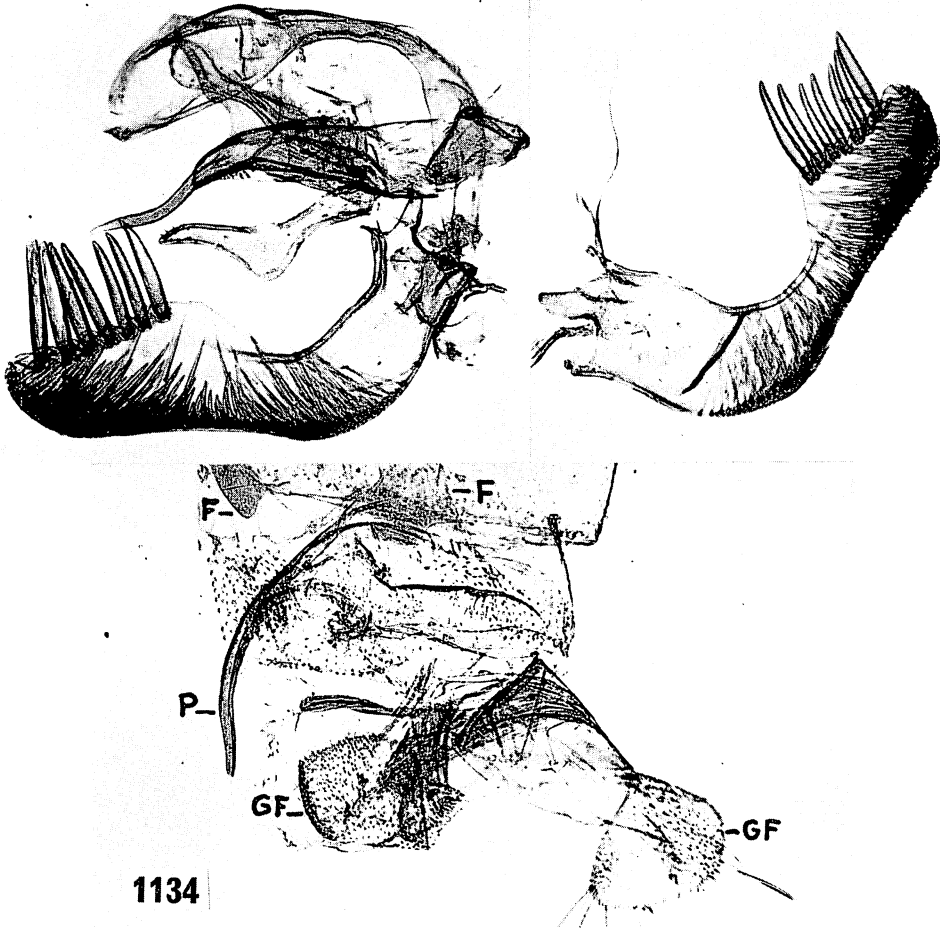


Figure 1134—Male genitalia of *Hyposmocoma* (*H.*) *nebulifera* Walsingham, holotype (BM slide 4091); mountains near Honolulu, 2,000 feet, Oahu. *F*, sclerotized flanges on sixth abdominal segment; *GF*, genital flaps; *P*, pseuduncus. Compare *metrosiderella* and *montivolans*.

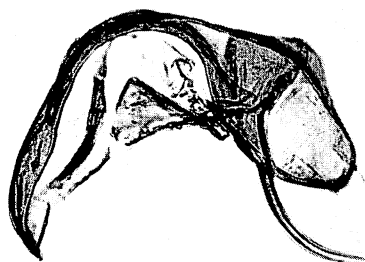
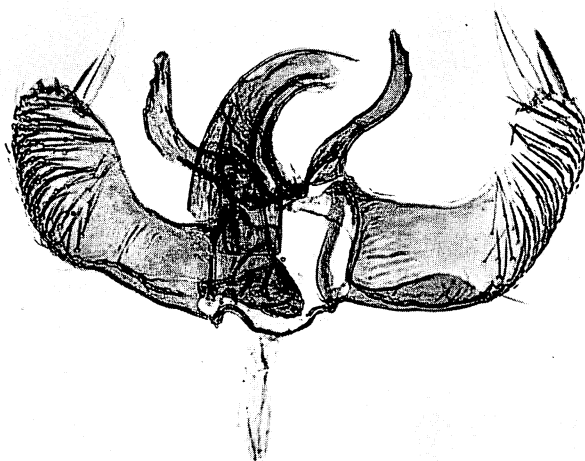
**1135**

Figure 1135—Male genitalia of *Hyposmocoma* (*H.*) *neckerensis* (Swezey) ("*Petrochroa*"), paratype (Bishop Museum slide, no number, remounted by E. C. Z.); Gardner Island. Compare *elegantula* in figure 1070.



Figure 1136—Male genitalia of *Hyposmocoma* (*H.*) *nephelodes* Walsingham, paratype (BM slide 7346); Olinda, 4,000 feet, Maui. The bottom photograph is mounted upside down; it was taken from the right side. The small sclerotization ("S") that seems to be at the base of the pseuduncus ("P") is on the opposite (left) side of the abdomen, as can be seen in figure 1137 of the holotype. Compare *arenella*, *carnea*, and *rubescens*.



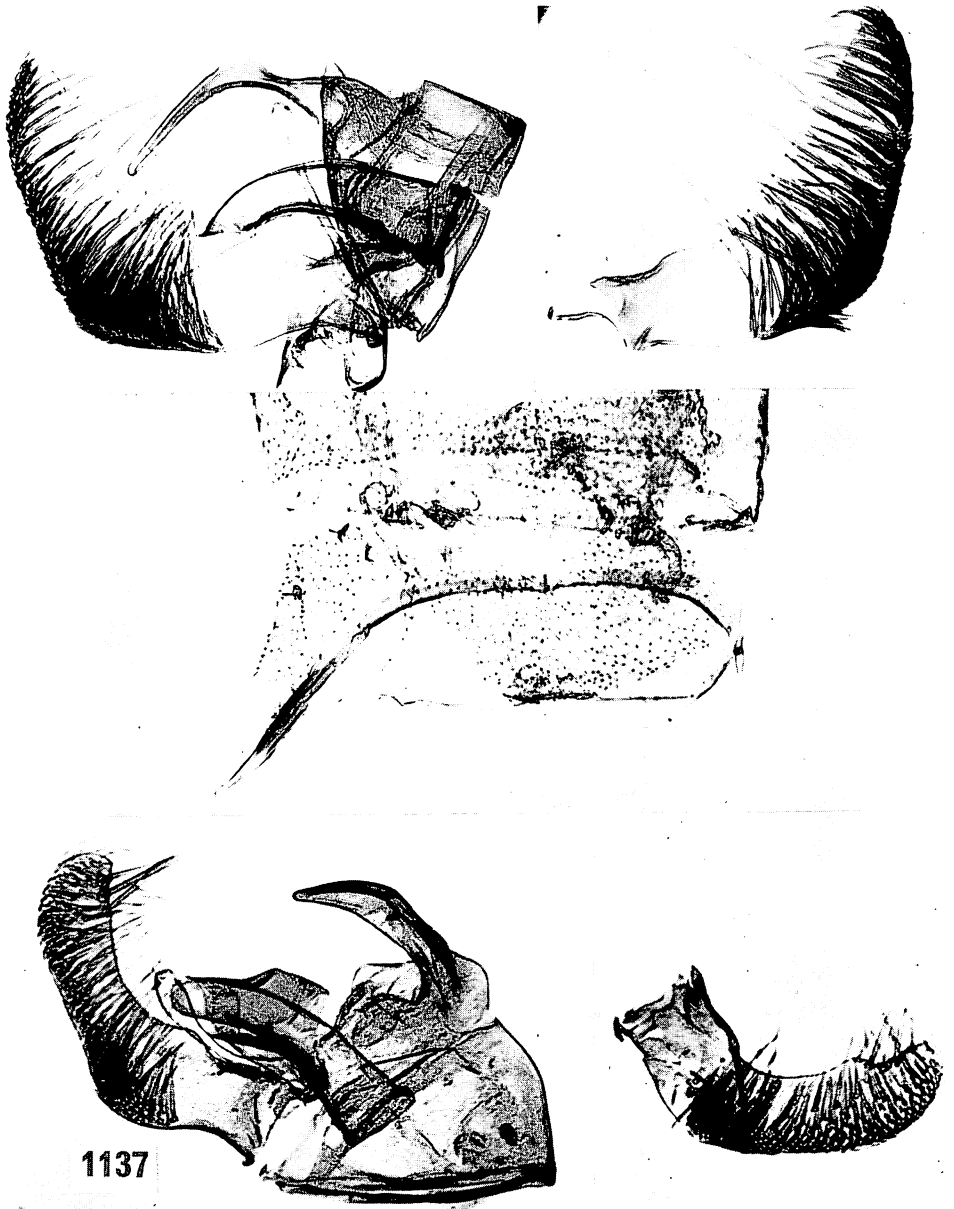


Figure 1137—Male genitalia of *Hypsomocoma*. Top and middle, (*H.*) *nephelodes* Walsingham, allotype (BM slide 4487); Waianae Mts., 3,000 feet, Oahu. The costae of the valvae bear small scars which indicate the basal sockets of aborted spurs. The pseuduncus is shown in ventral aspect. See figure 1136 of a paratype. Compare *arenella*, *carnea*, and *rubescens*. Bottom, (*H.*) *niger* Walsingham, holotype (BM slide 4128); Molokai, about 4,000 feet. This species lacks a pseuduncus.

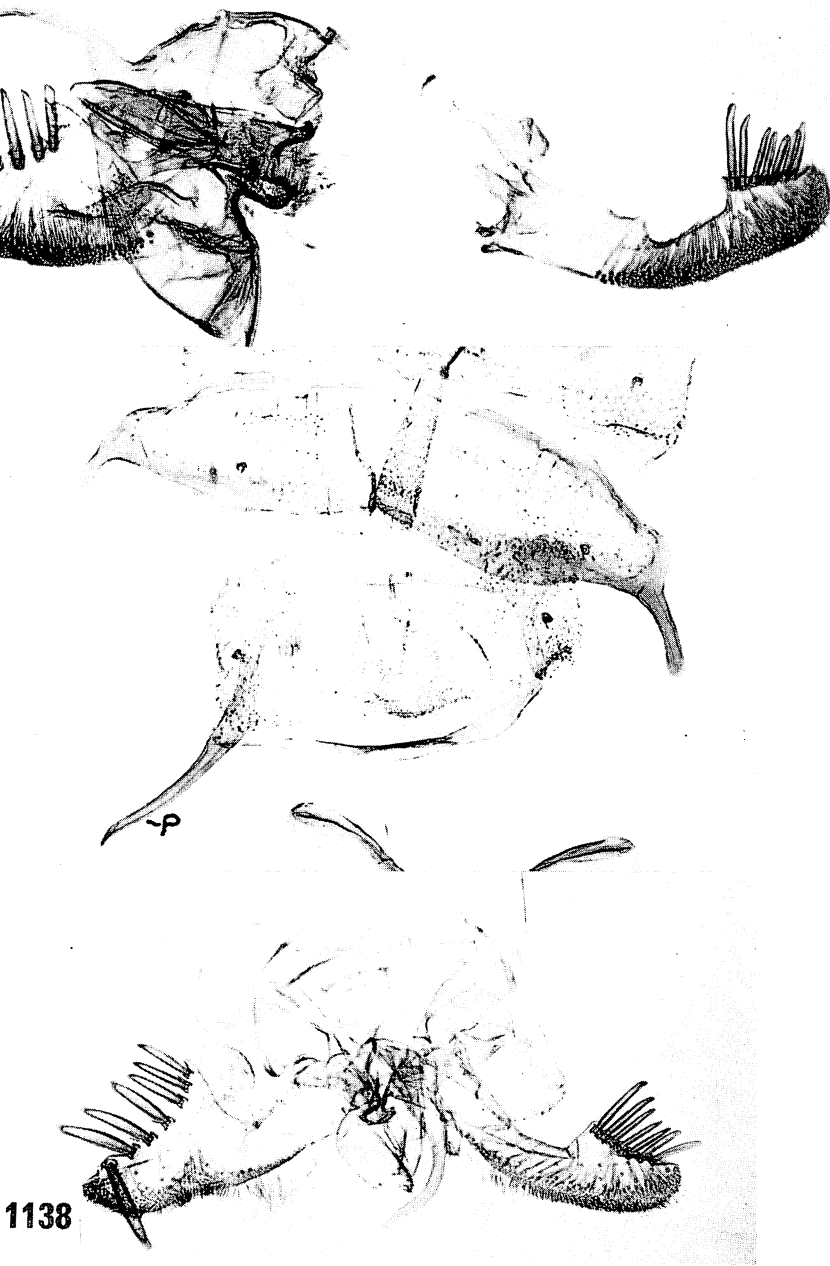
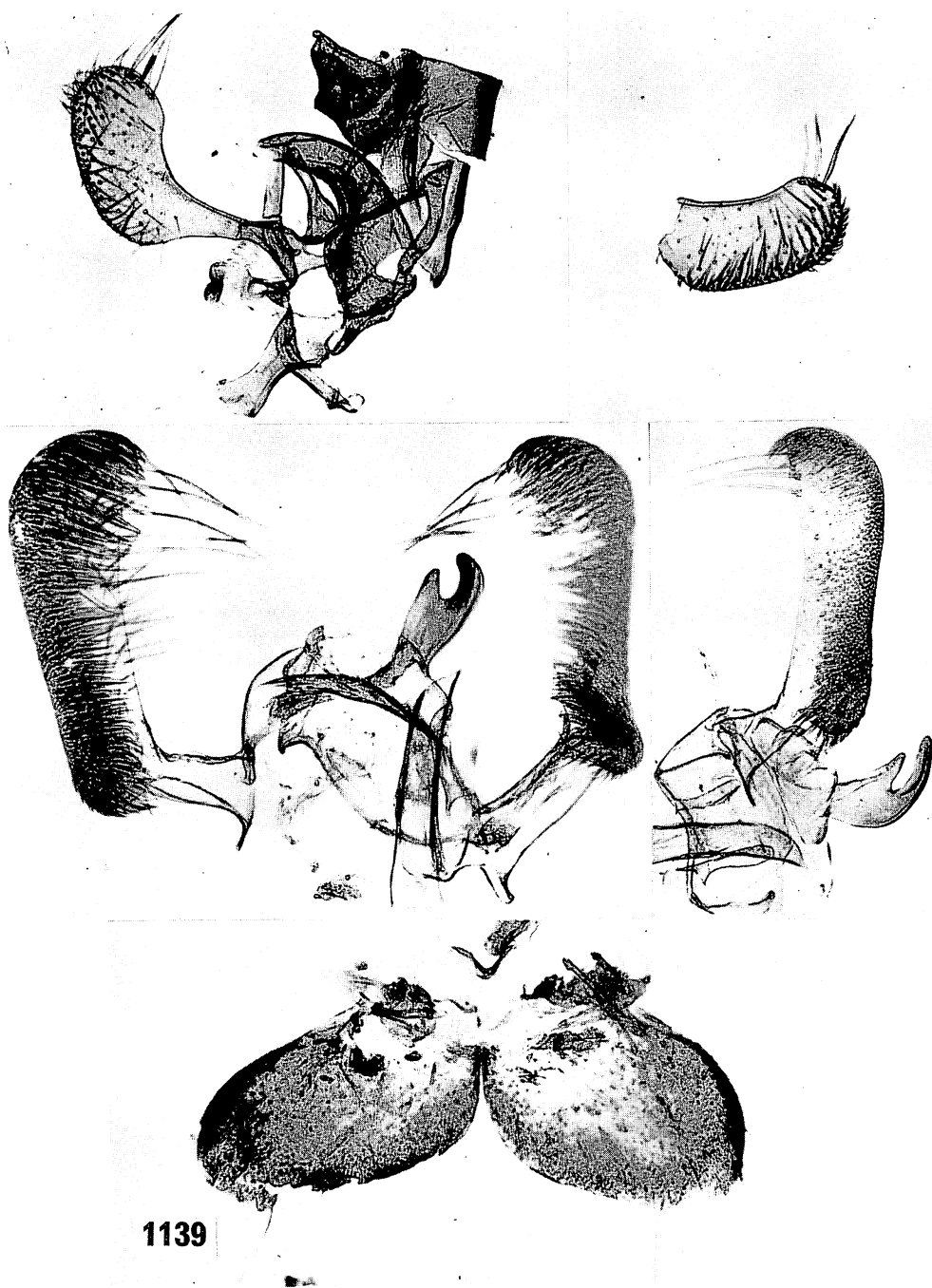
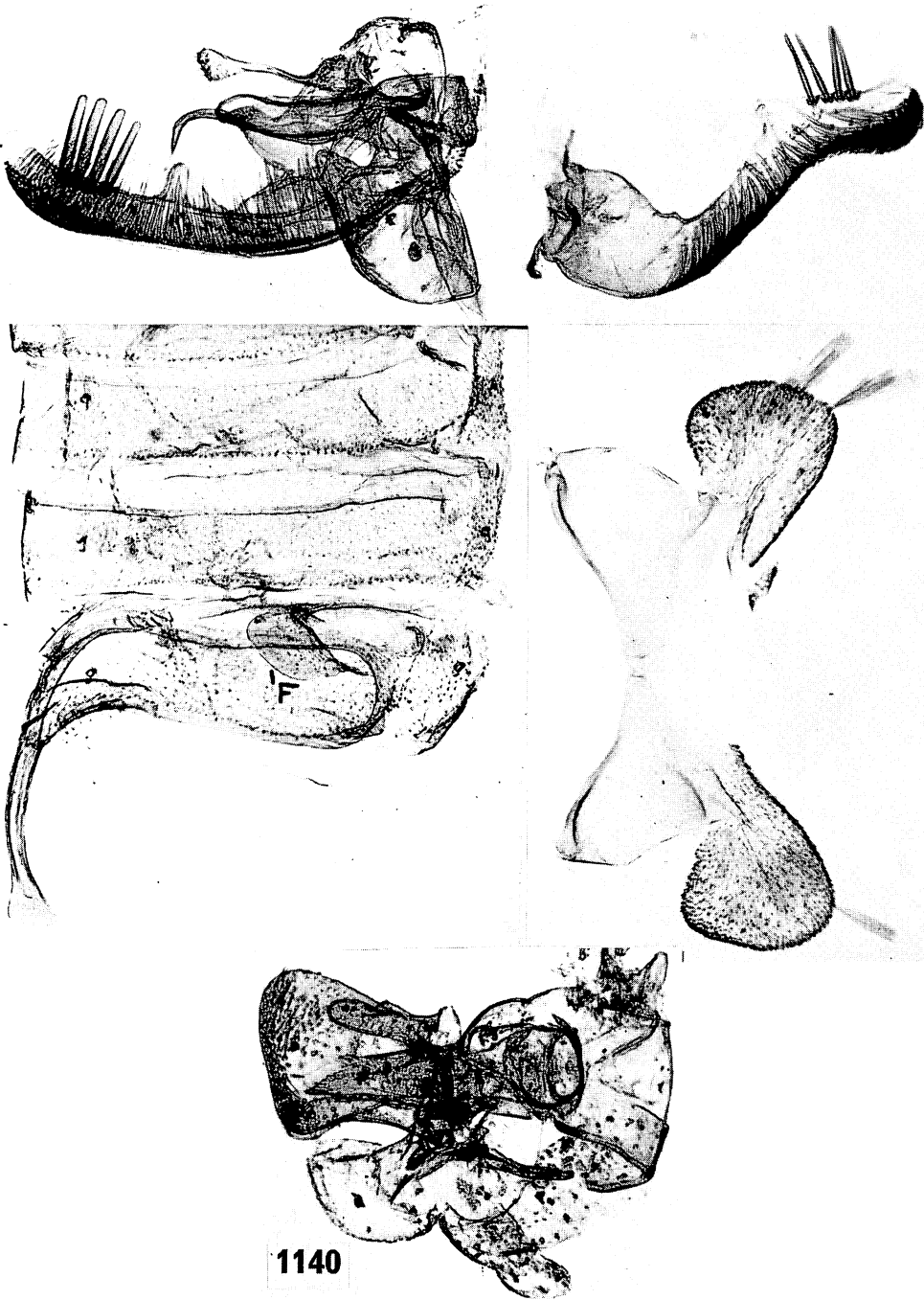


Figure 1138—Male genitalia of *Hyposmocoma* (*H.*) *nigralbida* Walsingham. Top and middle, holotype (BM slide 4081); Kauai, 3,000 to 4,000 feet. Compare the *iodes* and *literata* groups. Some specimens have only six spurs on the valvae. The middle figure is a ventral view of abdominal segments six and seven to show the extraordinary sclerotized processes; "P" is the pseuduncus. Bottom, a paratype from Kauai (Busck slide 41; Walsingham specimen 26810).



1139

Figure 1139—Male genitalia of *Hypsoscyma*. Top, (*H.*) *nigrescens* Walsingham, holotype (BM slide 4126); Kilauea, Hawaii. Compare *canella* and allies. Middle left and bottom, (*E.*) *niveiceps* Walsingham, paratype (BM slide 7510); Molokai, above 3,000 feet. Middle right, from the holotype of *niveiceps* (BM slide 4130); Lanai, 3,000 feet. Compare *adolescens*, *pucciniella*, *punctifumella*, and allies.



1140

Figure 1140—Male genitalia of *Hypsoscyma*. Top and middle, (*H. nividorsella* Walsingham, holotype (BM slide 4082); Kauai, 3,000 to 4,000 feet. The abdominal segments are seen in ventral view. Note the sclerotized, dorsal, submedial flange ("F"), and compare with the *malornata* group. Bottom, (*E. nigrodentata* Walsingham, holotype (BM slide 4323); Kauai, 3,000 to 4,000 feet. This is a poor mount of what is evidently a partly decomposed abdomen. The right valva is broken off, the right brachium is out of the picture, and the left brachium is at top right. Compare *brevistrigata* and *obliterata*.

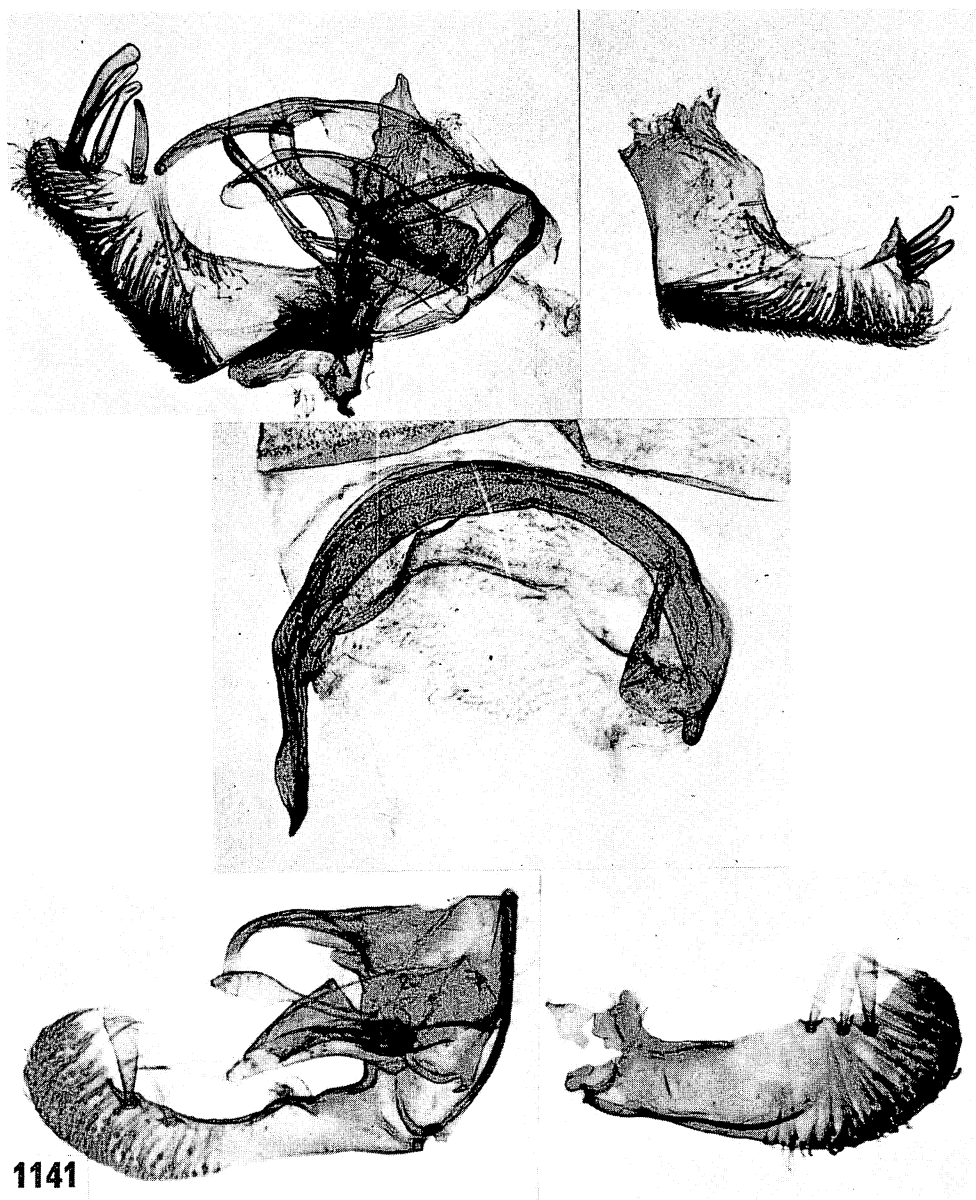
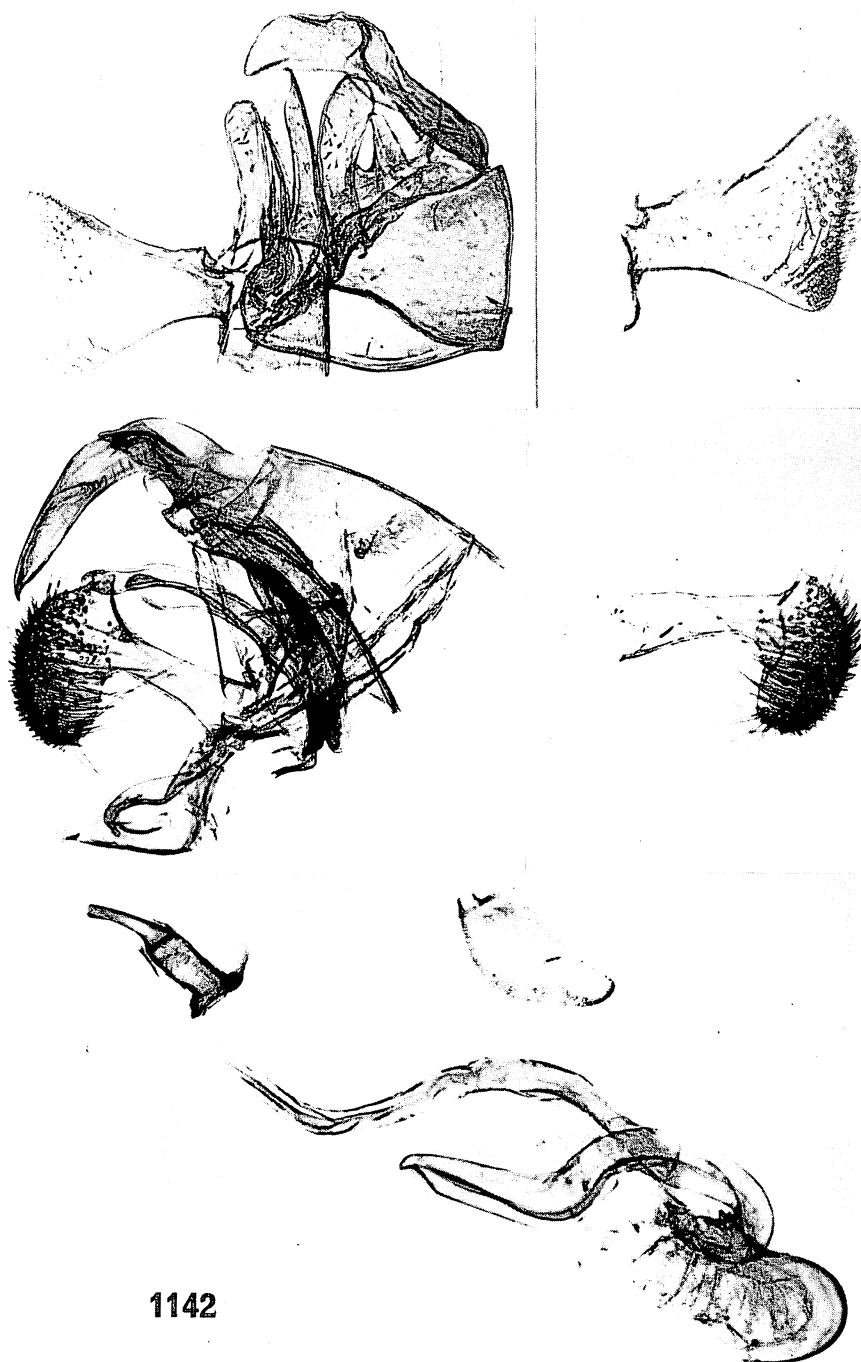


Figure 1141—Male genitalia of *Hyposmocoma*. Top and middle, (*H.*) *notabilis* Walsingham, holotype (BM slide 4093); Molokai, above 4,000 feet. Compare the *iodes* group. Bottom, (*H.*) *numida* Walsingham, holotype (BM slide 4125); Haleakala, 4,000 feet, Maui. Note the enlarged spur from the costal process on the left valva, and compare with the *mimema* group.



1142

Figure 1142—Male genitalia of *Hypsmocoma*. Top, (*E.*) *obliterata* Walsingham, holotype (BM slide 4324); Kauai, 3,000 to 4,000 feet. Compare *brevistrigata* and allies and the *exsul* group formerly placed in *Aphthonetus*. Middle and bottom, (*E.*) *obscura* Walsingham, holotype (BM slide 4339); Olinda, 4,000 feet, Maui. Note the sclerotized ejaculatory duct, and compare with the *fulvida* group. An isolated genital flap is above the middle of the ductus.

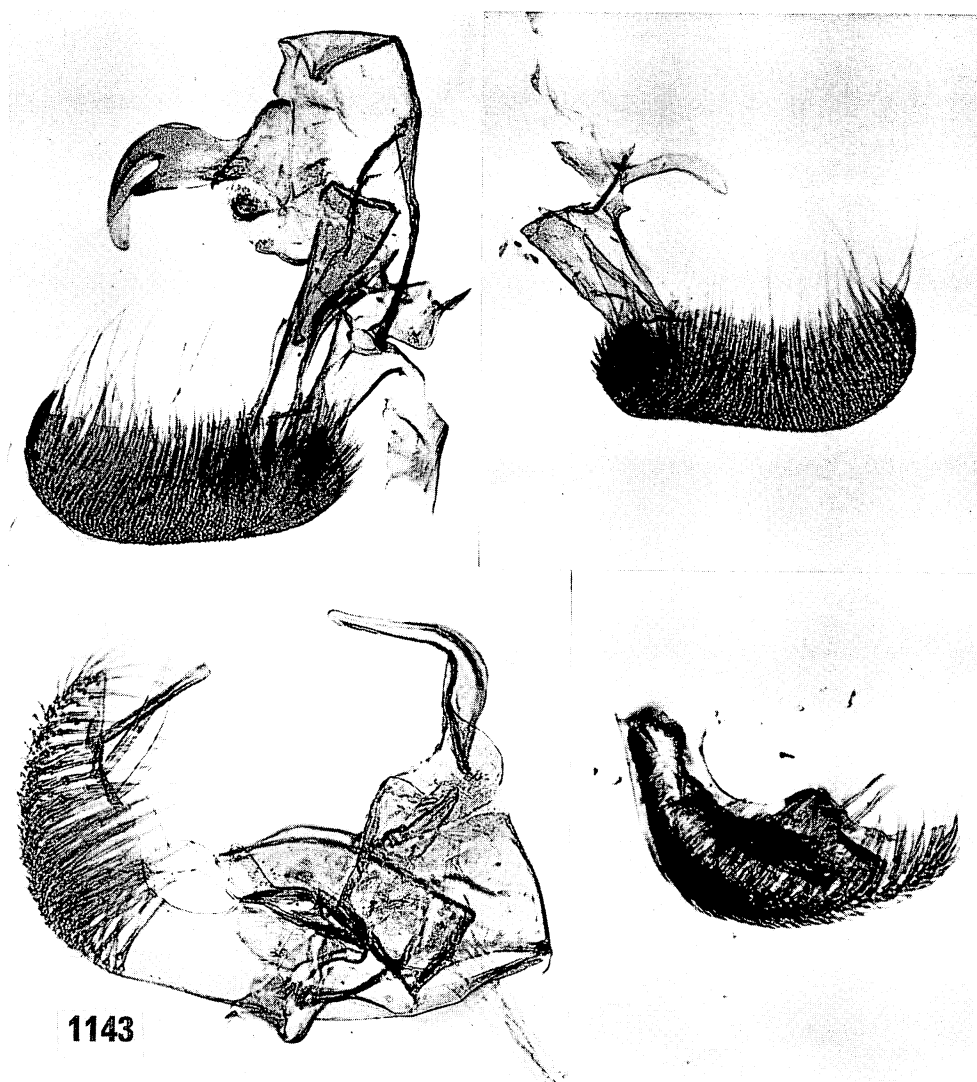


Figure 1143—Male genitalia of *Hypsmocoma*. Top, (*E.*) *ocellata* Walsingham, holotype (BM slide 4136); Kaholuamano, 4,000 feet, Kauai. Compare the *adolescens* group (figure 1034). Bottom, (*H.*) *ochreocervina* Walsingham, holotype (BM slide 4346); Waianae Mts., about 3,000 feet, Oahu. This species lacks a pseuduncus.

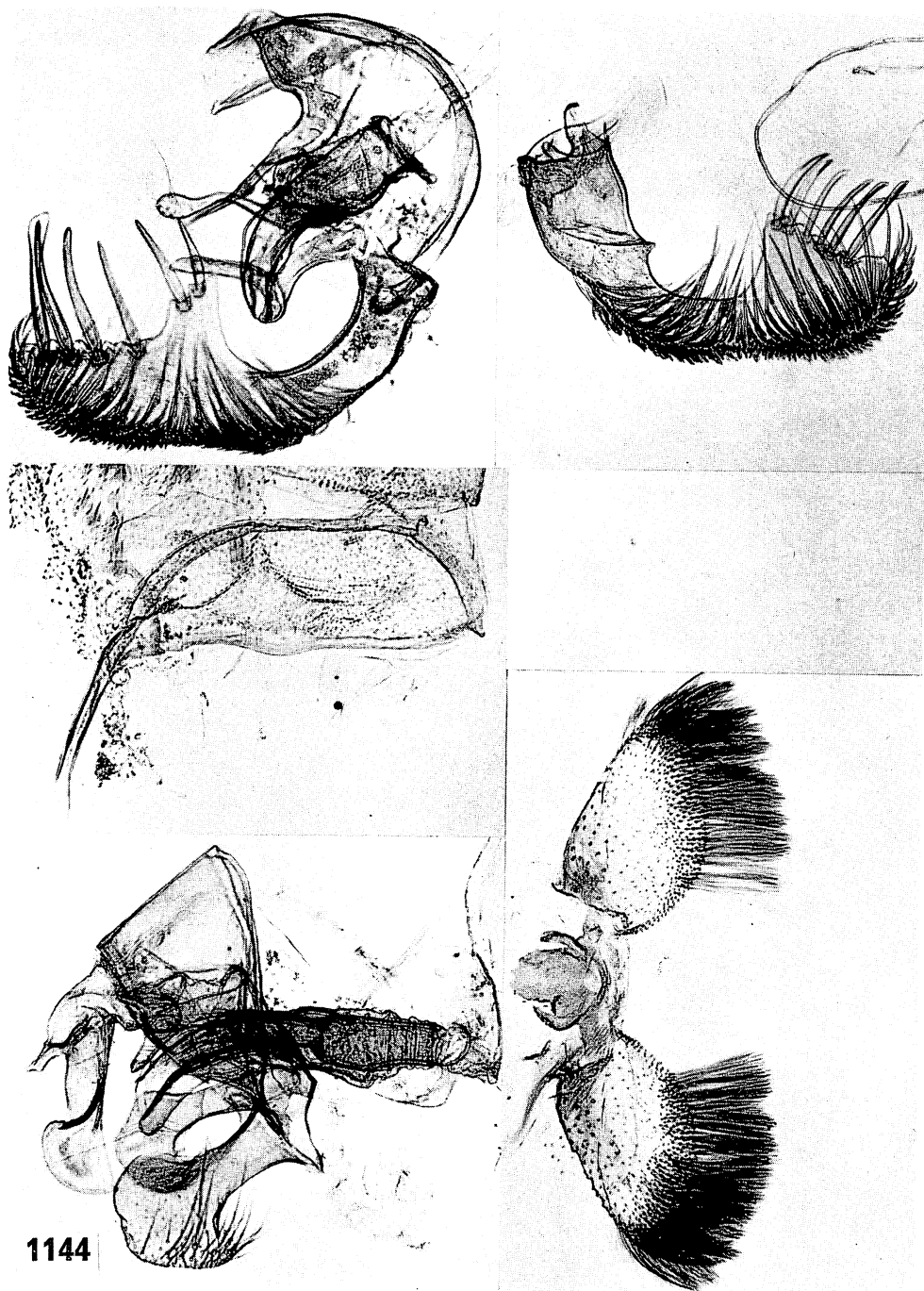


Figure 1144—Male genitalia of *Hyposmocoma*. Top and middle, (*H.*) *ochreociliata* Walsingham, holotype (BM slide 4357); Kilauea, Hawaii. Compare the *iodes* group. Bottom, (*E.*) *ochreovittella* Walsingham, holotype (BM slide 4334); Kona, 3,000 feet, Hawaii. Compare the *fulvida* group.



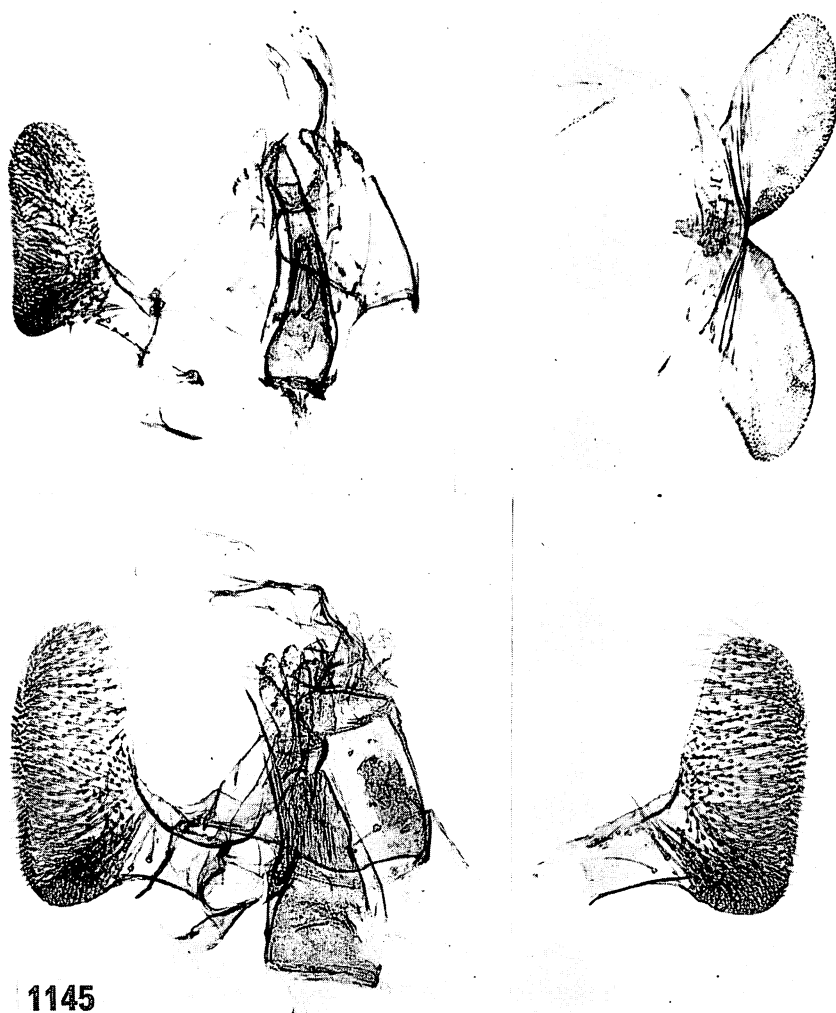


Figure 1145—Male genitalia of *Hypsmocoma*. Top, (*E.*) *oculifera* Walsingham, holotype (BM slide 4080); Kauai, 3,000 to 4,000 feet. Bottom, (*E.*) *ossea* Walsingham, holotype (BM slide 4149); Kona, 4,000 feet, Hawaii.



Figure 1146—Male genitalia of *Hyposmocoma*. Top and left middle, (*H.*) *paradoxa* Walsingham, holotype (BM slide 4348); Kauai, 3,000 to 4,000 feet. There appear to be three spurs lost from the right valva. Compare *iodes* group. Middle right and two bottom figures, (*H.*) new species 24, formerly confused as a paratype (BM slide 7502) of *paradoxa*; Molokai, above 3,000 feet. This "paratype" lacks a pseuduncus while the pseuduncus is strongly developed on the holotype. The right brachium is shown at middle right; it differs from *paradoxa* as do the anellar lobes and other characters.

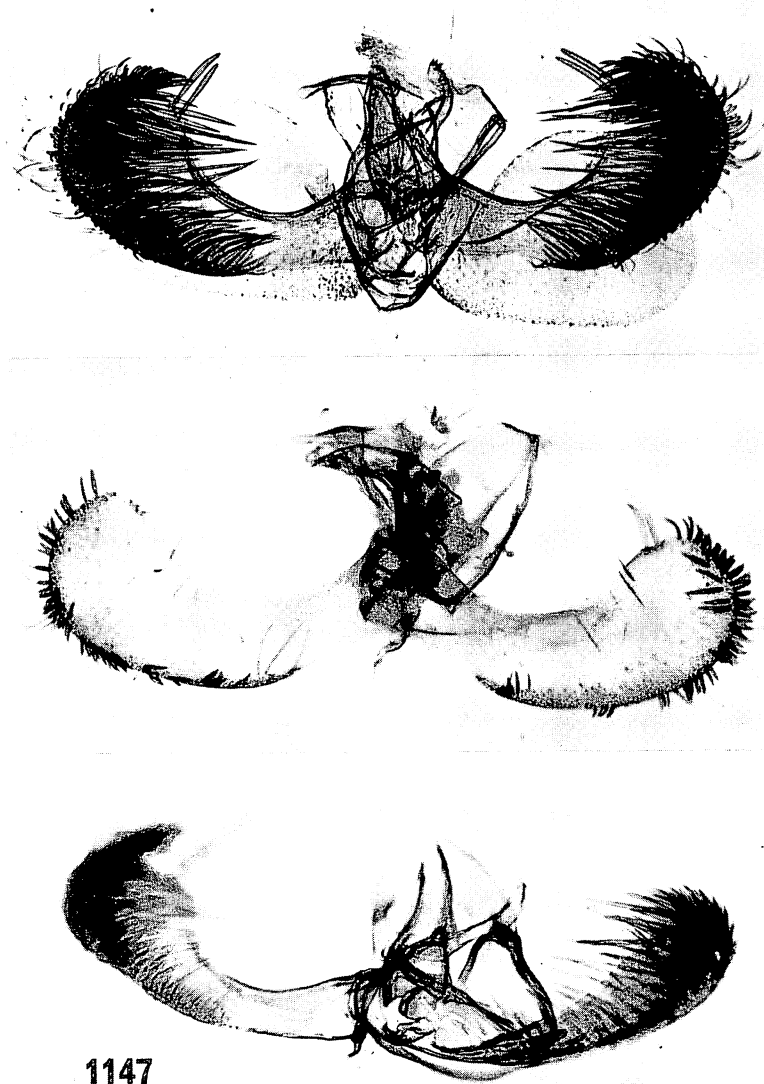
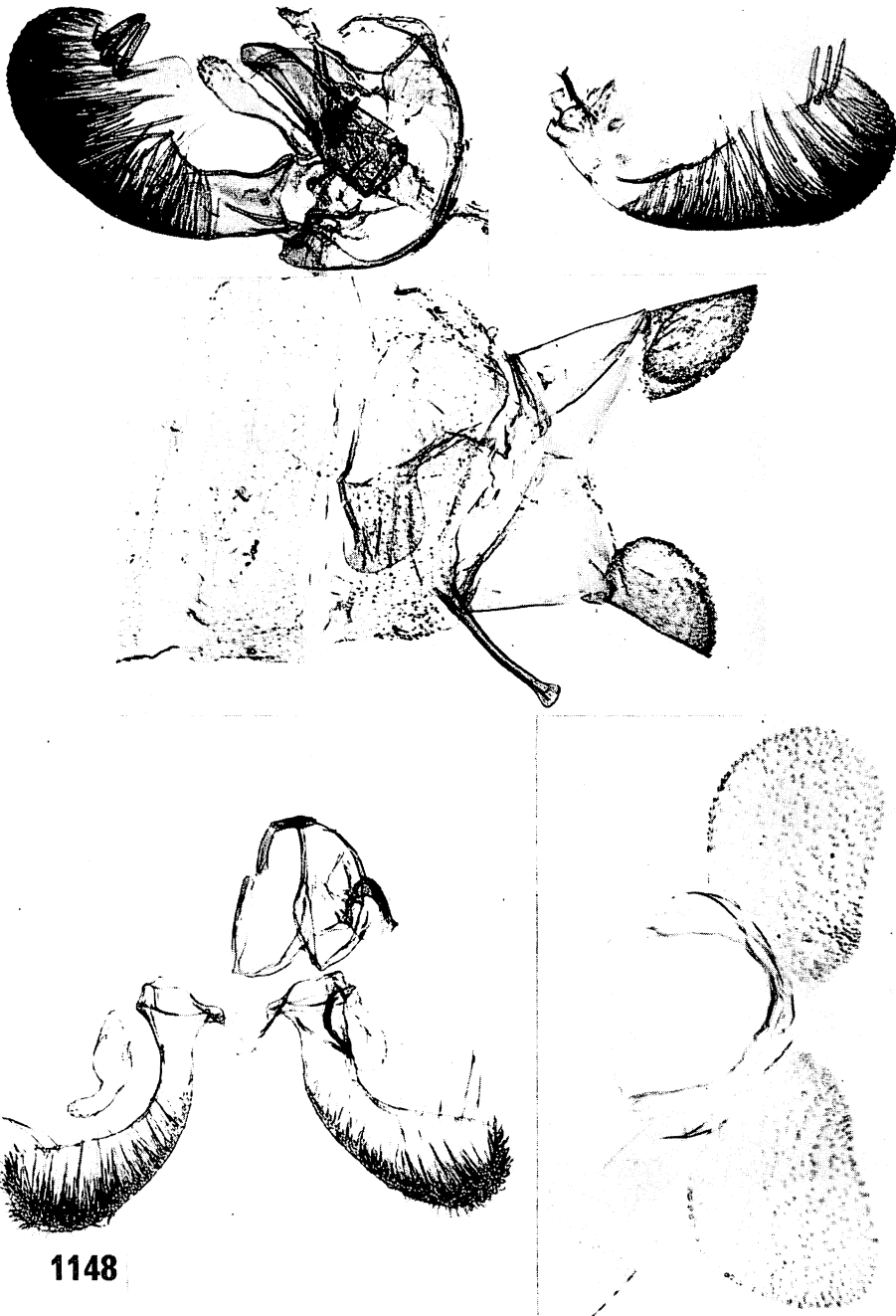


Figure 1147—Male genitalia of *Hyposmocoma*. Top, (*H.*) *parda* (Butler), determined by Walsingham (BM slide 6472). There is no pseuduncus. Note the large genital flaps, in situ. Middle, another specimen of *parda* determined by Walsingham (BM slide 7509); Kona, 5,000 feet, Hawaii. The two spurs are broken off the left valva. Bottom, (*H.*) *pharsotoma* Meyrick, holotype (BM slide 9576 Clarke); Koolau Mts., near Honolulu. This is a poorly oriented mount. It has been remounted in figure 1150. Compare these species with the *illuminata* group.



1148

Figure 1148—Male genitalia of *Hyposmocoma*. Top and middle, (*H. partita* Walsingham, holotype (BM slide 4089); Hilo, 2,000 feet, Hawaii. Compare the *malornata* group. Bottom, (*H. petrosia* Meyrick, lectotype (BM slide 9571 Clarke); Koolau Mts., Oahu. Specimen remounted; see also figure 1149.

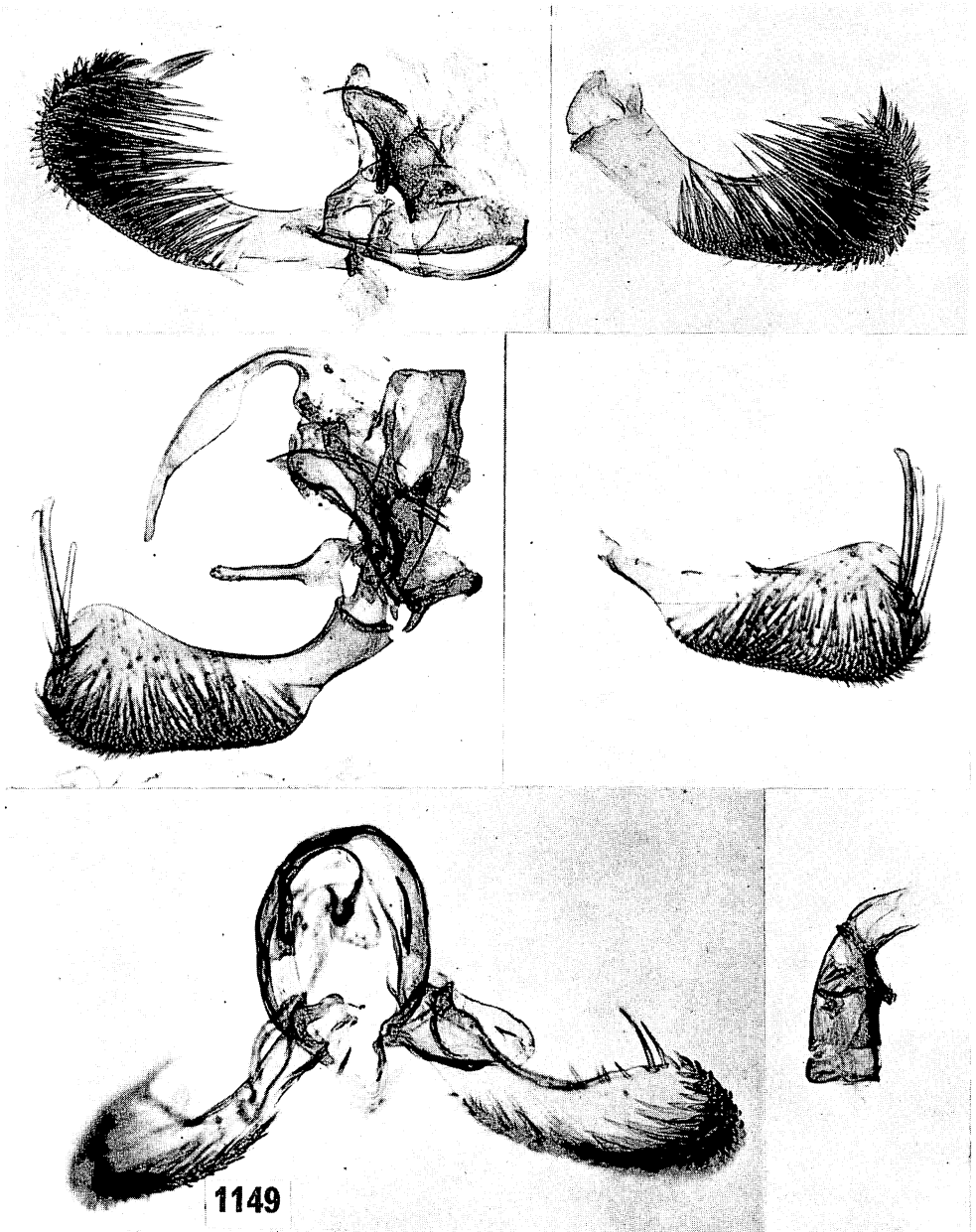


Figure 1149—Male genitalia of *Hypsmocoma*. Top, (*H.*) *patriciella* Walsingham, holotype (BM slide 4118); Haleakala, 5,000 feet, Maui. Compare the *illuminata* group. Middle, (*H.*) *persimilis* Walsingham, holotype (BM slide 4319); Kona, 4,000 feet, Hawaii. Compare the *admirationis* group. Bottom, (*H.*) *petroschia* Meyrick, lectotype (BM slide 9571 Clarke); Koolau Mts., Oahu. The apex of the ejaculatory duct has been withdrawn from the aedeagus and is at right. See figure 1148 in which this slide is remounted.

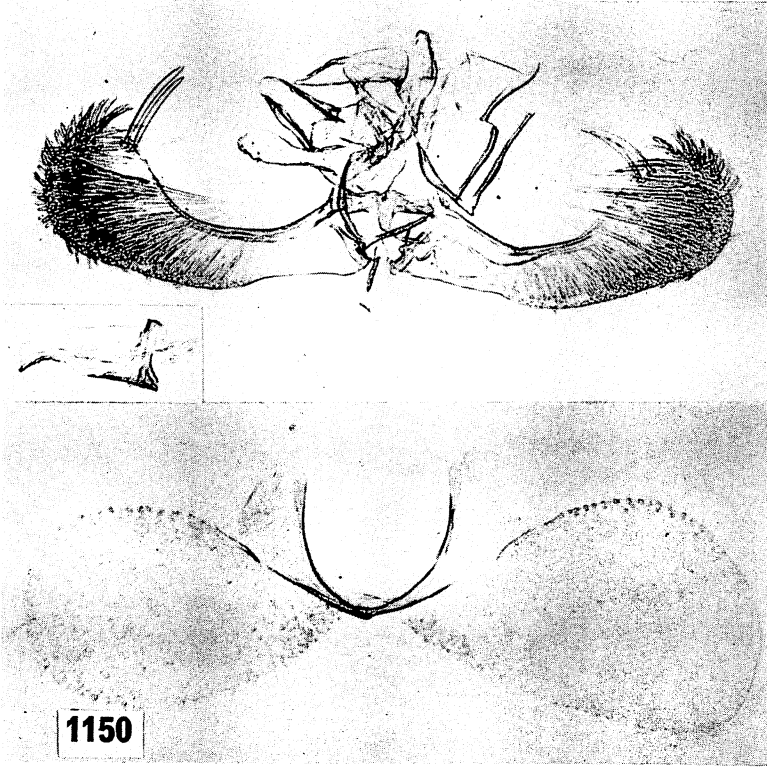


Figure 1150—Male genitalia of *Hyposmocoma (H.) pharsotoma* Meyrick, holotype (BM slide 9576 Clarke); Koolau Mts., near Honolulu. The distal end of the ejaculatory duct has been pulled out of the aedeagus and a figure of it is inset at left. Compare figure 1147 which was made before the slide was remounted.

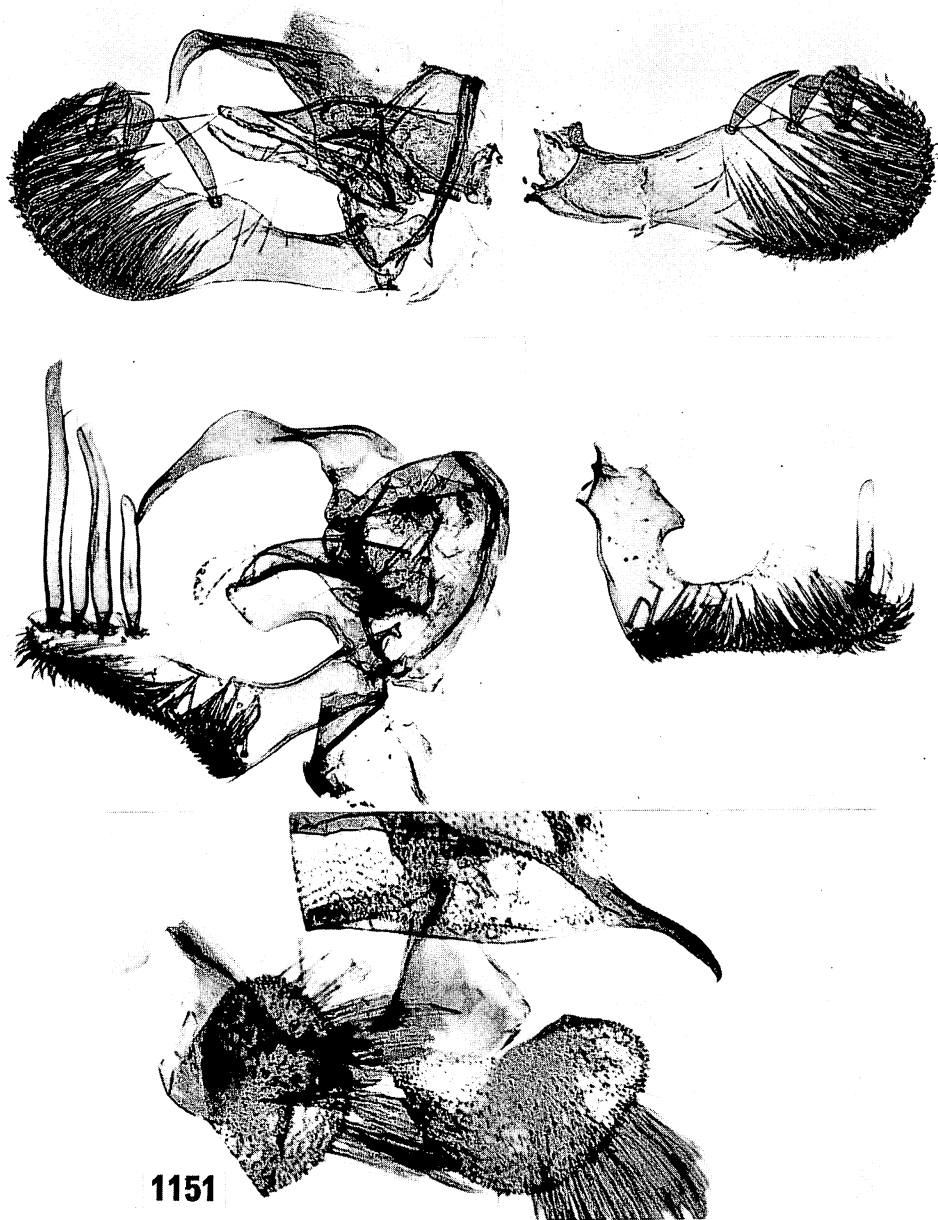


Figure 1151—Male genitalia of *Hypsmocoma*. Top, (*H.* *phalacra* Walsingham, allotype (BM slide 4482); Kauai, 3,000 to 4,000 feet. Compare *bella*. Middle and bottom, (*H.* *picticornis* Walsingham, holotype (BM slide 4148); Molokai, above 3,000 feet. There are three short spurs at the base of the long spur on the right valva. See figures 1152 to 1154. Compare *geminella* and *sabulella*.

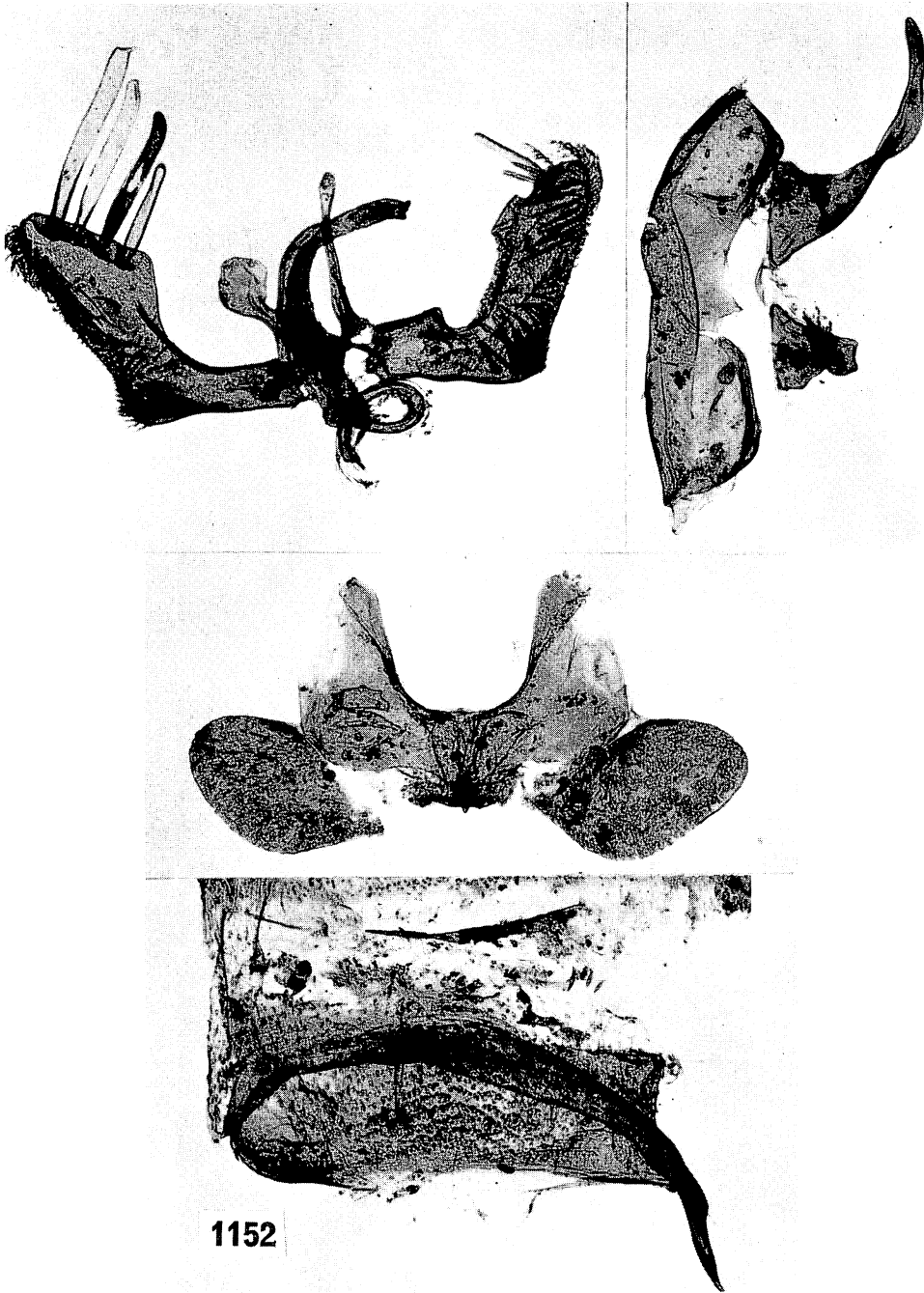


Figure 1152—Male genitalia of *Hyposmocoma* (*H.*) *picticornis* Walsingham, paratype (BM slide 14298); Molokai, above 3,000 feet. Abdomen partly decomposed. Compare figures 1151, 1153, 1154.



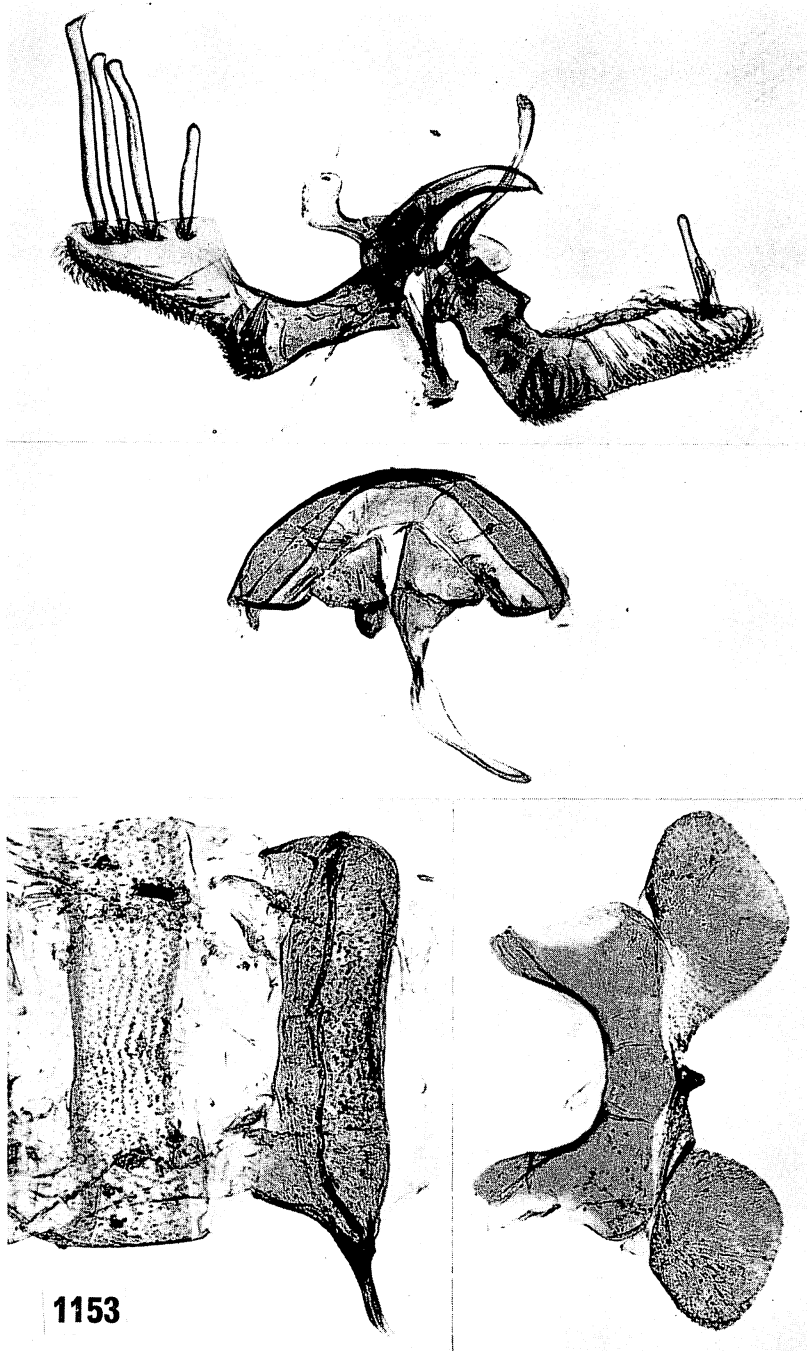


Figure 1153—Male genitalia of *Hyposmocoma* (*H.*) *picticornis* Walsingham (variety)?, paratype (BM slide 14299); Molokai, above 3,000 feet. Compare figures 1151, 1152, 1154.



Figure 1154—Male genitalia of *Hyposmocoma* (*H.*) *picticornis* Walsingham (subspecies or variety?), paratype (BM slide 7330); Olinda, 4,000 feet, Maui. What appears to be the right anellar lobe is a torn piece of the side of the eighth sternite; the right anellar lobe adheres to the aedeagus. Note the differences in the shapes of the valvae between this and the holotype. The pseuduncus is as it appears on the holotype. See the text for discussion. Compare figures 1151 to 1153.

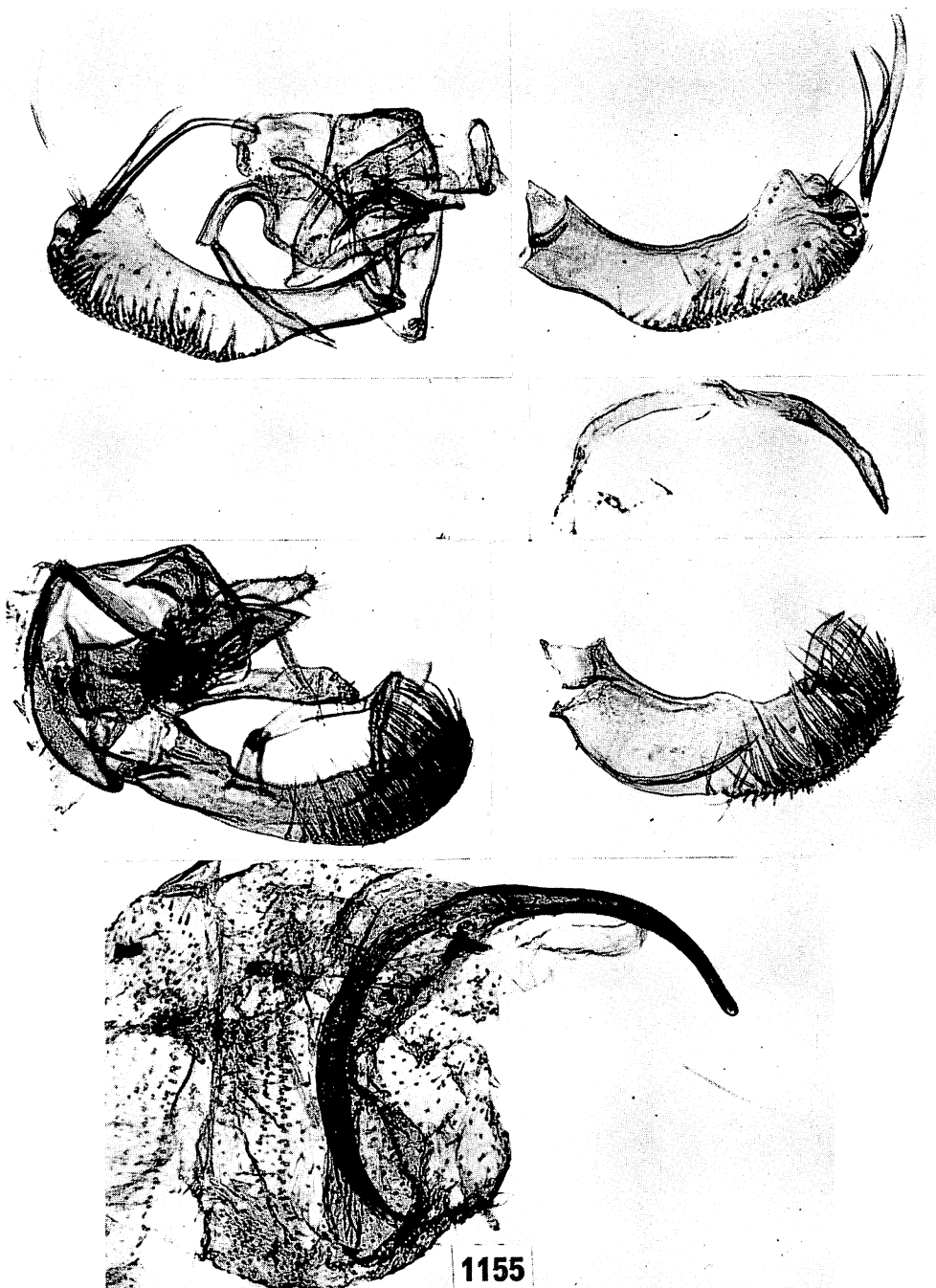
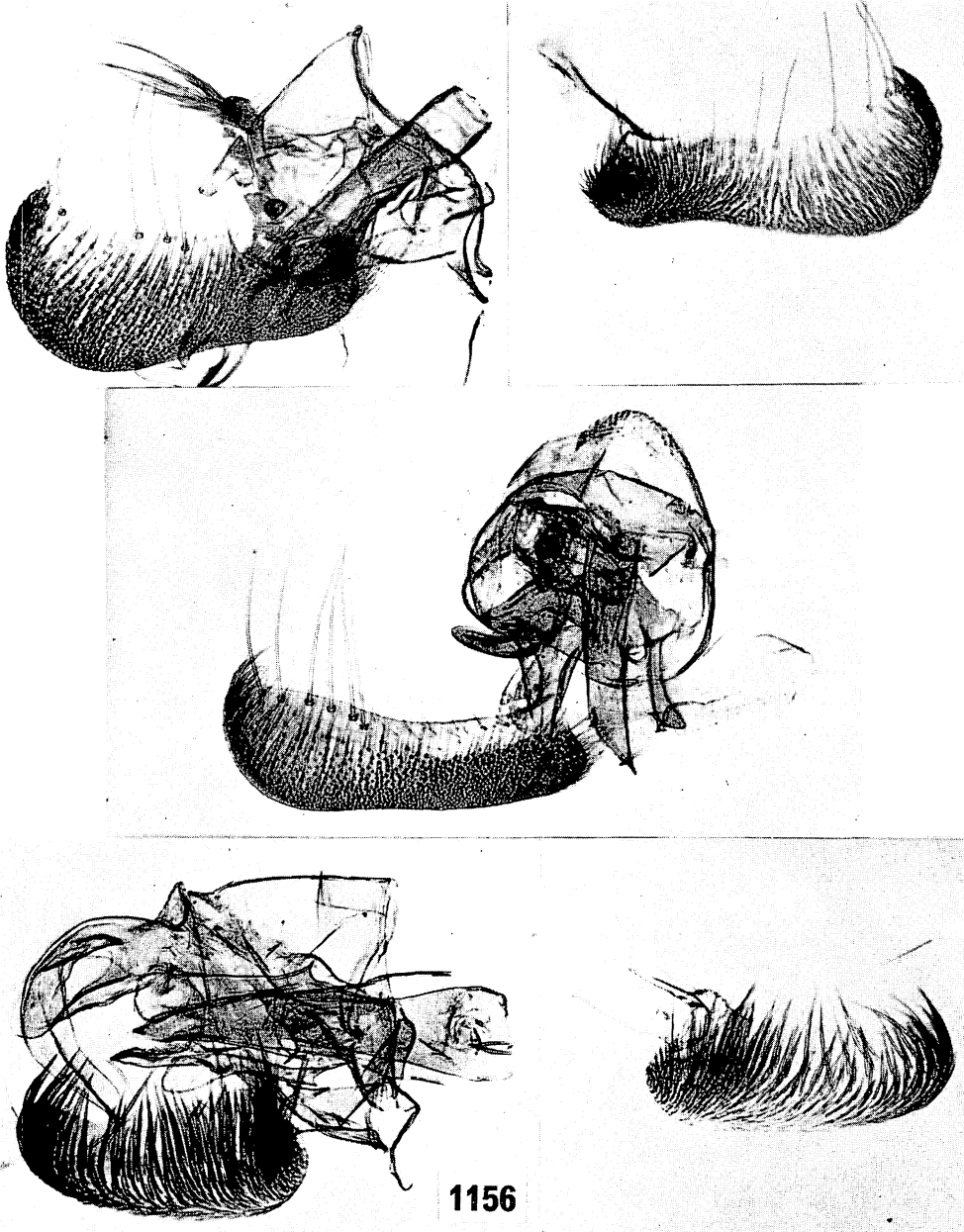


Figure 1155—Male genitalia of *Hypsocoma*. Top three figures, (*H.*) *propinqua* Walsingham, holotype (BM slide 4123); Molokai, 4,000 feet. The right brachium is broken and bent down across the left valva. The curved structure beneath the right valva is the pseuduncus. Compare the *admirationis* group. Middle and bottom, (*H.*) *pseudolita* Walsingham, holotype (BM slide 4483); Waianae Mts., Oahu. The larger part of the genitalia have been photographed from the back of the slide. This shows the ectal aspect of the left valva (note the large spur on the costal process). Compare the *mimema* group.



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Figure 1156—Male genitalia of *Hypsmocoma*. Top, (*E.*) *pucciniella* Walsingham, holotype (BM slide 4141); Kilauea, Hawaii. Middle, (*E.*) *punctifumella* Walsingham, holotype (BM slide 4131); Olinda, 4,000 feet, Maui; right valva lost. Although allied, these are distinct species. Compare the *adolescens* group. Bottom, (*E.*) *radiatella* Walsingham, holotype (BM slide 4495); Kona, 4,000 feet, Hawaii. Compare figure 1158 of the paratype.

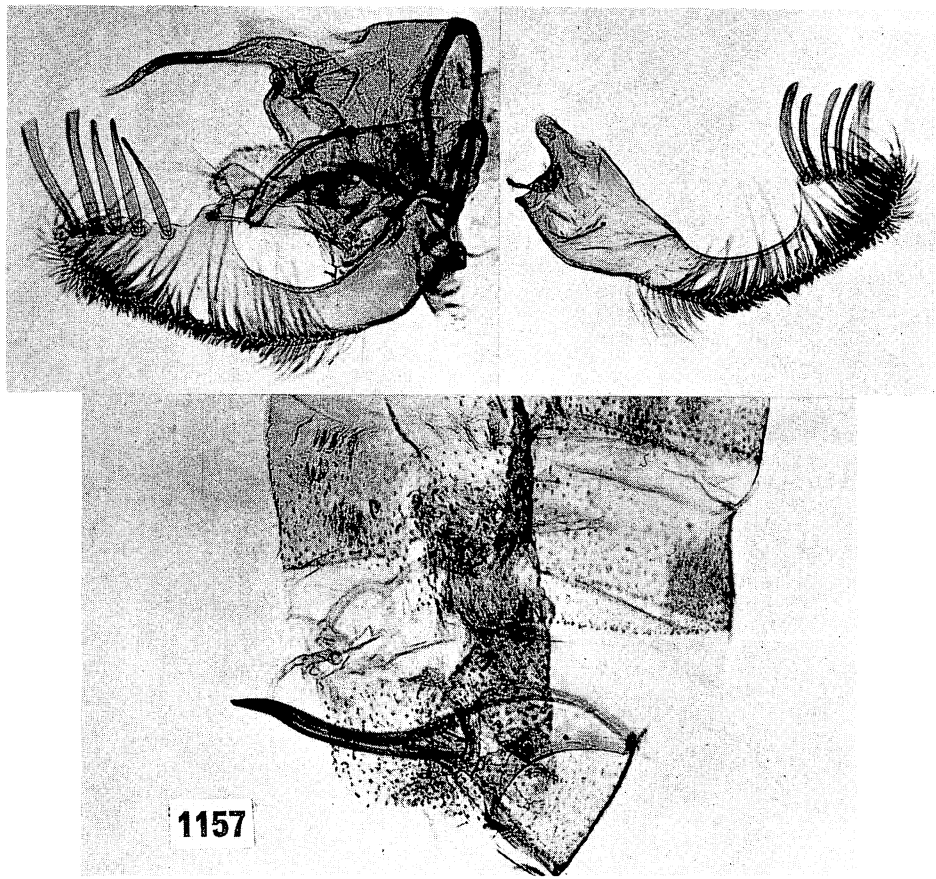


Figure 1157—Male genitalia of *Hypsmocoma* (*H.*) *quinquemaculata* Walsingham, holotype (BM slide 4359); Kona, 4,000 feet, Hawaii. Compare the *iodes* group.

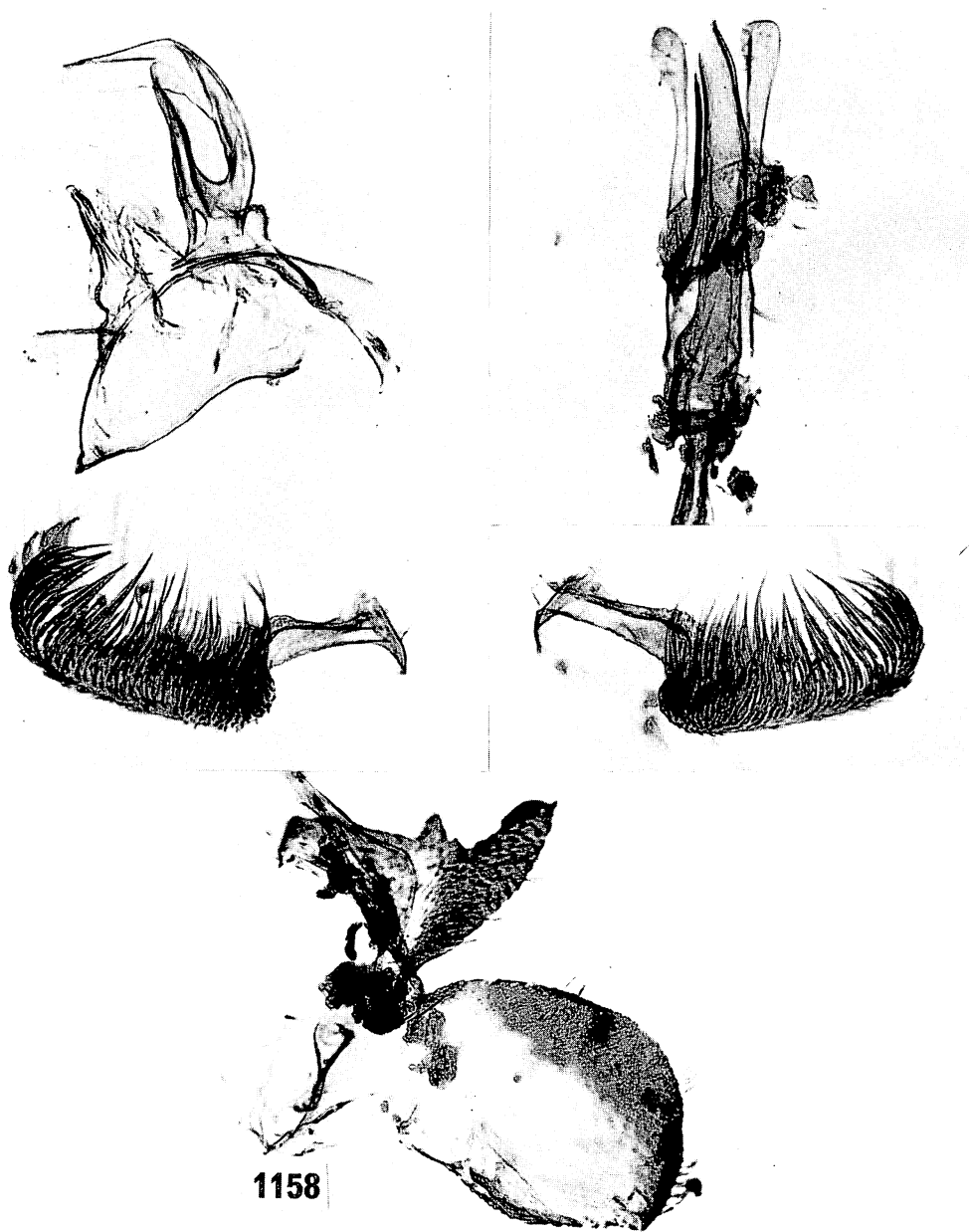


Figure 1158—Male genitalia of *Hyposmocoma* (*E.*) *radiatella* Walsingham, paratype (BM slide 7348); Kaholuamano, 4,000 feet, Kauai. Compare figure 1156 of the holotype from Hawaii. Compare *roseofulva*.

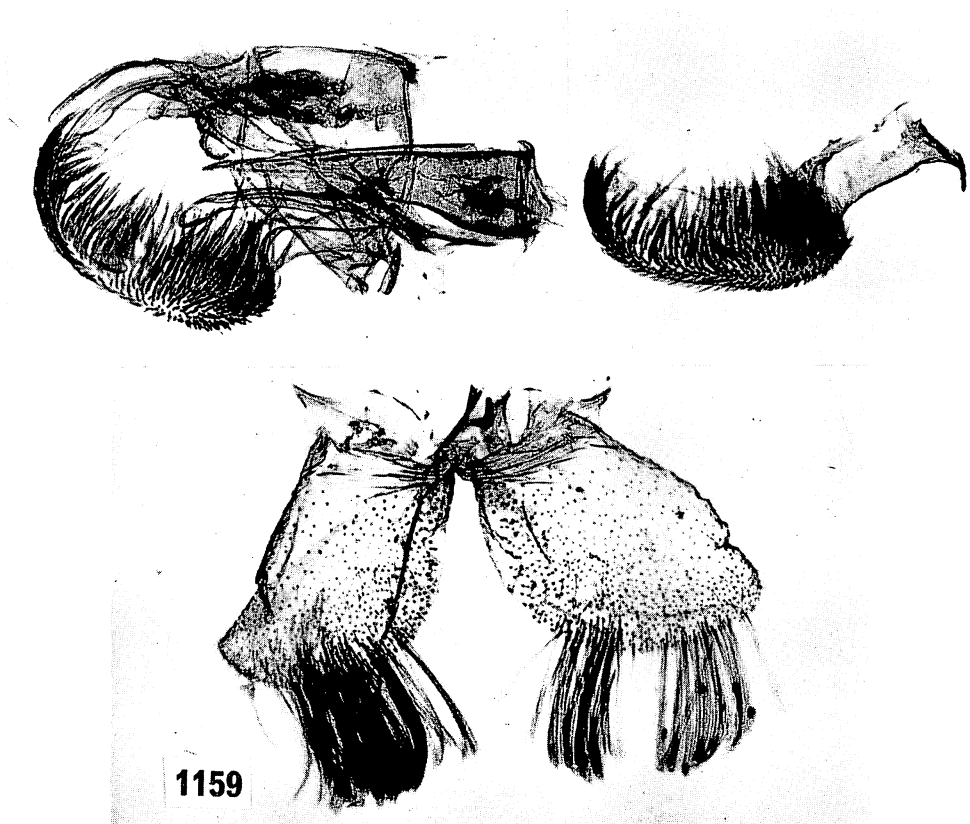


Figure 1159—Male genitalia of *Hypsoscoma* (*E.*) *roseofulva* Walsingham, holotype (BM slide 4344); Kauai, 3,000 to 4,000 feet. Compare *radiatella*.

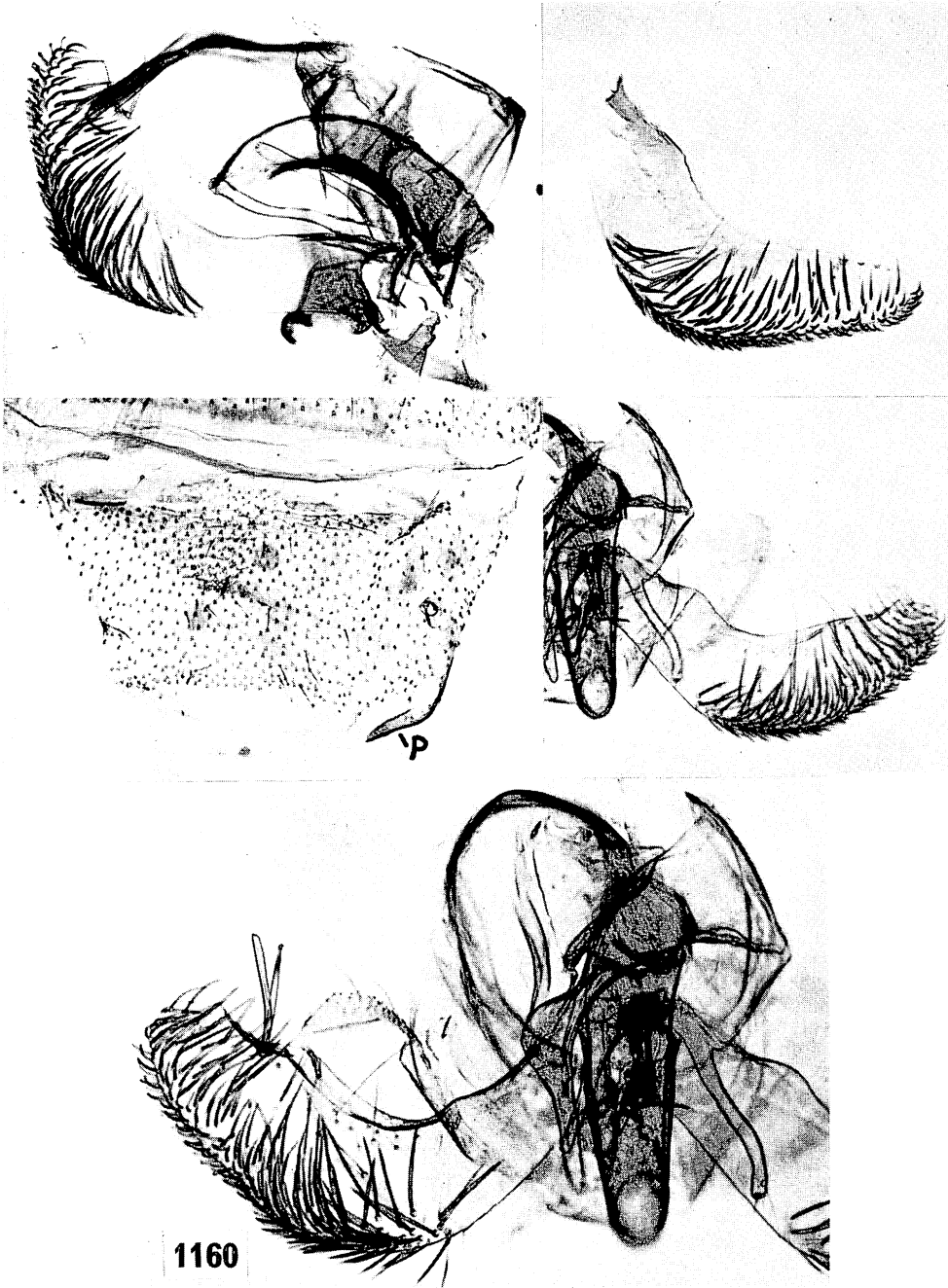


Figure 1160—Male genitalia of *Hyposmocoma* (*H.*) *rubescens* Walsingham, top and middle left, allotype (BM slide 4488); Kauai, 3,000 to 4,000 feet. Middle right and bottom (in greater enlargement), a paratype (BM slide 6459); Kaholuamano, 4,000 feet, Kauai. Note that on the right valva only scars and vestiges of the spurs remain. Compare *arenella*, *carnea*, and *nephelodes*. The incipient pseuduncus is marked "P".



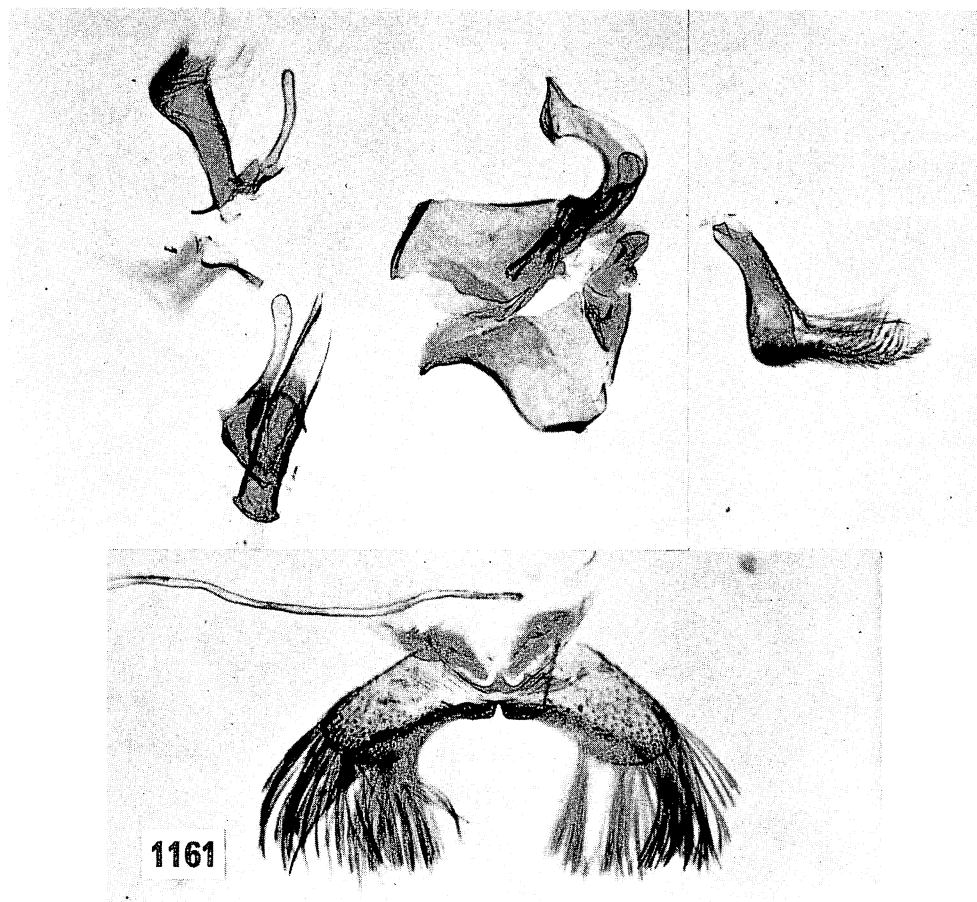


Figure 1161—Male genitalia of *Hypsoscopia* (*E.*) *rusius* Walsingham, holotype (BM slide 4351); Molokai, above 3,000 feet. The left valva has lost its distal part. The genital flaps are at a steep angle in the mount and are thus optically distorted. This species belongs to the “*Neelysia*” group. Walsingham described it as a typical *Hypsoscopia* and placed it in association with species to which it is not allied.

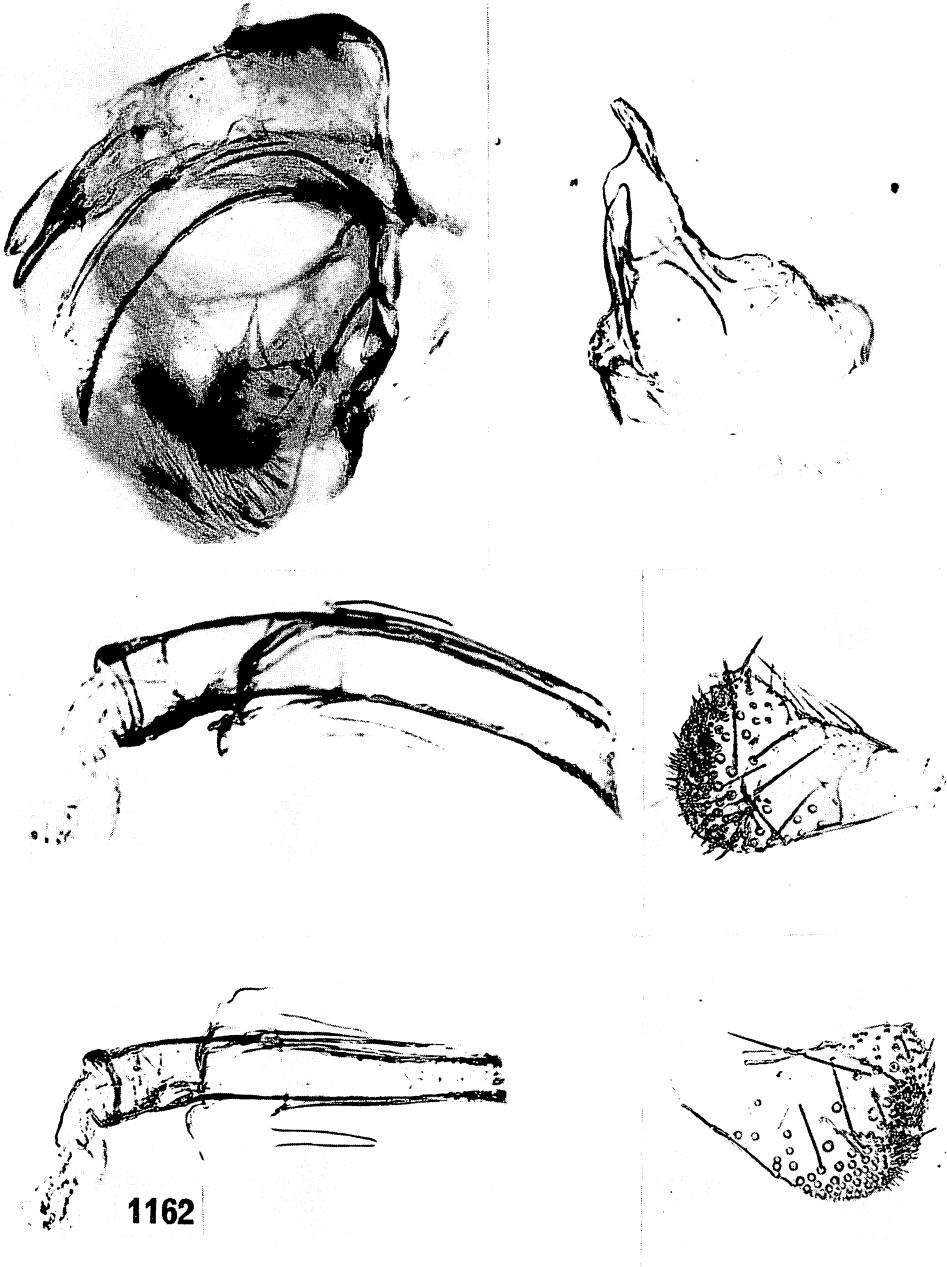


Figure 1162—Male genitalia of *Hypsoscoma* (*E.*) *rutilella* (Walsingham) ("*Rhinomactrum*"), holotype (BM slide 4422). Top left, from an original unsatisfactory mount, in right aspect. The specimen was remounted, but it broke into several parts. At top right is an oblique ventral view showing part of the tegumen and the brachia. Middle left, a lateral view of the aedeagus. Below, same, shown in ventral aspect at lesser magnification (note the adhering small anellar lobes). Note the small valvae at right. Compare the *brevistrigata* group and the *exsul* group that were formerly placed in "*Aphthonetus*".

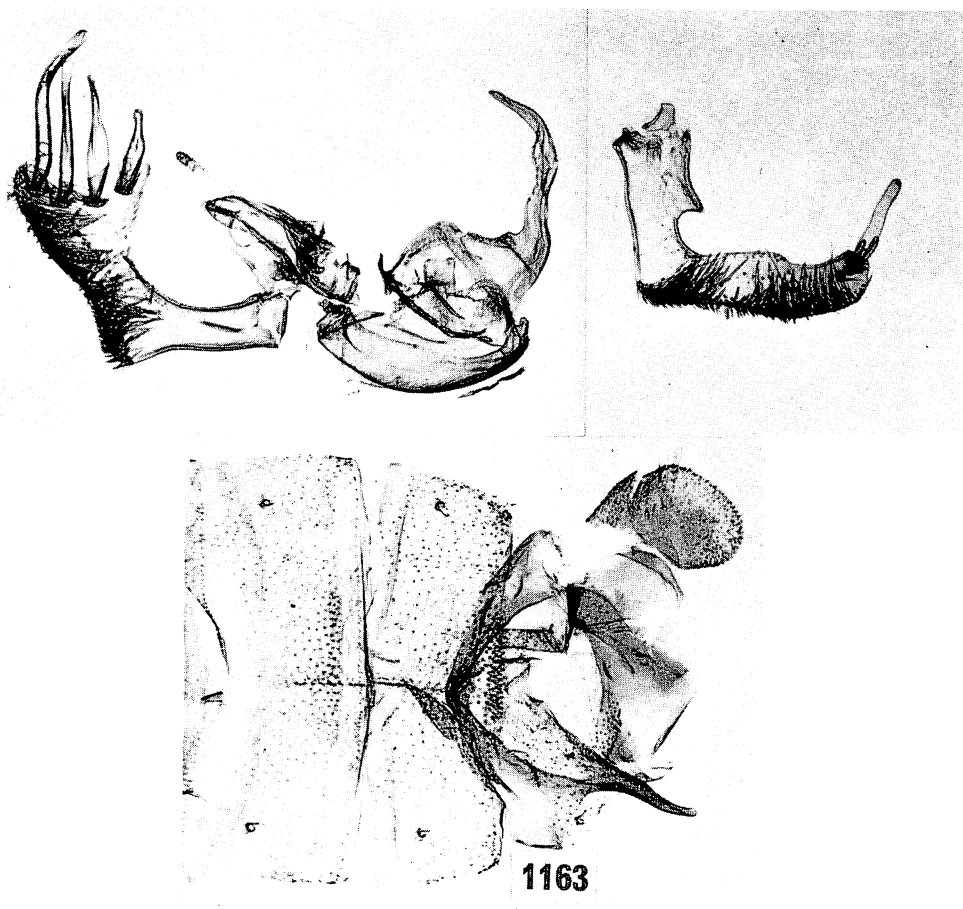


Figure 1163—Male genitalia of *Hypsoscoma* (*H.*) *sabulella* (Walsingham), allotype (BM slide 4099); Halemanu, 4,000 feet, Kauai. Compare the *picticornis* group.

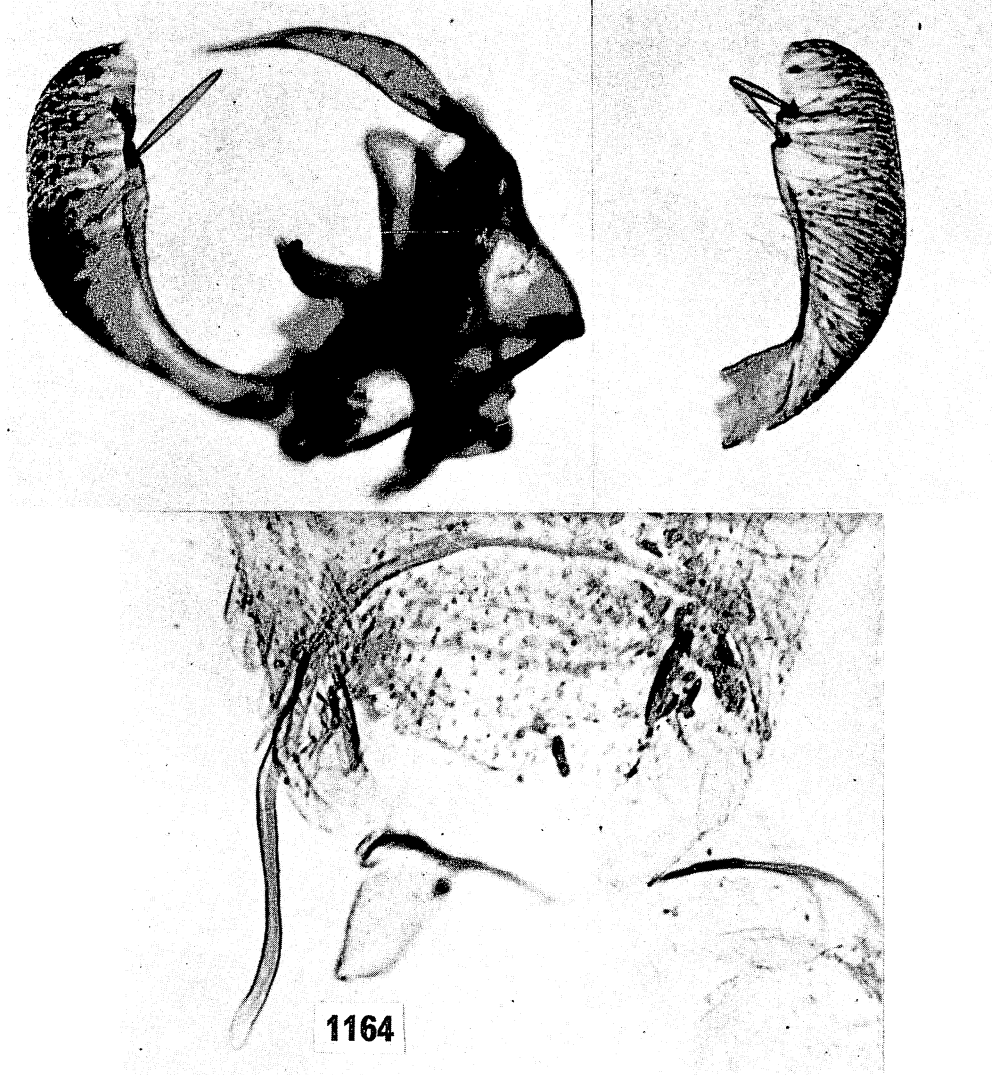


Figure 1164—Male genitalia of *Hyposmocoma* (*H.*) *saccophora* Walsingham, allotype (BM slide 4329); Waianae Mts., Oahu. The distal spur (or two?) has been lost from the left valva. Compare figure 1165. The pseuduncus is seen from beneath. See the text for additional discussion.

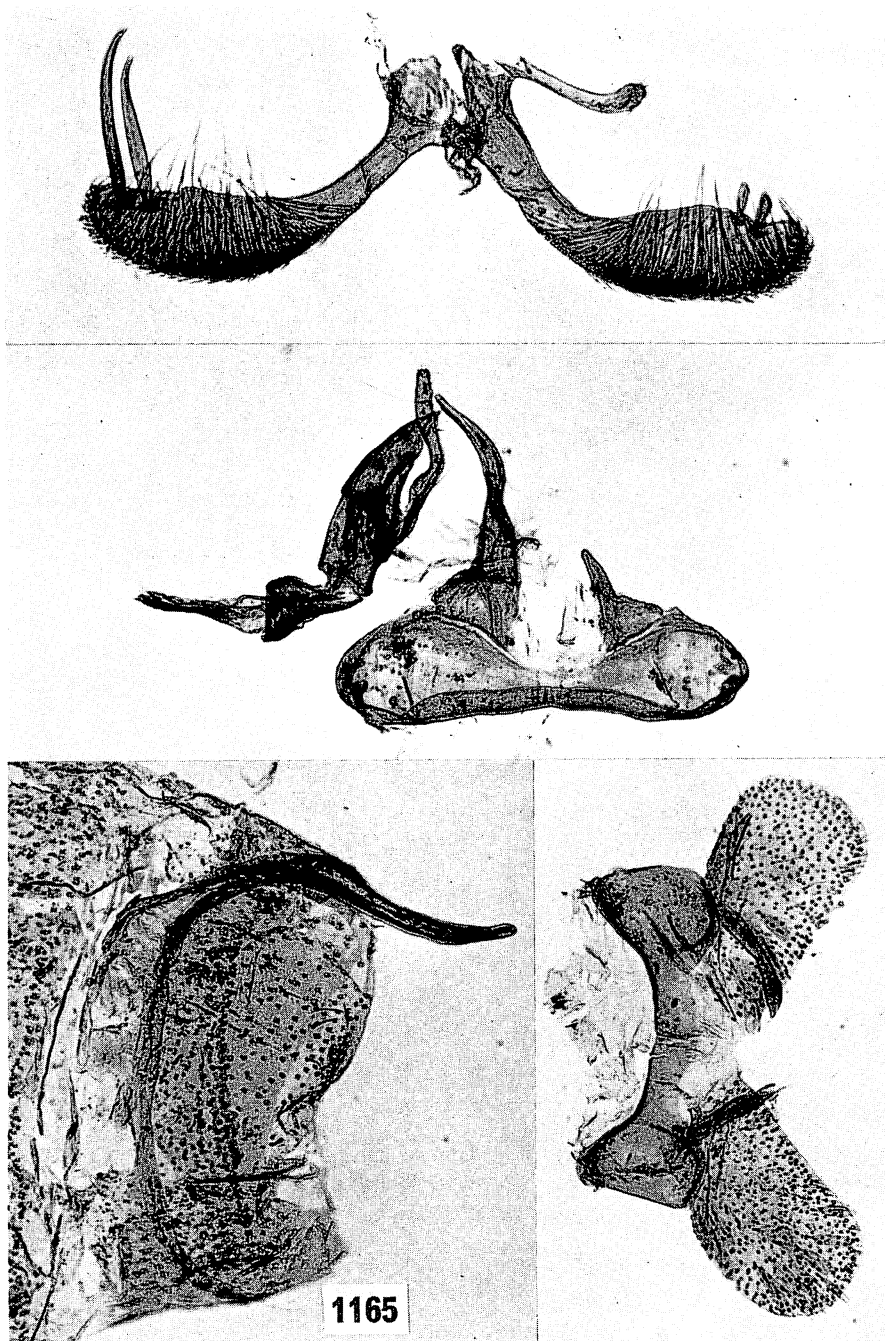


Figure 1165—Male genitalia of a specimen determined as *Hypsmocoma* (*H.*) *saccophora* Walsingham by Dr. Swezey, but it is atypical and is possibly a distinct form; reared specimen from Waimanalo, Oahu (BM slide 14300). The inner spur of the left valva is lost. Compare figure 1164 of the allotype and see text.



Figure 1166—Male genitalia of *Hyposmocoma* (*H.*) new species 27, formerly confused as a paratype of *saccophora* Walsingham (BM slide 7327); Molokai, above 3,000 feet. Note the broad, squamiform spurs on the valvae. Compare *saccophora* (figures 1164, 1165) and the *adelphella* group.

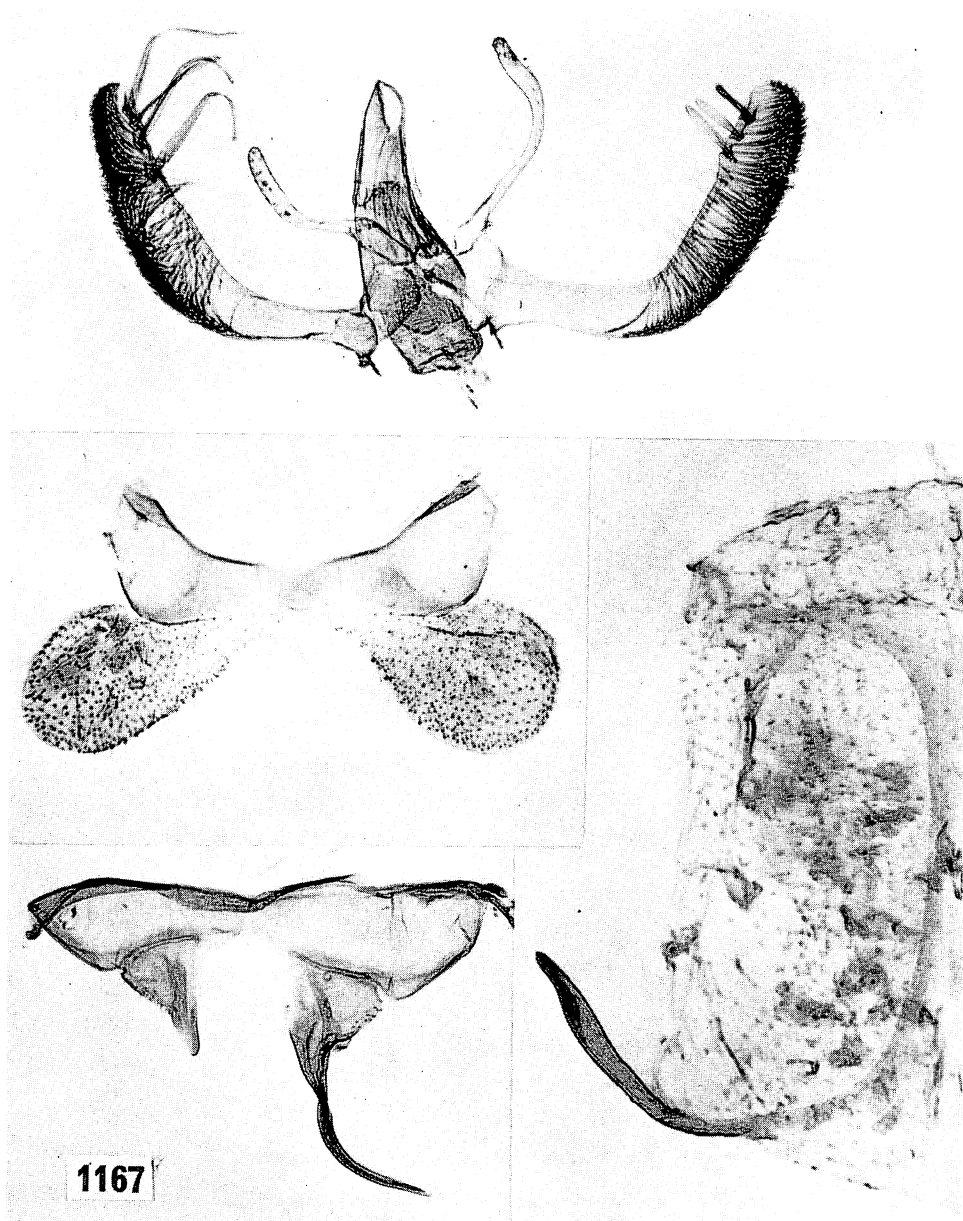
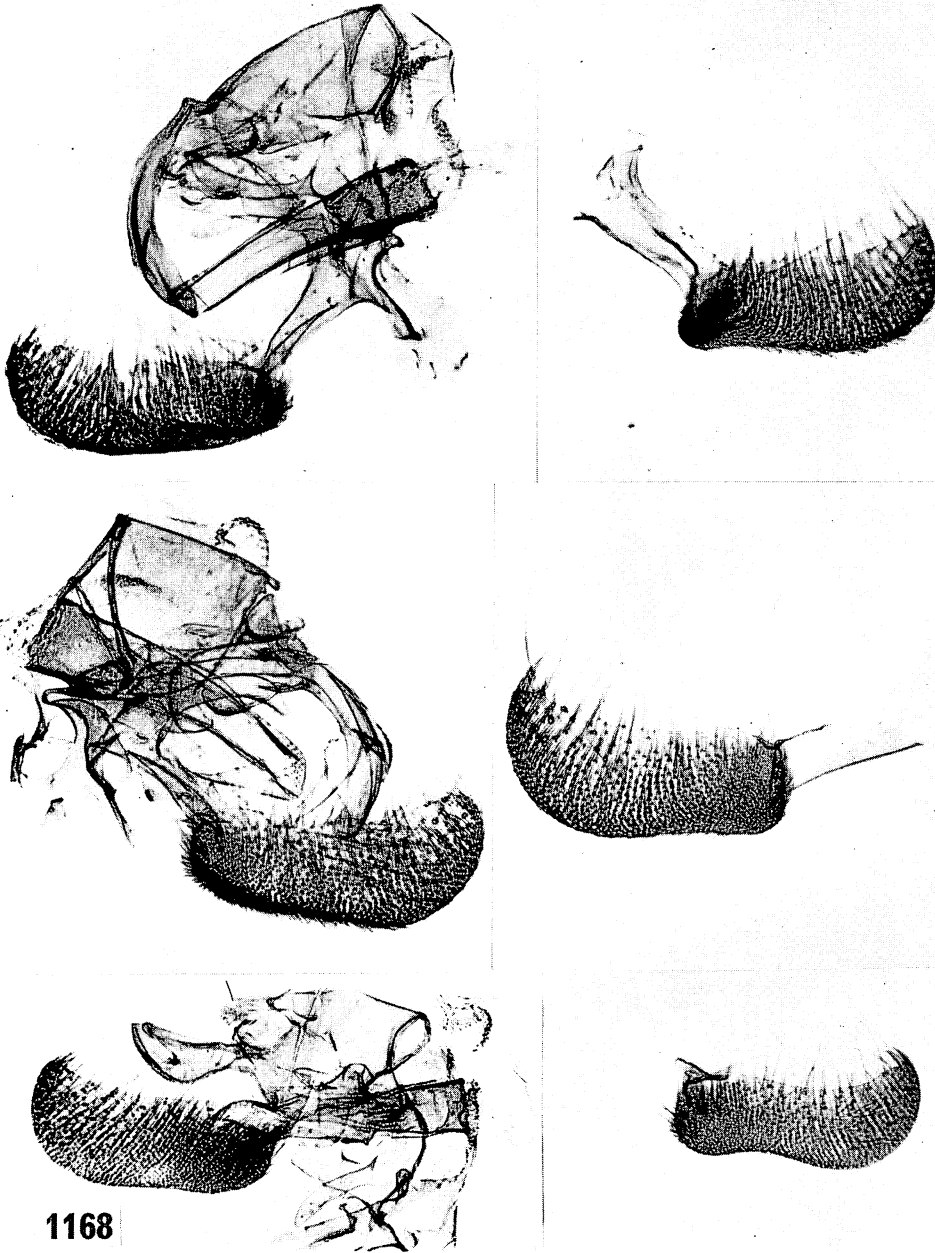


Figure 1167—Male genitalia of *Hyposmocoma* (*H.*) new species 28, near *saccophora*; Necker Island; J. W. Beardsley, September, 1964 (slide Z-III-8-65). The spurs on the left valva have been distorted by the mounting process.



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Figure 1168—Male genitalia of *Hyposmocoma*. Top, (*E.*) *scepticella* Walsingham, holotype (BM slide 4142); Olinda, 4,000 feet, Maui. Middle, (*E.*) *scepticella dubia* Walsingham, here considered a synonym of *scepticella*, holotype (BM slide 4143); Haleakala, 4,000 feet, Maui (photographed from the back of the slide mount). Bottom, (*E.*) *semifuscata* Walsingham, holotype (BM slide 4140); Kona, 3,000 feet, Hawaii. The apex of the right brachium is broken off. Compare these species with the *adolescens* group. These slide preparations are not well made.



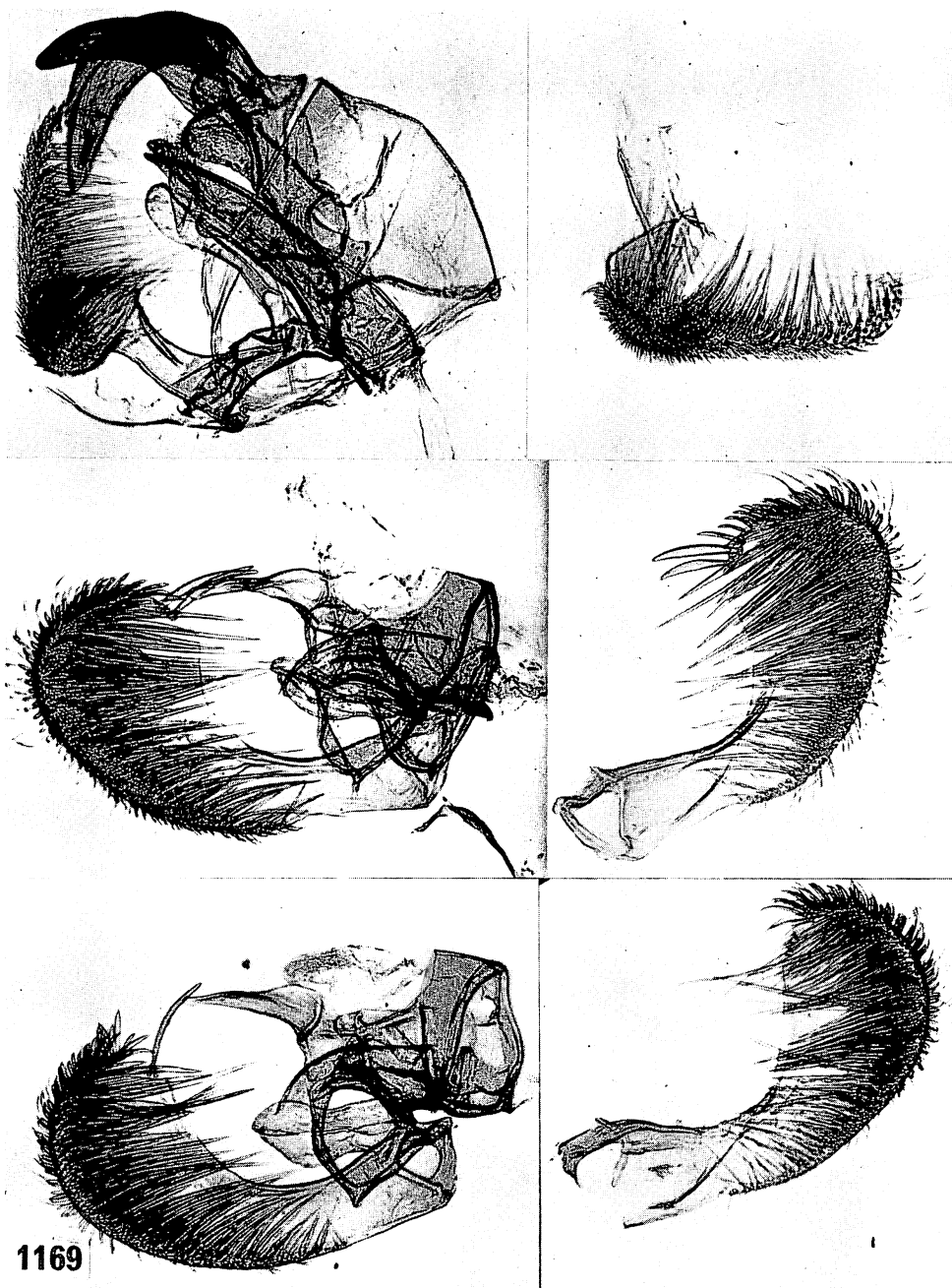


Figure 1169—Male genitalia of *Hyposmocoma*. Top, (*E.*) *scandens* Walsingham, holotype (BM slide 4340); Kauai, 3,000 to 4,000 feet. Compare *maestella*. Middle, (*H.*) *saliaris* Walsingham, allotype (BM slide 4481); Kona, 4,000 feet, Hawaii. Bottom, (*H.*) *schismatica* Walsingham, holotype (BM slide 4327); Kaholuamano, 4,000 feet, Kauai. Compare middle and bottom species with the *illuminata* group.



Figure 1170—Male genitalia of *Hypsoscopia* (*H.*) *scolopax* Walsingham, holotype (BM slide 4489); Kauai, 3,000 to 4,000 feet. The lower figure is upside down. Compare the *admirationis* group.



Figure 1171—Male genitalia of *Hypsmocoma* (*H.*) *semicolon* (Walsingham) ("*Dysphoria*"), holotype (BM slide 4395); Kaholuamano, Kauai. Compare *commensella*.

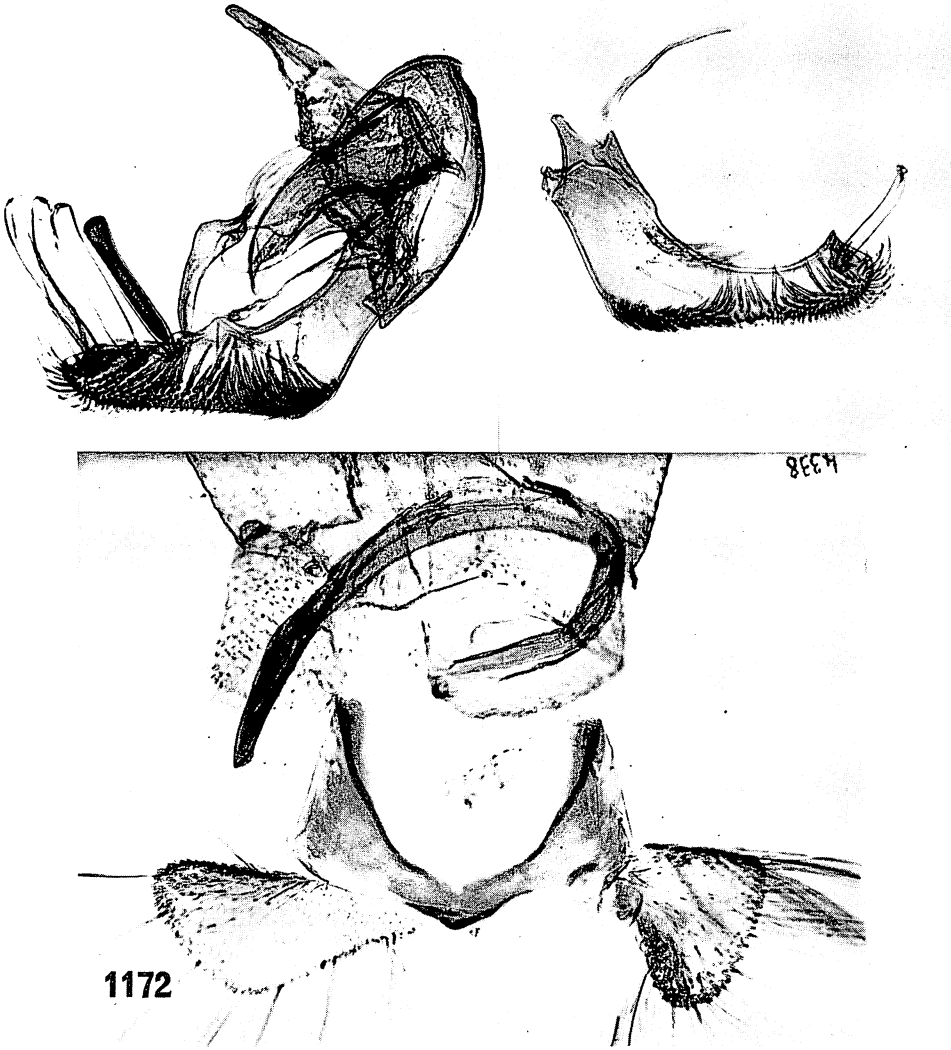


Figure 1172—Male genitalia of *Hypsmocoma* (*H.*) *sideritis* Walsingham, allotype (BM slide 4338); Olinda, 4,000 feet, Maui. Compare the *iodes* group.

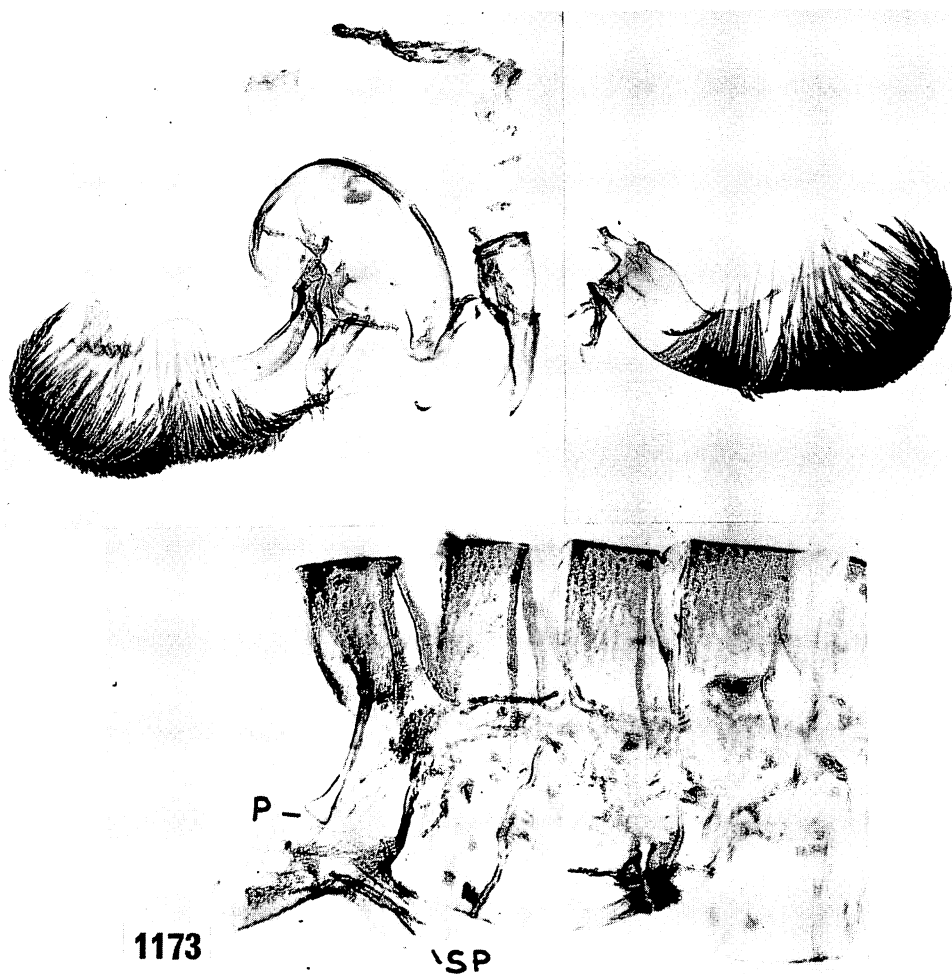


Figure 1173—Male genitalia of *Hyposmocoma (H.) similis* Walsingham, holotype (BM slide 4355); Kona, 4,000 feet, Hawaii. The photograph of the abdomen has been mounted upside down. Note the sclerotized anterior margins of sternites 5, 6, and 7. *P*, pseuduncus; *SP*, sclerotized dorsal flangelike process. Note the mid-costal lobe on the left valva. This species belongs to, and should be compared with, the *malornata* complex.

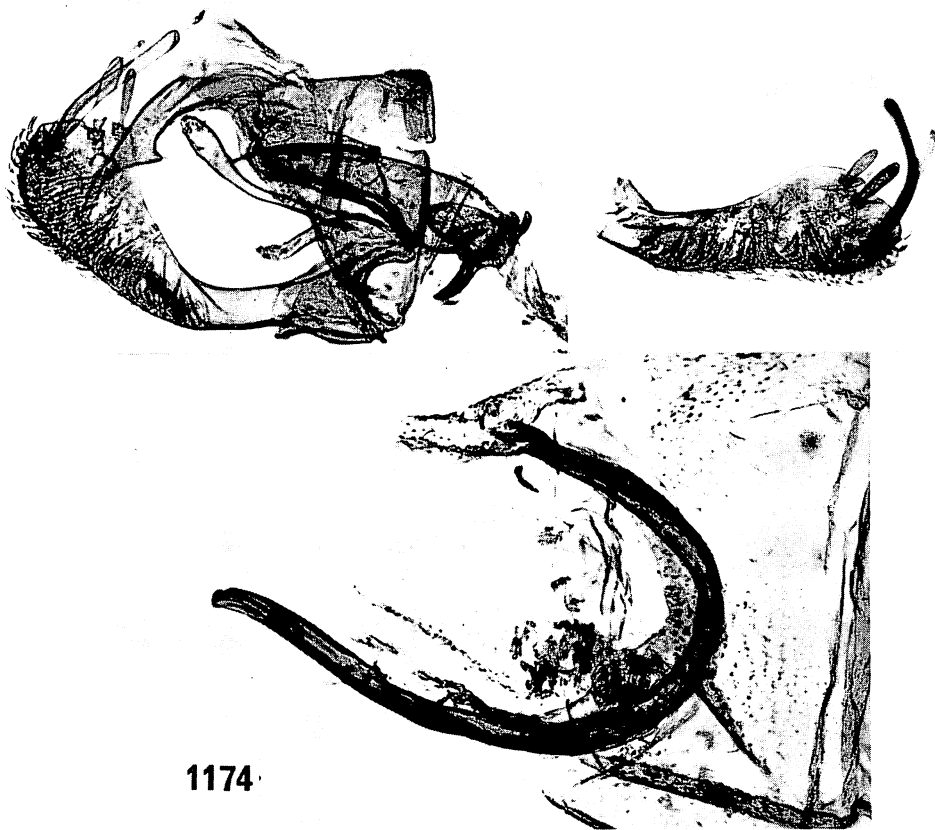


Figure 1174—Male genitalia of *Hyposmocoma* (*H.*) *somatodes* Walsingham, holotype (BM slide 5490); Kilauea, Hawaii. Compare the *admirationis* group. This species does not have a subcostal brush on the hindwing of the male, but the allied *lorella* (figure 1187) does have these brushes.

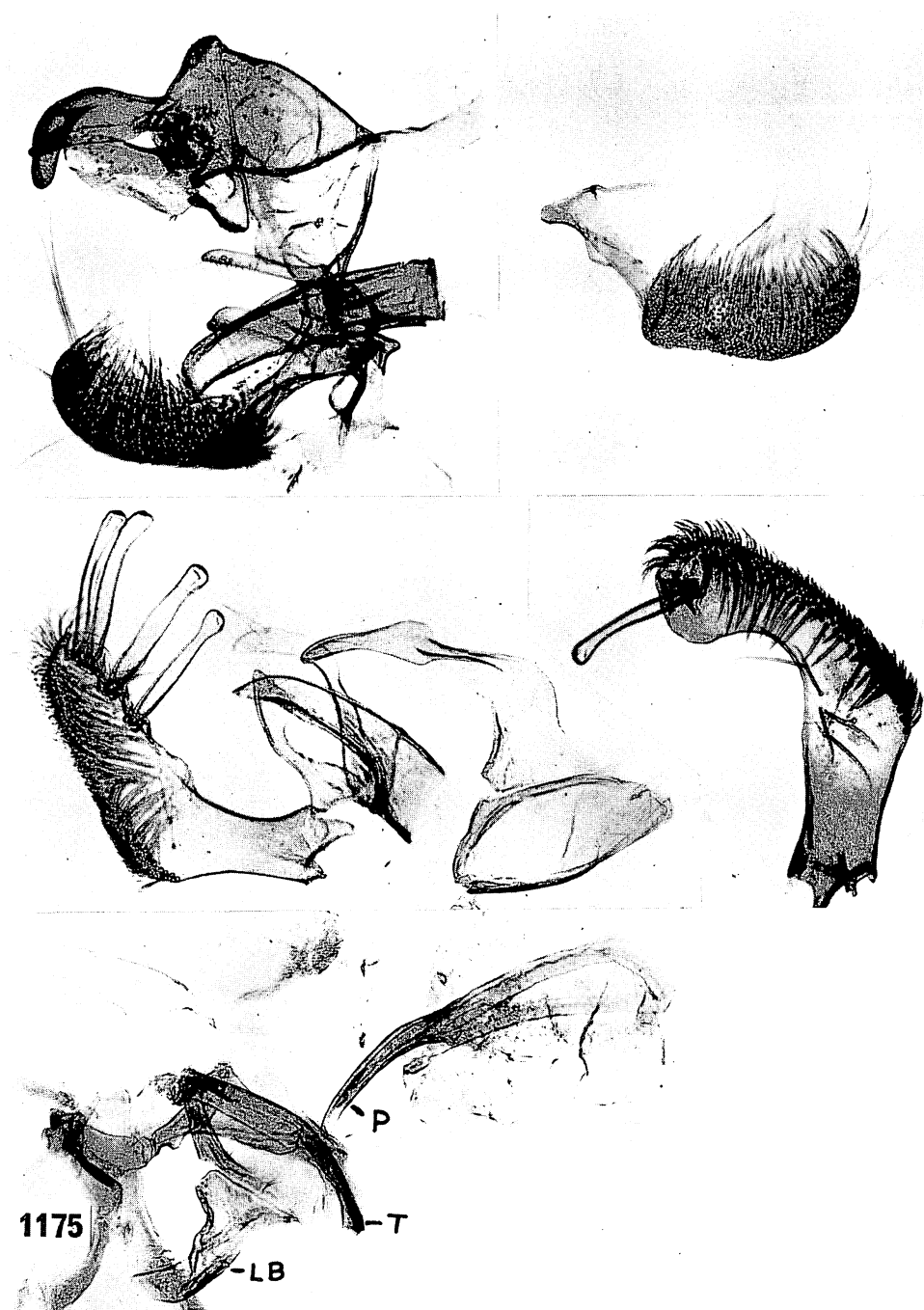


Figure 1175—Male genitalia of *Hypsoscoca*. Top, (*E.*) *stigmatella* Walsingham, holotype (BM slide 4144); Molokai, about 4,500 feet. Compare the *adolescens* group. Middle and bottom, (*H.*) *straminella* Walsingham, allotype (BM slide 4115); Kona, 4,000 feet; right valva at a different magnification. *LB*, left brachium, ventral aspect; *P*, pseuduncus; *T*, crushed tegumen.

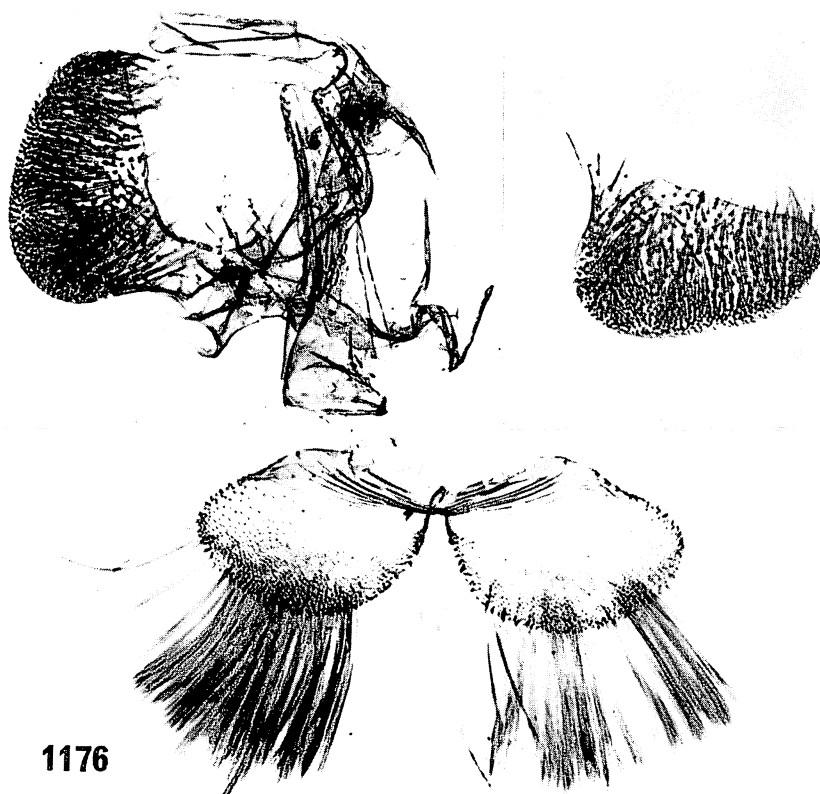


Figure 1176—Male genitalia of *Hypsmocoma* (*E.*) *subargentea* Walsingham, holotype (BM slide 4150); Kauai, 3,000 to 4,000 feet. Compare *argentea* and *subnitida*.



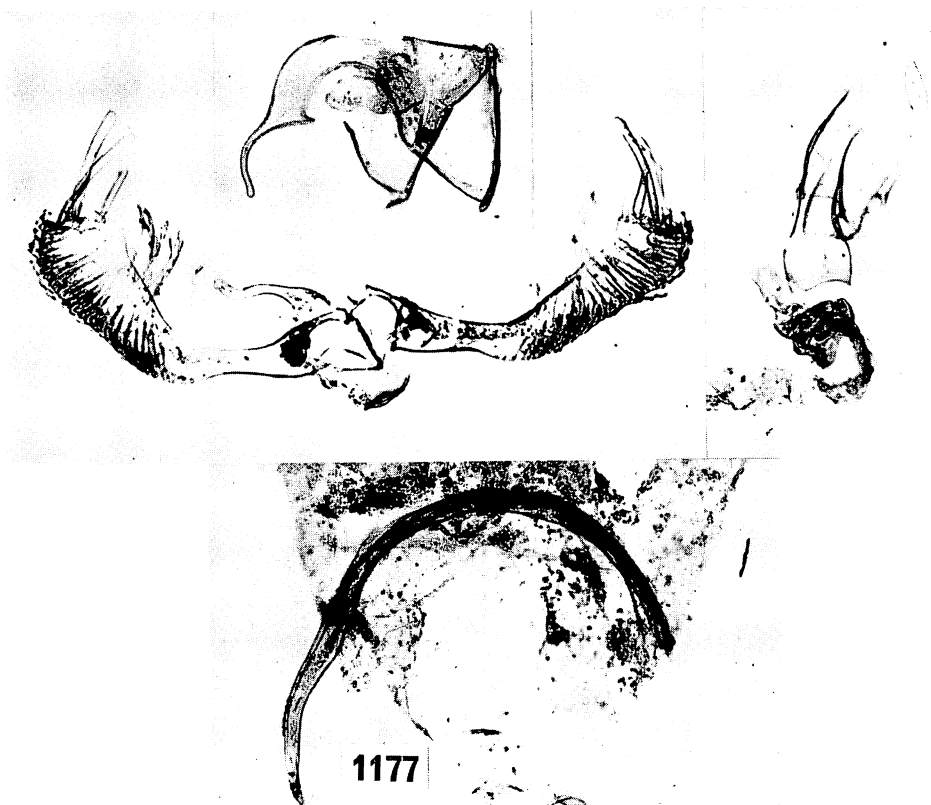
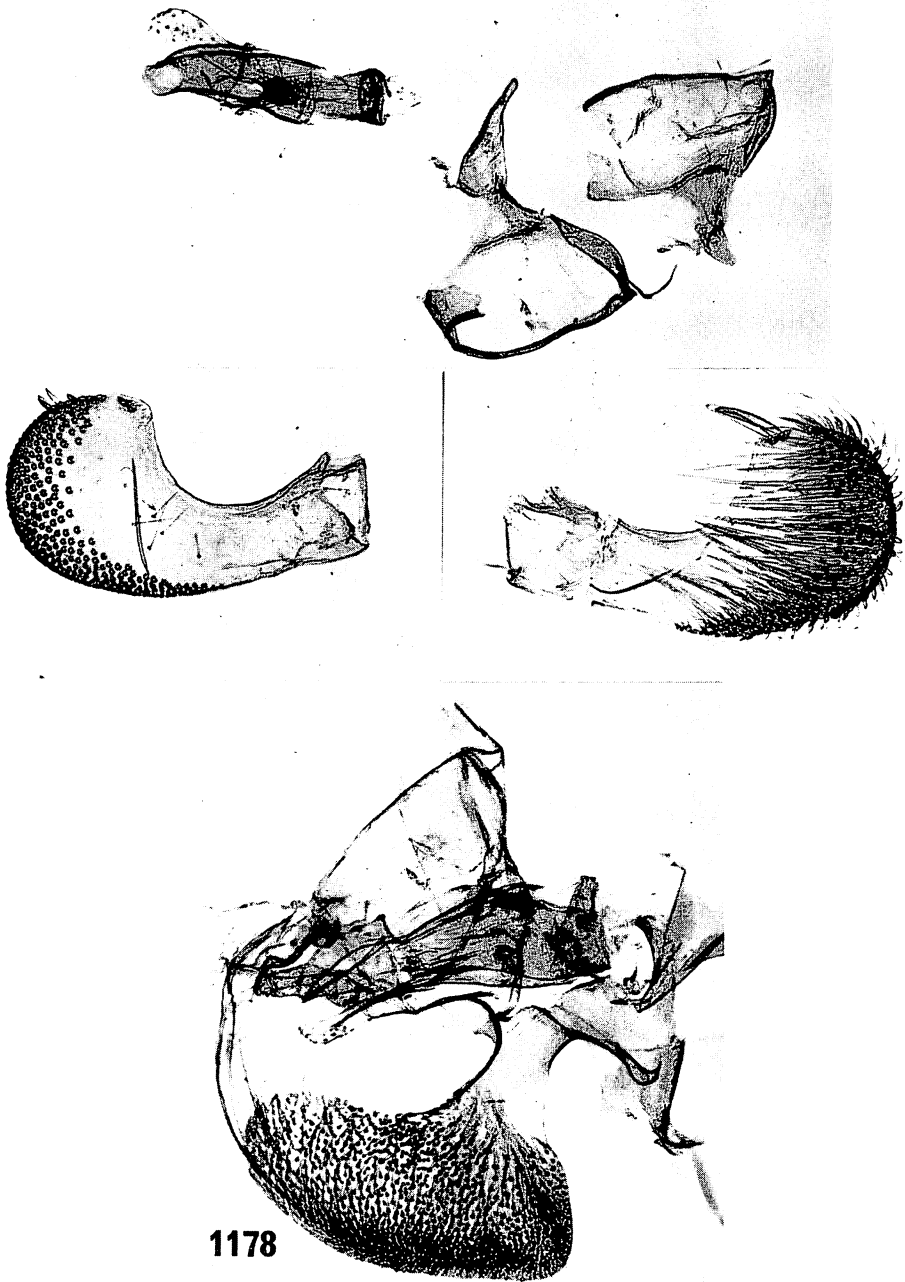


Figure 1177—Male genitalia of *Hypsmocoma* (*H.*) *subcitrella* Walsingham, allotype (BM slide 5231); Kaholuamano, 4,000 feet, Kauai. The abdomen is partly decomposed. Compare the *admirationis* group.



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Figure 1178—Male genitalia of *Hypsmocoma*. Top and middle, (*H.*) *subflavidella* Walsingham, holotype (BM slide 4106); Haleakala, 5,000 feet, Maui. Compare the *illuminata* group. Bottom, (*E.*) *subnitida* Walsingham, holotype (BM slide 4502); Kilauea, Hawaii. Compare *subargentea* and *subsericea*.

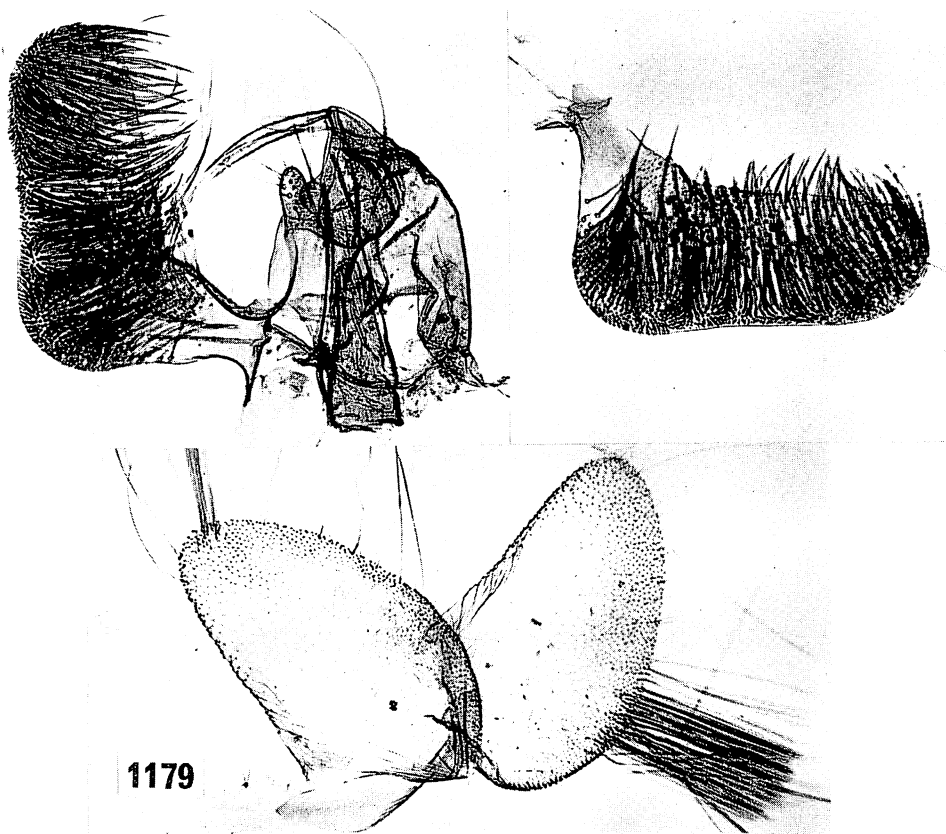


Figure 1179—Male genitalia of *Hypsmocoma* (*E.*) *subsericea* Walsingham, holotype (BM slide 4345); Molokai, 4,000 feet. Compare *illuminata*.

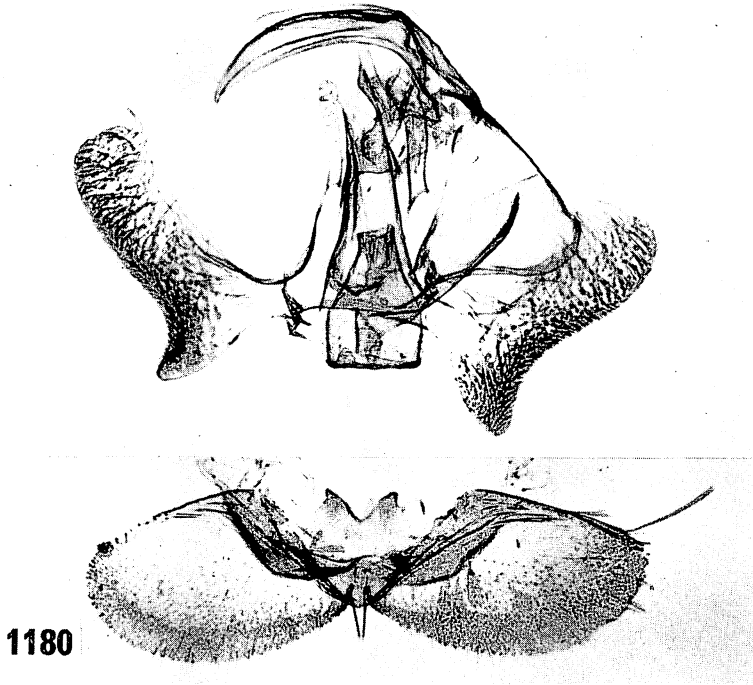


Figure 1180—Male genitalia of *Hyposmocoma* (E.) new species 29, formerly confused as a paratype (BM slide 7511) of *subsericea* (figure 1179, which see); Kilauea, Hawaii. This belongs to the “*Hyperdasyella*” group.

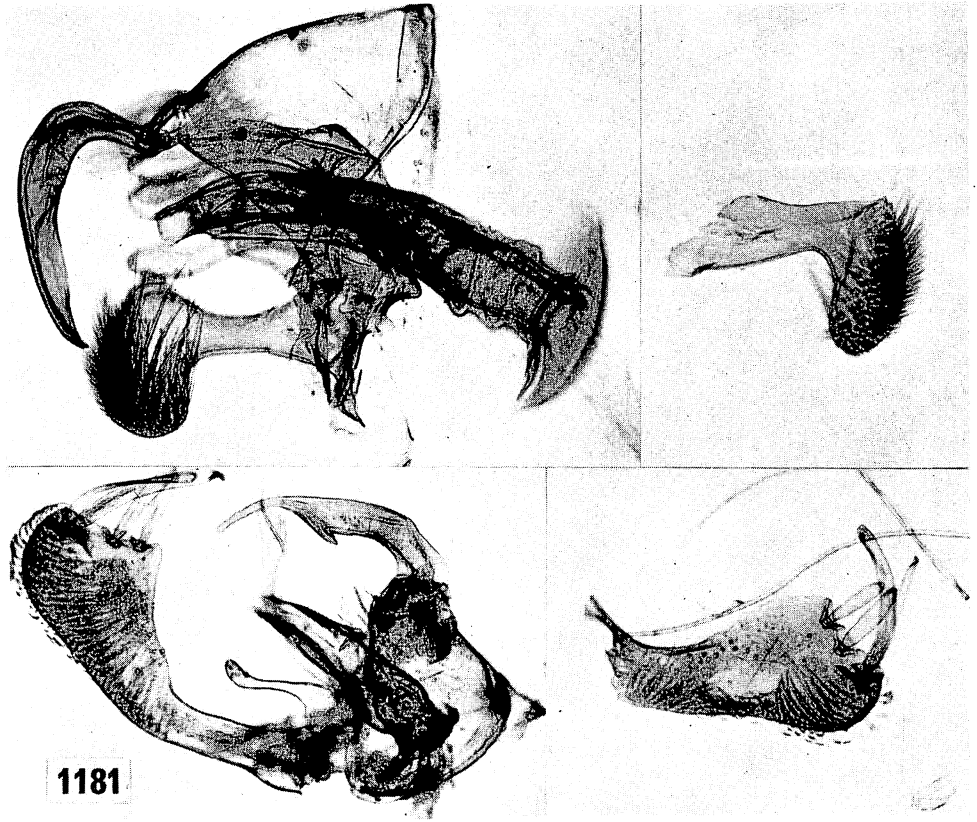


Figure 1181—Male genitalia of *Hypsmocoma*. Top, (*E.*) *sudorella* Walsingham, holotype (BM slide 4335); Kauai, 3,000 to 4,000 feet. The ejaculatory duct is sclerotized. Compare the *fulvida* group. Bottom, (*H.*) *subscolopax* Walsingham, holotype (BM slide 5488); Kilauea, Hawaii. Compare the *admirationis* group. This species has a small, incipient pseuduncus; compare the allied *torella* (figure 1187) which has a very strong pseuduncus.

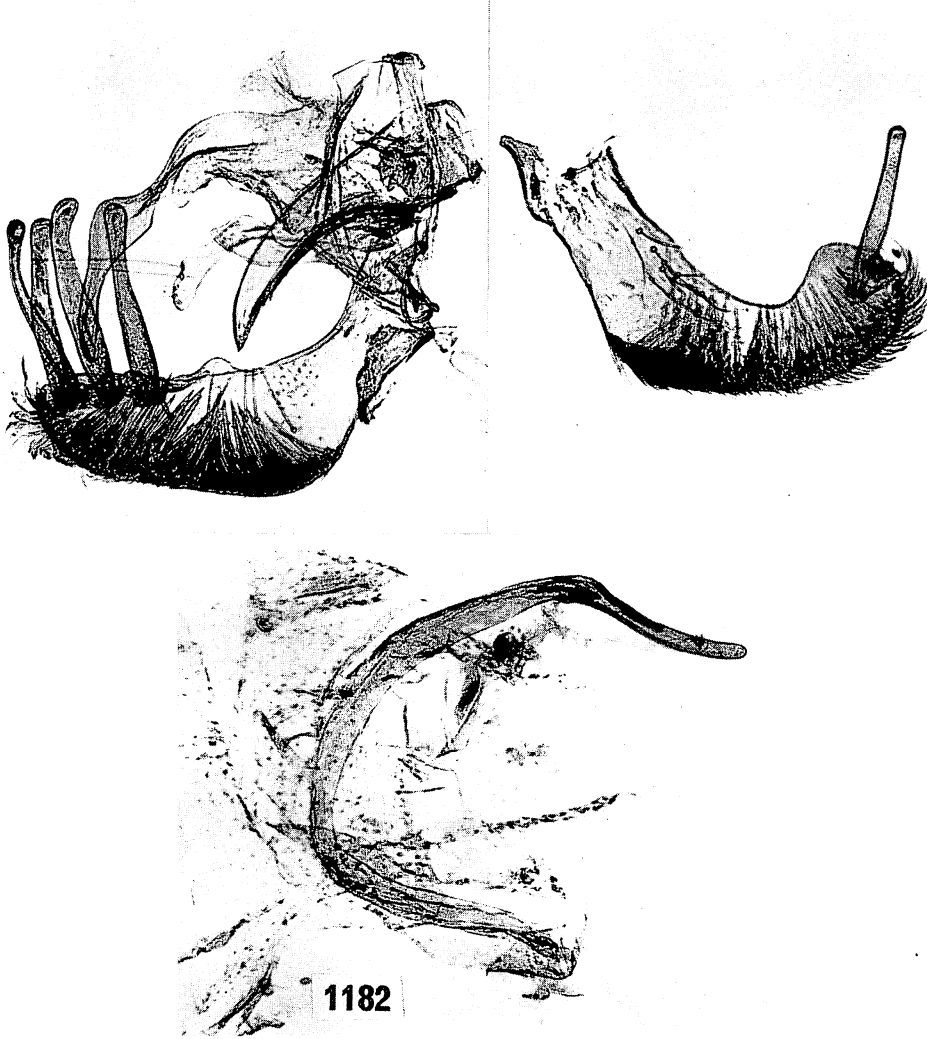


Figure 1182—Male genitalia of *Hypsmocoma* (*H.*) *suffusa* (Walsingham), formerly considered a form of *domicolens*; holotype (BM slide 4095); Kilauea, Hawaii.

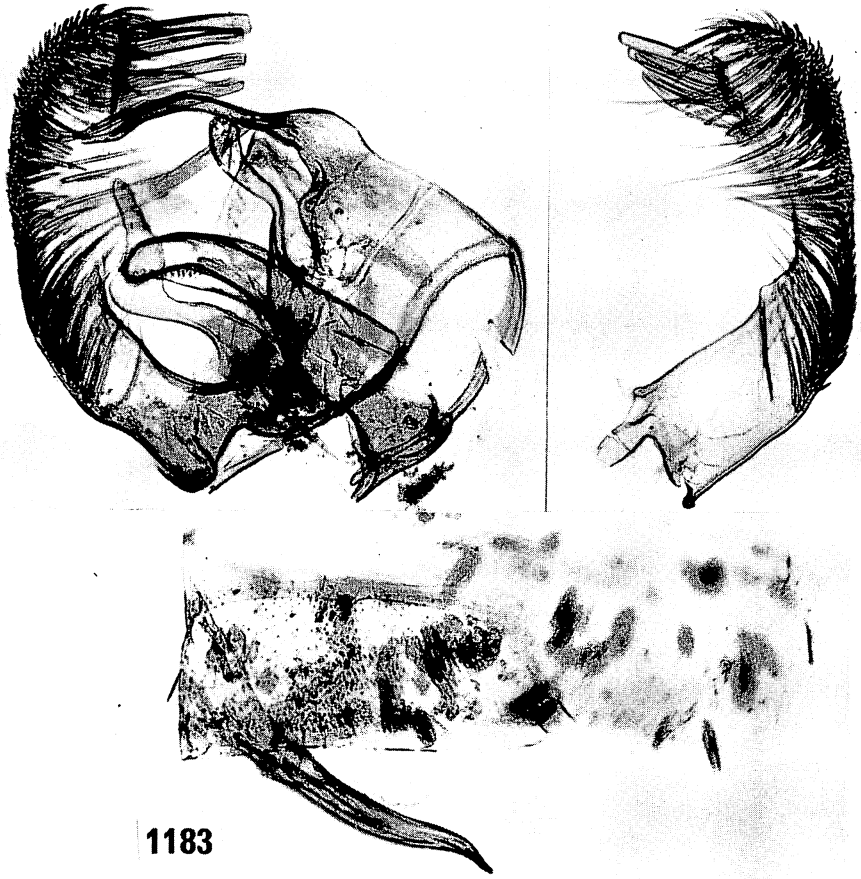


Figure 1183—Male genitalia of *Hypsoscoma* (*H.*) *syrrhaptus* Walsingham, holotype (BM slide 4347); Kauai, 3,000 to 4,000 feet. Compare the *iodes* group. Compare figure 1184 and note different anellar lobes. The male hindwing lacks a subcostal brush.

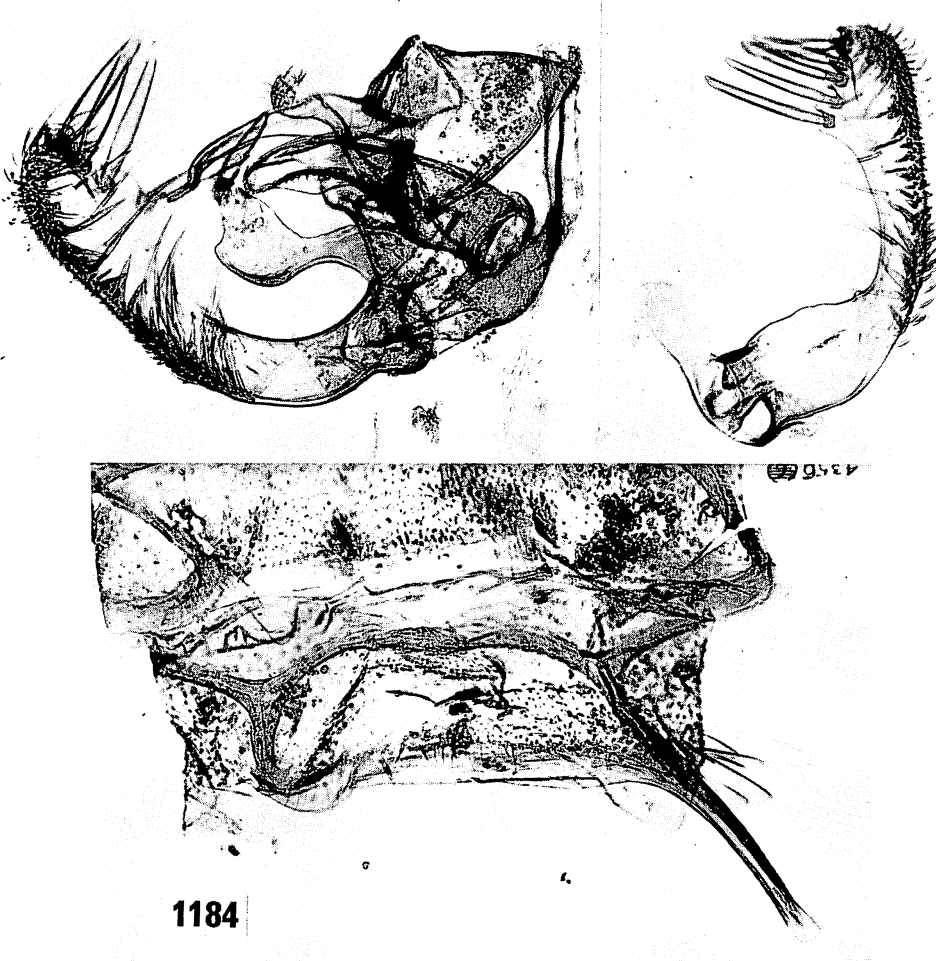


Figure 1184—Male genitalia of *Hypsoscoma* (*H.*) *tarsimaculata* Walsingham, holotype (BM slide 4356); Kauai, 3,000 to 4,000 feet. Compare the *iodes* group. Compare figure 1183 and note, for example, different anellar lobes. The male of this species has a subcostal brush on the hindwing.



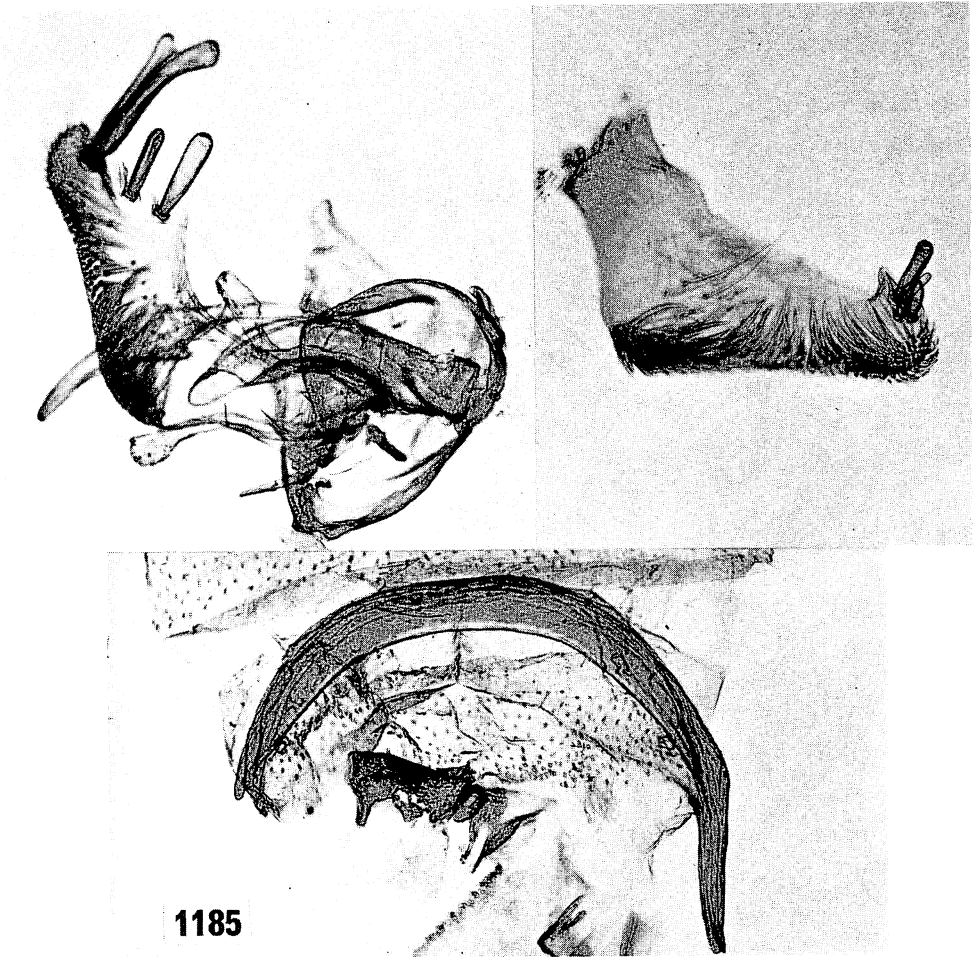


Figure 1185—Male genitalia of *Hypsmocoma* (*H.*) *tenuipalpis* Walsingham, holotype (BM slide 4085); forest above Pelekunu, Molokai. Compare *albifrontella* and allies.



Figure 1186—Male genitalia of *Hyposmocoma*. Top and middle, (*H.*) *tetraonella* Walsingham, holotype (BM slide 5489); Kona, 4,000 feet, Hawaii. See also figure 791. Compare the *admirationis* group. Bottom, (*E.*) *thermoxyla* Meyrick, lectotype (BM slide 9567 Clarke); Koolau Mts., near Honolulu. The apex of the ejaculatory duct is shown at right, pulled out of the aedeagus. Compare ("*Aphthonetus*") *fluctuosa* and associates.

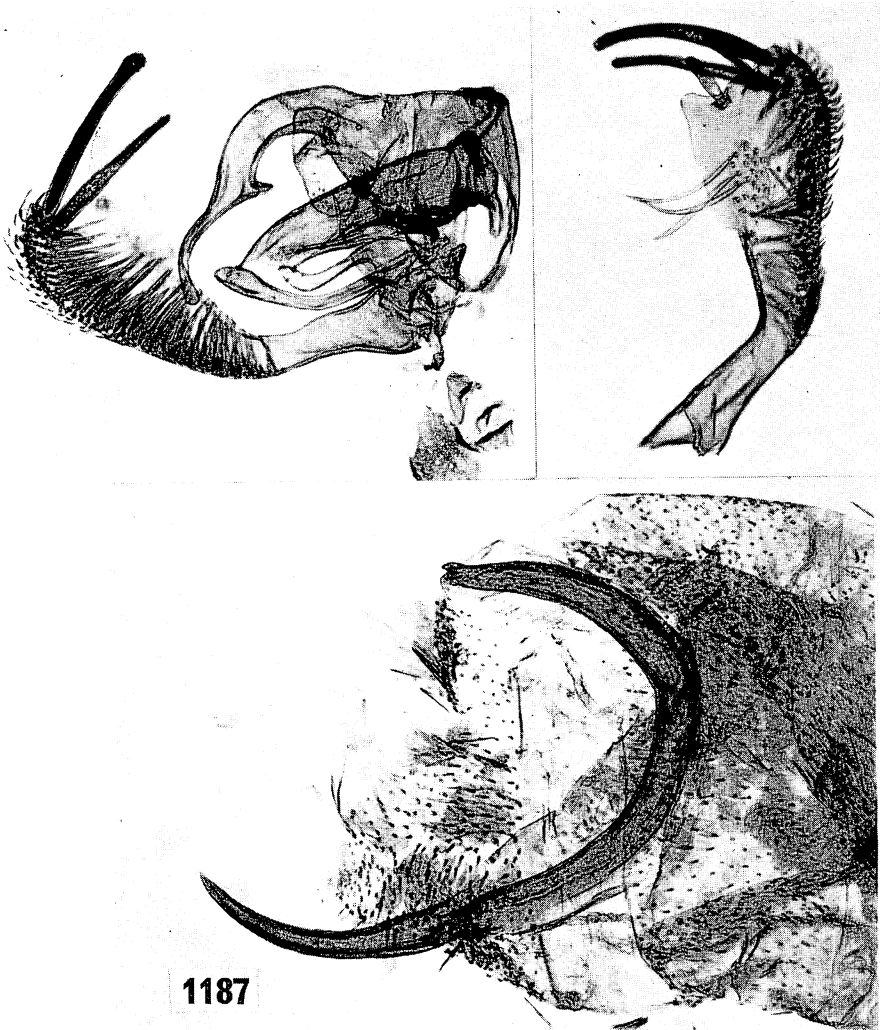


Figure 1187—Male genitalia of *Hypsmocoma* (*H.*) *torella* Walsingham, holotype (BM slide 4485); Molokai (no further data). Compare the *admirationis* group. These genitalia closely resemble those of *turdella*, for example, but this species has a subcostal brush on the hindwing of the male which is lacking on *turdella* (figure 1192).

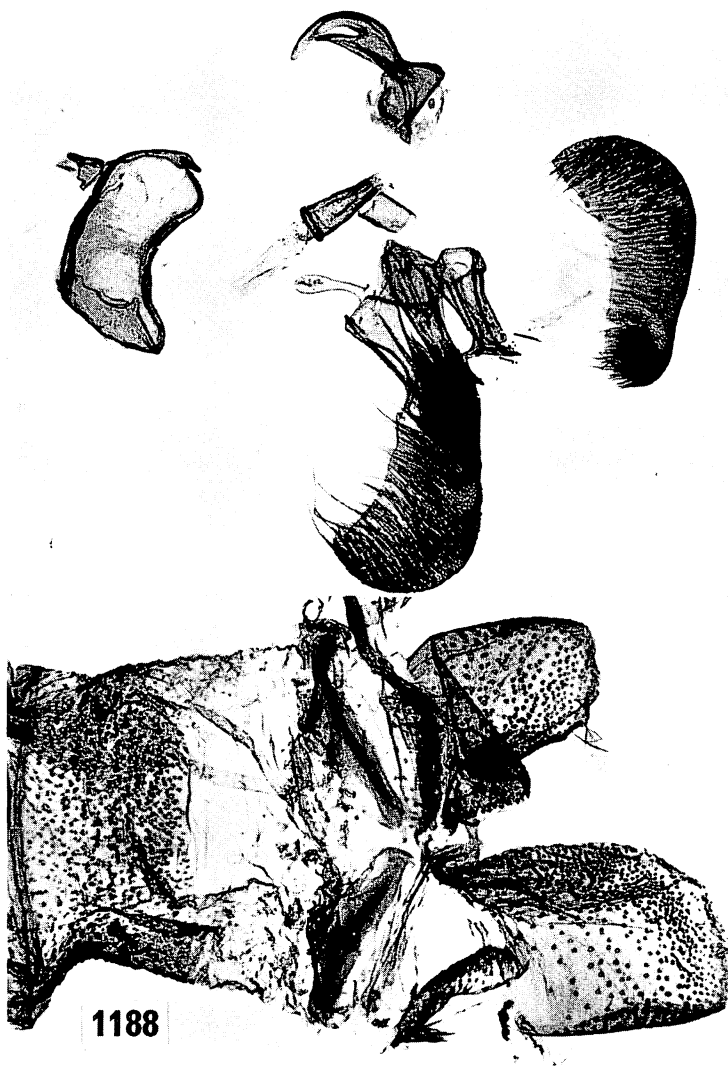
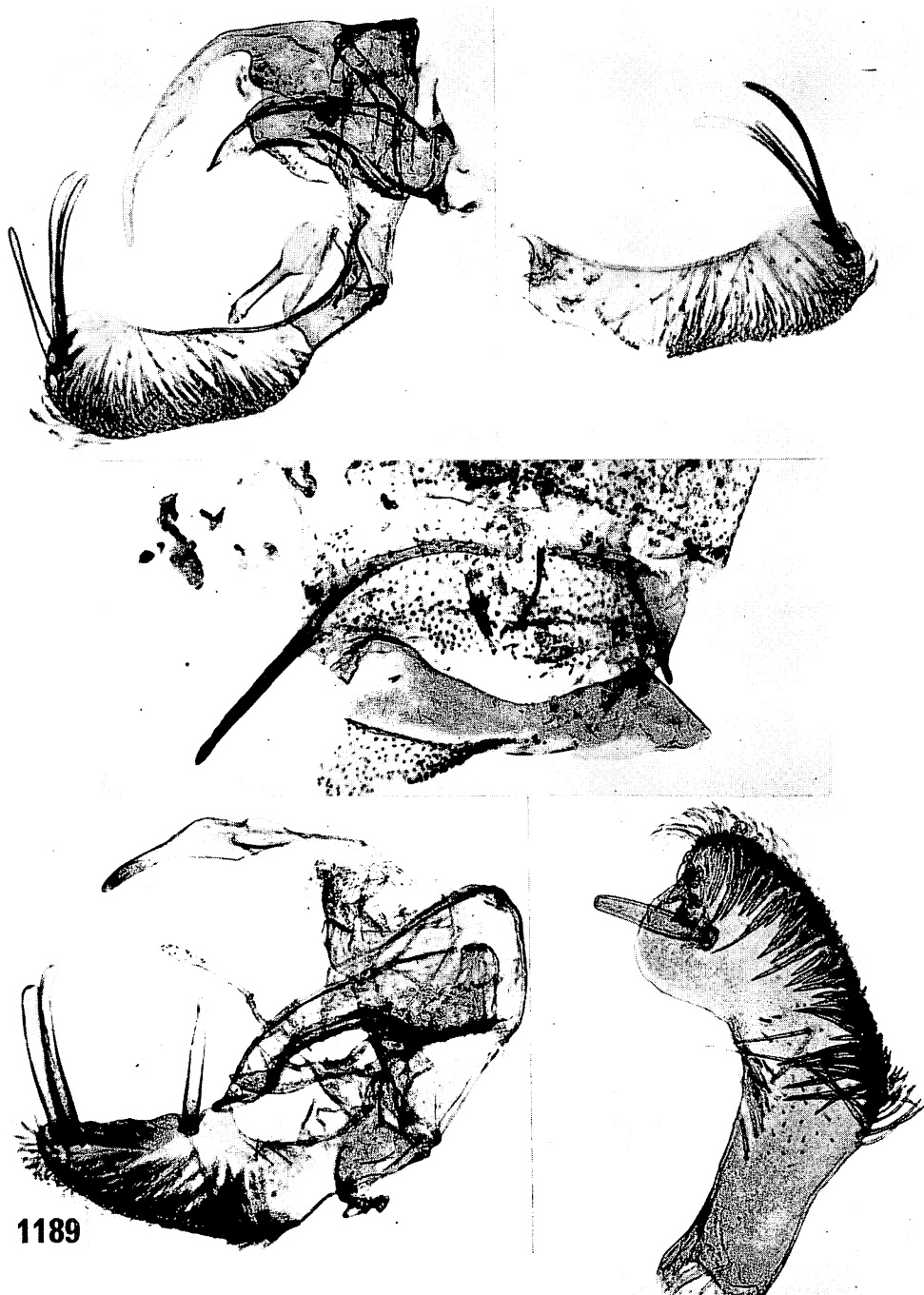


Figure 1188—Male genitalia of *Hypsocoma* (*H.*) *tricincla* Walsingham, paratype (BM slide 6469); Kilauea, Hawaii. Compare the *adolescens* group.



1189

Figure 1189—Male genitalia of *Hypsmocoma*. Top and middle, (*H.*) *trimaculata* Walsingham, holotype (BM slide 4320); Waianae Mts., Oahu. Compare the *admiratonis* group. Bottom, (*H.*) *tripartita* Walsingham, holotype (BM slide 4103); Molokai, 4,000 feet. The right valva is shown at a higher magnification. There is a strong pseuduncus which has not been illustrated. Compare the *iodes* group. Evidently two spurs have been lost from the left valva.



Figure 1190—Male genitalia of *Hyposmocoma*. Top, (*H.*) *triptila* Meyrick, lectotype (BM slide 9577 Clarke); Koolau Mts., Oahu. The black spots on the extraordinary, trowellike submedial spur on the costa of the left valva are air bubbles trapped inside. There is a strong pseuduncus which is not shown. The tegumen is small. The position of the specimen in the mount makes the photograph somewhat confusing. *Ae*, aedeagus; *LA*, left anellar lobe; *RA*, right anellar lobe; *RB*, right brachium; *T*, tegumen. Compare the *mimema* group. Bottom, (*H.*) *unistriata* Walsingham, holotype (BM slide 4120); above Pelekunu, Molokai.

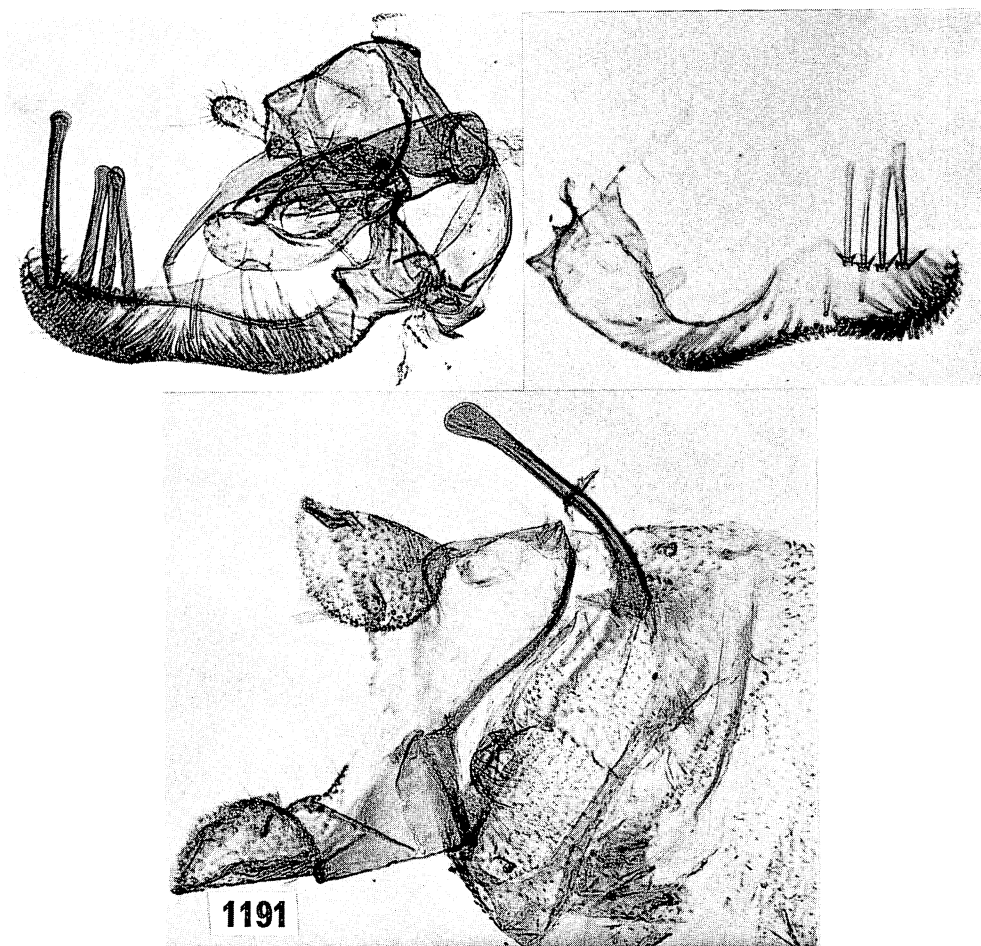


Figure 1191—Male genitalia of *Hypsocoma* (*H.*) *trossulella* Walsingham, holotype (BM slide 4090); Waianae Mts., about 2,000 feet, Oahu. Note the small costal process near the basal third of the right valva and, also, the large process on the left valva. This species may belong to or near the *malornata* complex.



Figure 1192—Male genitalia of *Hyposmocoma* (*H.*) *turdella* Walsingham, allotype (BM slide 4491); Lanai, 2,000 feet. Compare the *admirationis* group. The male of this species lacks a subcostal brush on the hindwing, but compare the closely similar genitalia of *torella* (figure 1187) which has brushes.



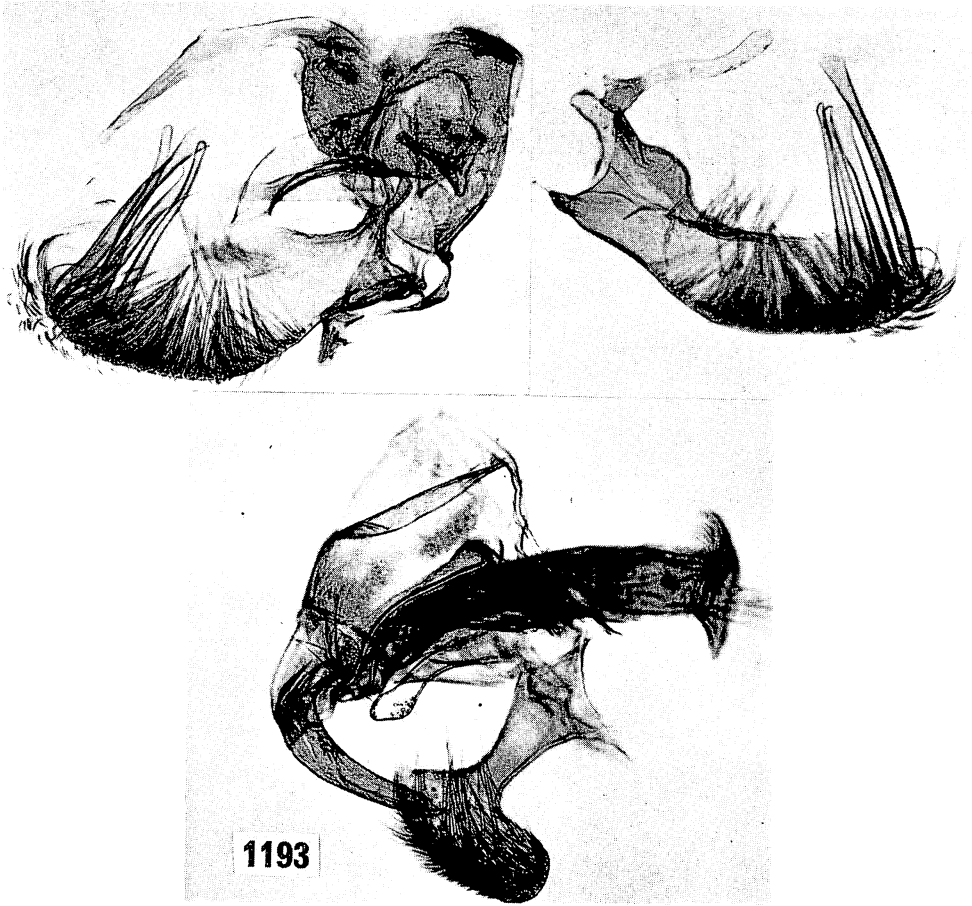


Figure 1193—Male genitalia of *Hypsmocoma*. Top, (*H.*) *vermiculata* Walsingham (BM slide 4133); Kilauea, Hawaii. This species has no pseuduncus. Compare the closely related *marginolata* (figure 1118), which has subcostal brushes on the hindwings of the males, whereas *vermiculata* lacks the brushes. Bottom, (*E.*) *vicina* Walsingham, holotype (BM slide 4336); Waianae Mts., 1,700 feet, Oahu. The ejaculatory duct is sclerotized. Compare the *fulvida* group.

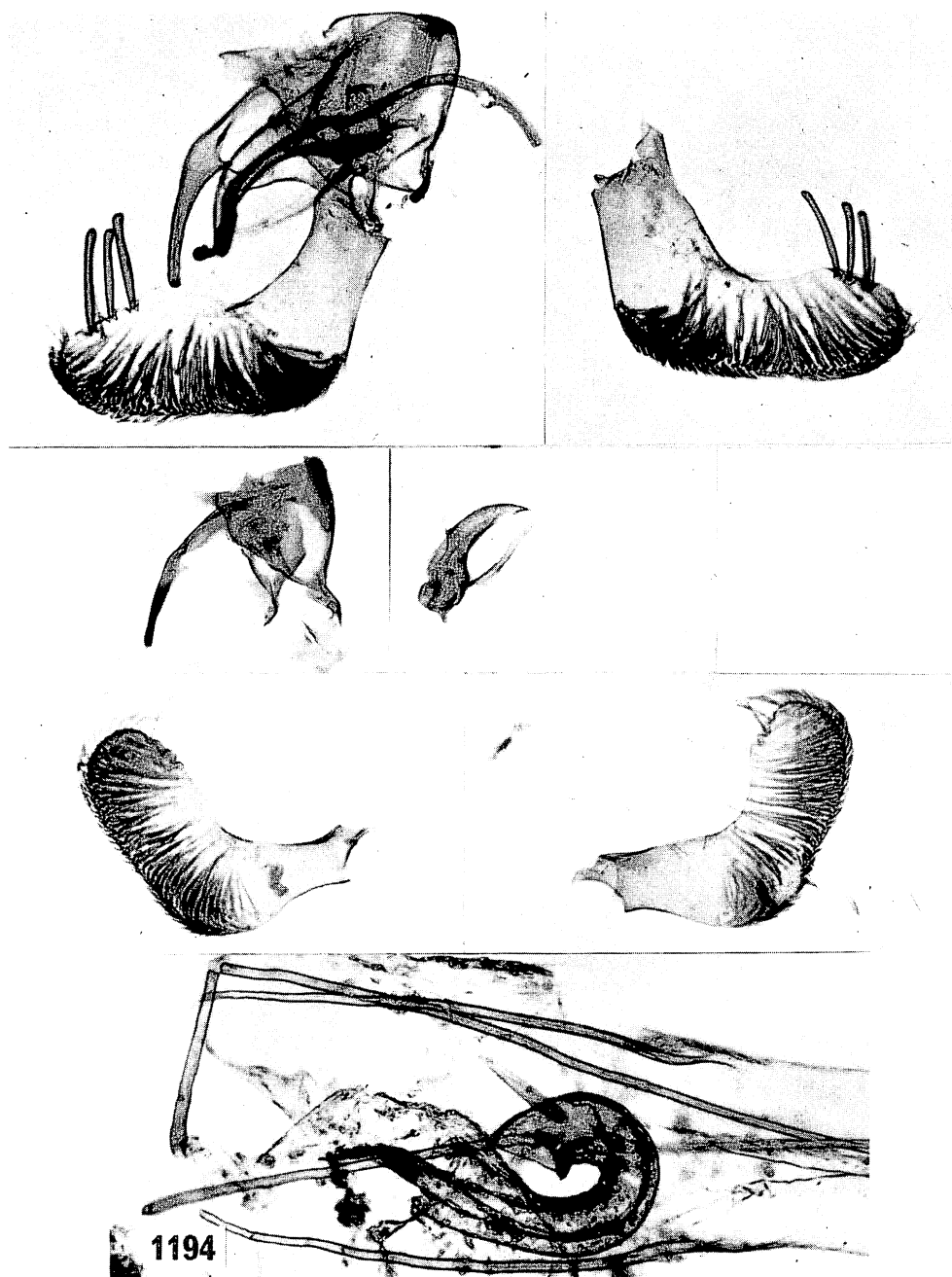


Figure 1194—Male and female genitalia of *Hypsomocoma* (*H.*) *virgata* Walsingham. Top, male genitalia of the allotype (BM slide 4111); Molokai, about 4,000 feet. Middle four, from a paratype (BM slide 5467); supposedly of the same species, but possibly a distinct form; Haleakala, 5,000 feet, Maui. Bottom, ostium of the holotype (BM slide 7919); Molokai, about 4,000 feet. Compare the *auripennis* group.

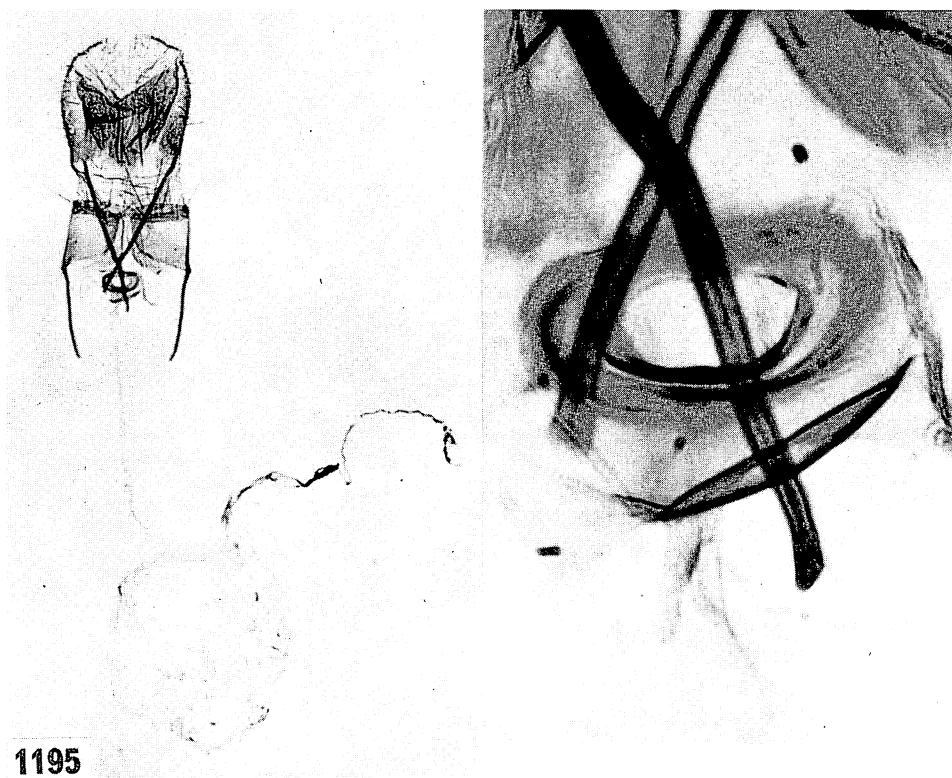


Figure 1195—Female genitalia of *Hypsmocoma* that is supposedly a paratype of (*E.*) *adelphella* (Walsingham) from Kauai, 3,000 to 4,000 feet (BM slide 8024). Compare figure 1226 and see the text.

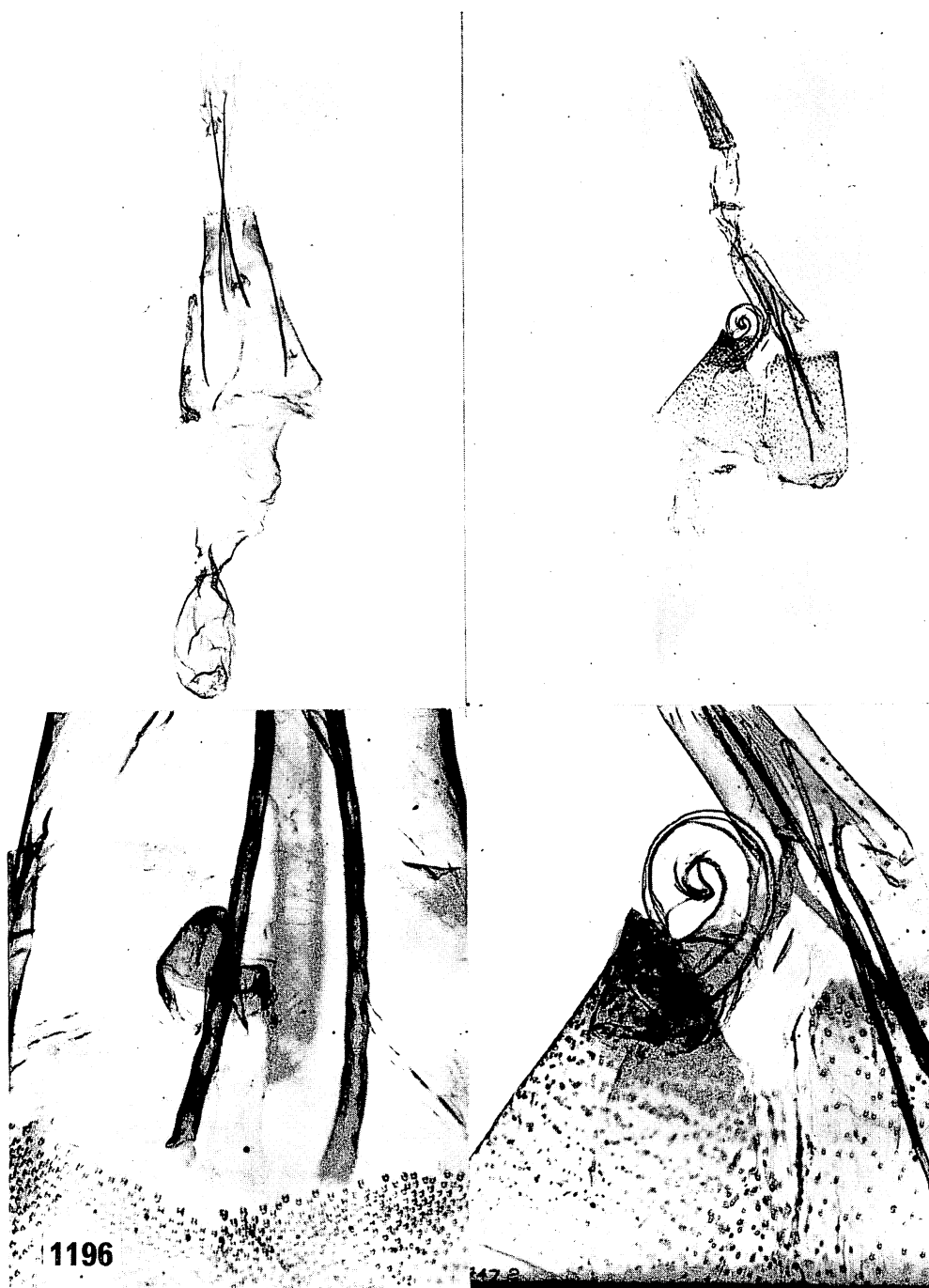


Figure 1196—Female genitalia of *Hypsoscyma*. Left, top and bottom, (*E.*) *chilonella chilonella* Walsingham, allotype (BM slide 6454); Kauai, 3,000 to 4,000 feet (the print of the complete genitalia has been reversed). Right, top and bottom, (*H.*) *adjacens* (Walsingham), holotype (BM slide 4472); Kauai, 3,000 to 4,000 feet. The bursae do not contain signa in these species. The ostium is enlarged in each lower figure. Note the great difference in these representatives of the two subgenera of *Hypsoscyma*.

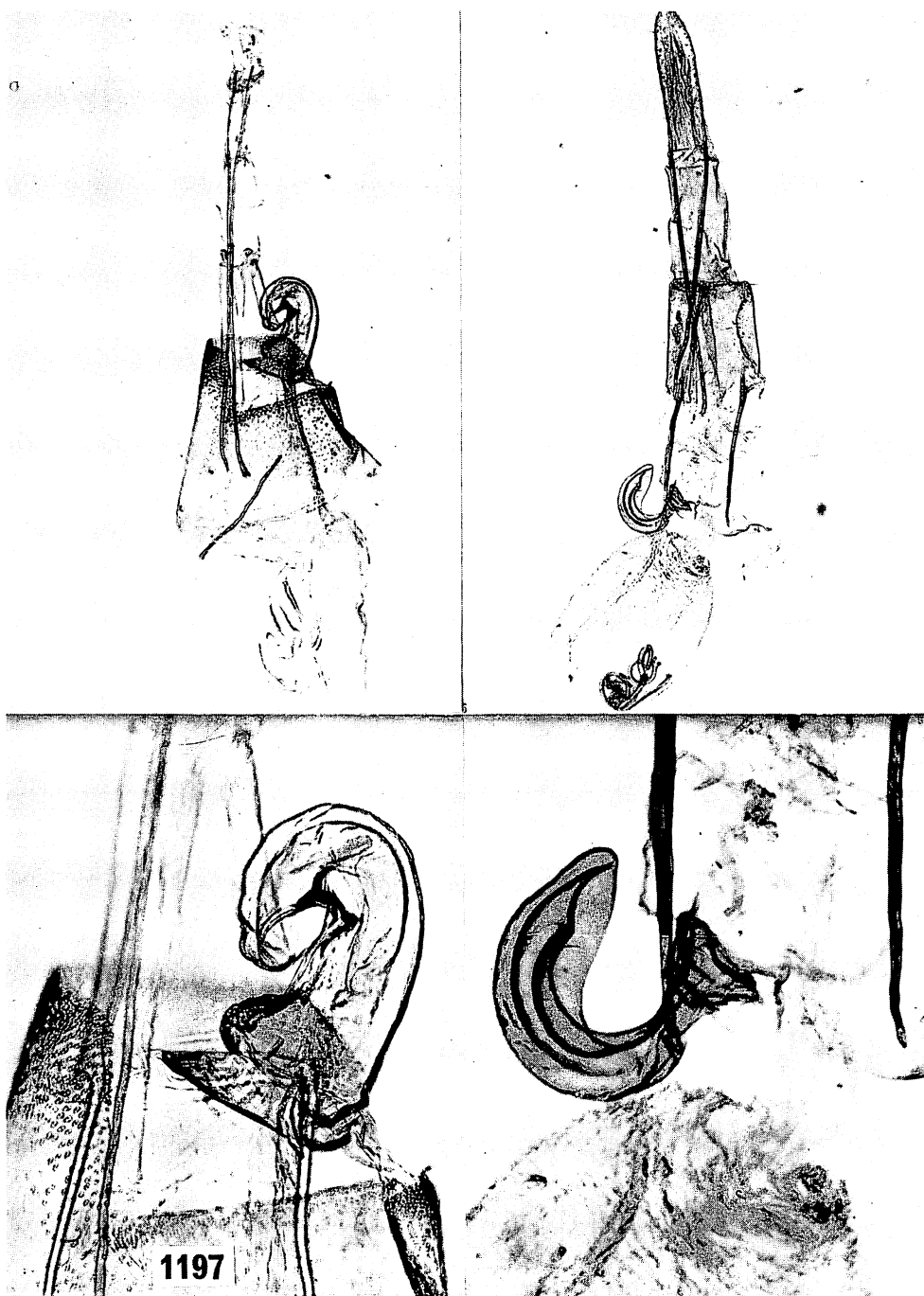
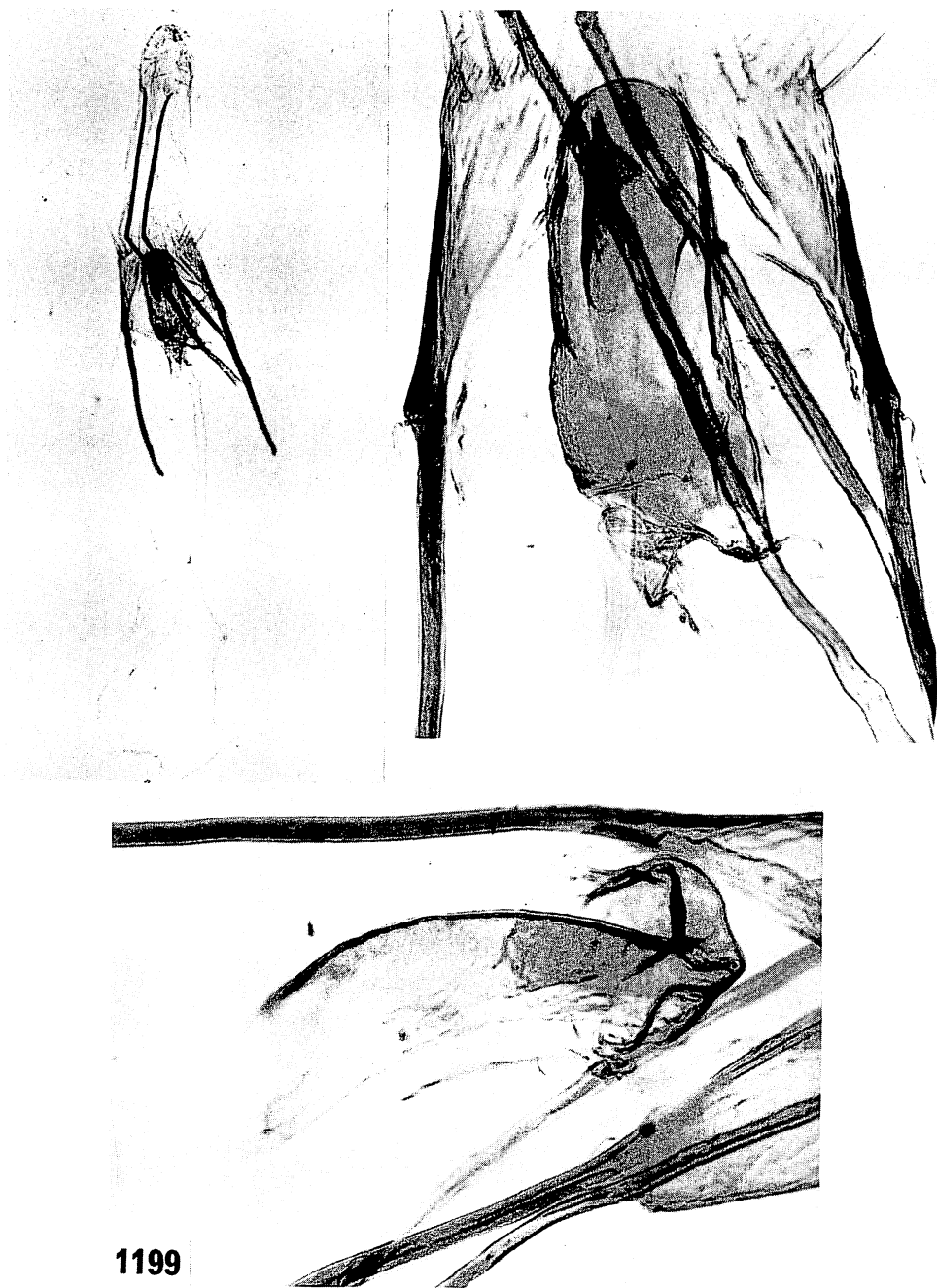


Figure 1197—Female genitalia of *Hypsoscoma*. Left, (*H. divisa* Walsingham, allotype (BM slide 4470); Kauai, 3,000 to 4,000 feet. Right, (*H. domicolens* (Butler), holotype (BM slide 4096); Makawao, about 2,000 feet, Maui (this specimen was wrongly labeled "male"). The bursae of these species lack signa.



Figure 1198—Female genitalia of *Hyposmocoma*. Top, left and right, *(E.) coprosmae* (Swezey) ("*Semnoprepia*"), paratype (slide Z-IX-5-61-C); Malamalama, Oahu. Note the unusual dorsal prolongations dorsad and cephalad of the ostium ("O"). Bottom left, ostium of *(E.) fulvogrisea* (Walsingham) ("*Semnoprepia*"), allotype (BM slide 7230); Kauai, 3,000 to 4,000 feet. Bottom right, ostium of *(E.) homopyrrha* (Meyrick) ("*Phthoraula*"), holotype (slide Z-IX-5-61-A); Nuuanu, Honolulu.



1199

Figure 1199—Female genitalia of *Hypsoscoma* (*Euperissus*) species. Top, left and right, ("Aphthonetus") *empetra* (Meyrick); Koolau Mts., Oahu; Perkins, 1909 (Meyrick collection) (BM slide 15864). Bottom, ("Aphthonetus") *polia* (Walsingham); Halemanu, 4,000 feet, Kauai; allotype (BM slide 7564). *Caution*: the abdomen was found detached from the moth—an error is possible.

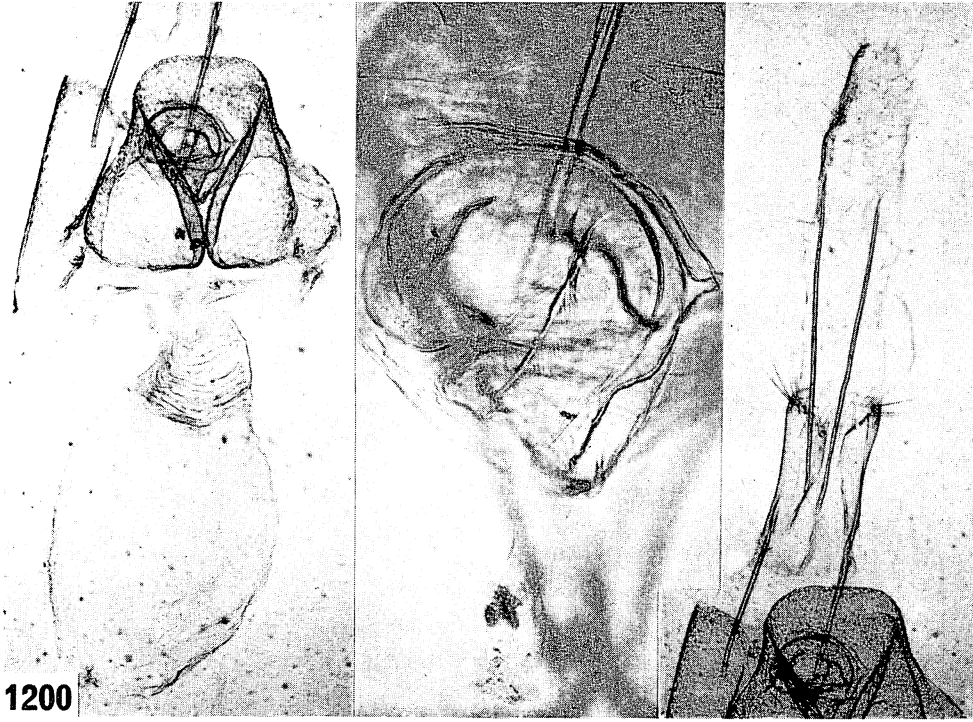


Figure 1200—Female genitalia of *Hypsoscoma* (*H.*) *genitalis* Walsingham, allotype (BM slide 8544). The middle figure shows the ostium focused within the peculiar, enveloping seventh abdominal segment.



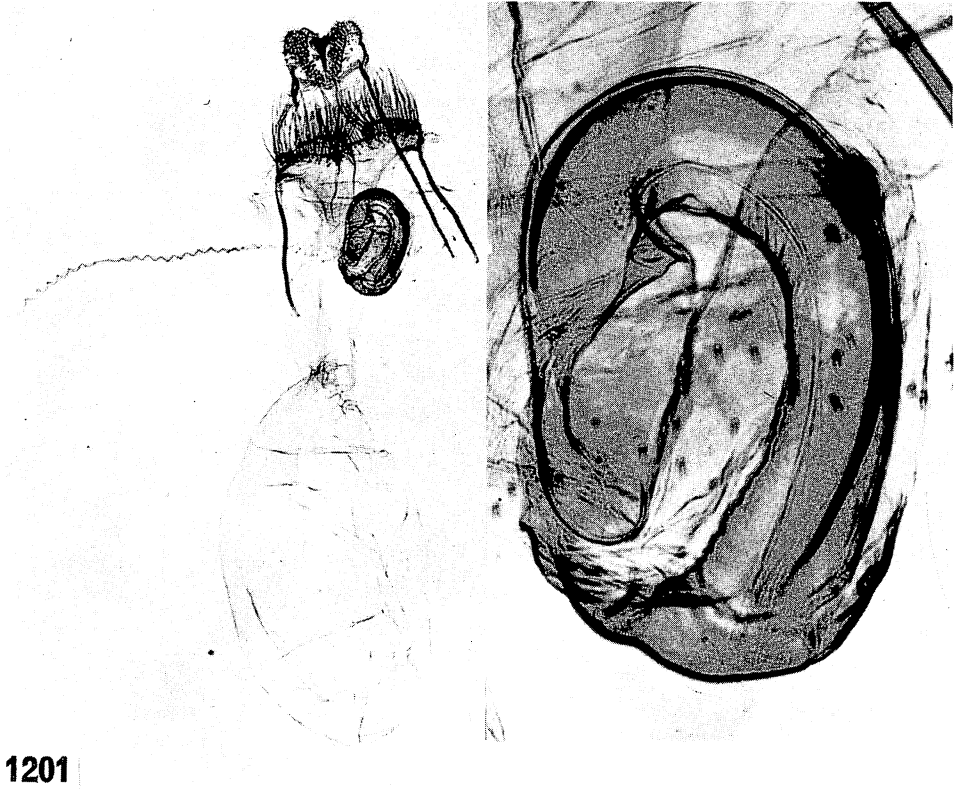


Figure 1201—Female genitalia of *Hyposmocoma* (*H.*) *hygroscopta* Meyrick; Halemanu, Kauai; an undesignated paratype in the Meyrick collection (BM slide 15869).

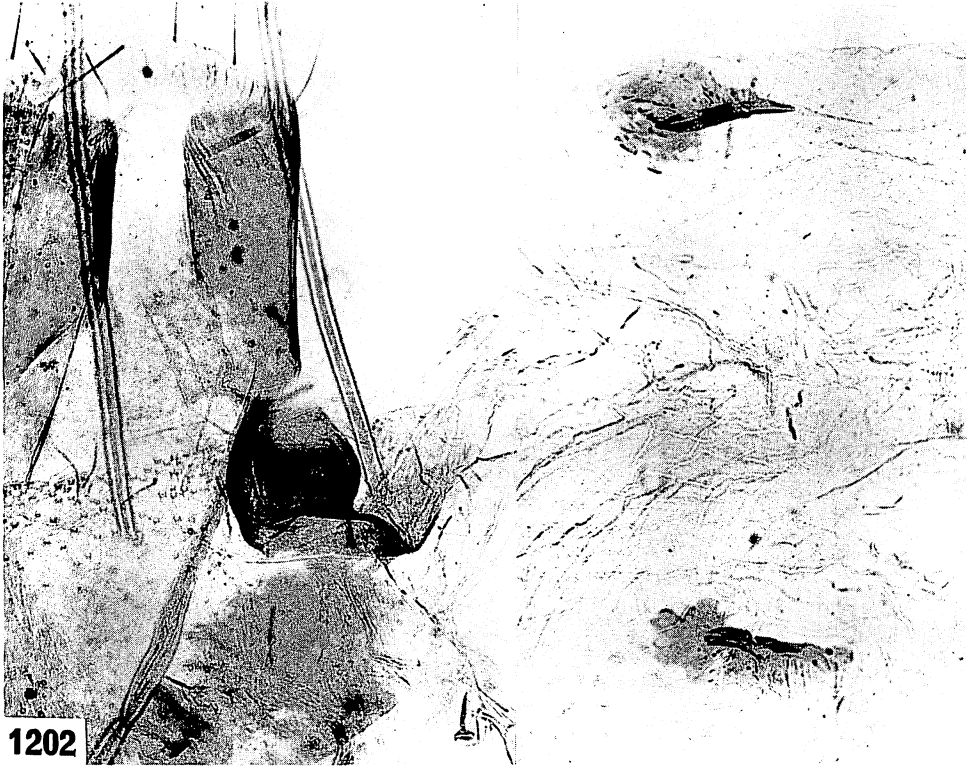


Figure 1202—Ostium and signa of the bursa copulatrix of *Hyposmocoma* (E.) *latiflua* Meyrick (Busck slide 205); Oahu.

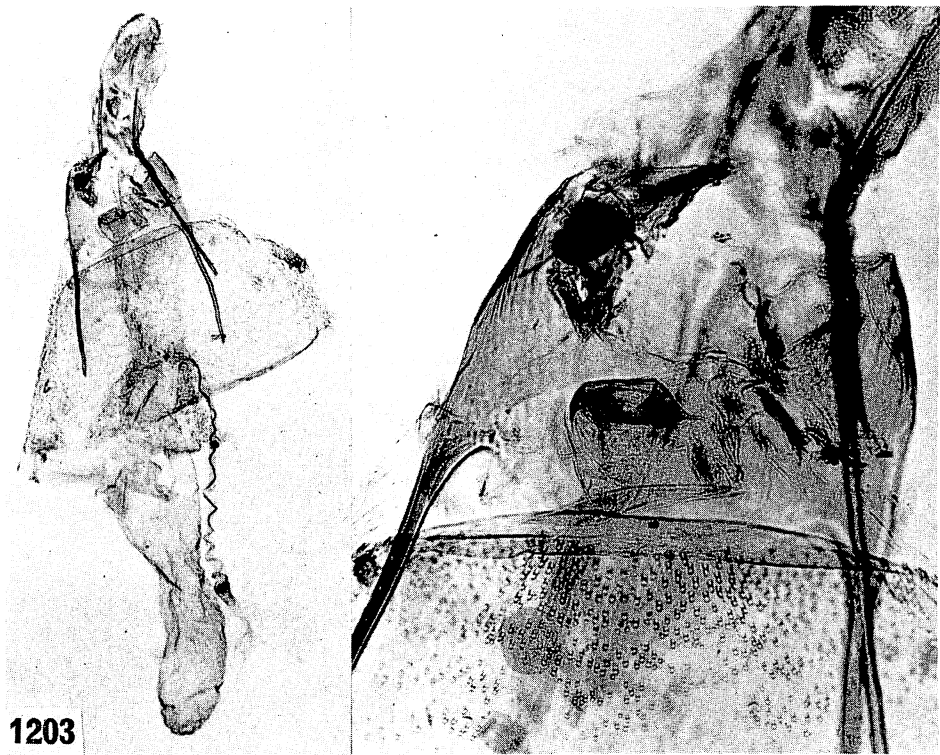


Figure 1203—Female genitalia of *Hyposmocoma* (E.) (“*Aphthonetus*”) *lichenalis* (Walsingham), paratype (BM slide 7559); Lanai.



Figure 1204—Female genitalia of *Hypsoscoma* (*E.*) *nipholoncha* (Meyrick); Mt. Tantalus, Oahu; holotype (slide Z-70-1).

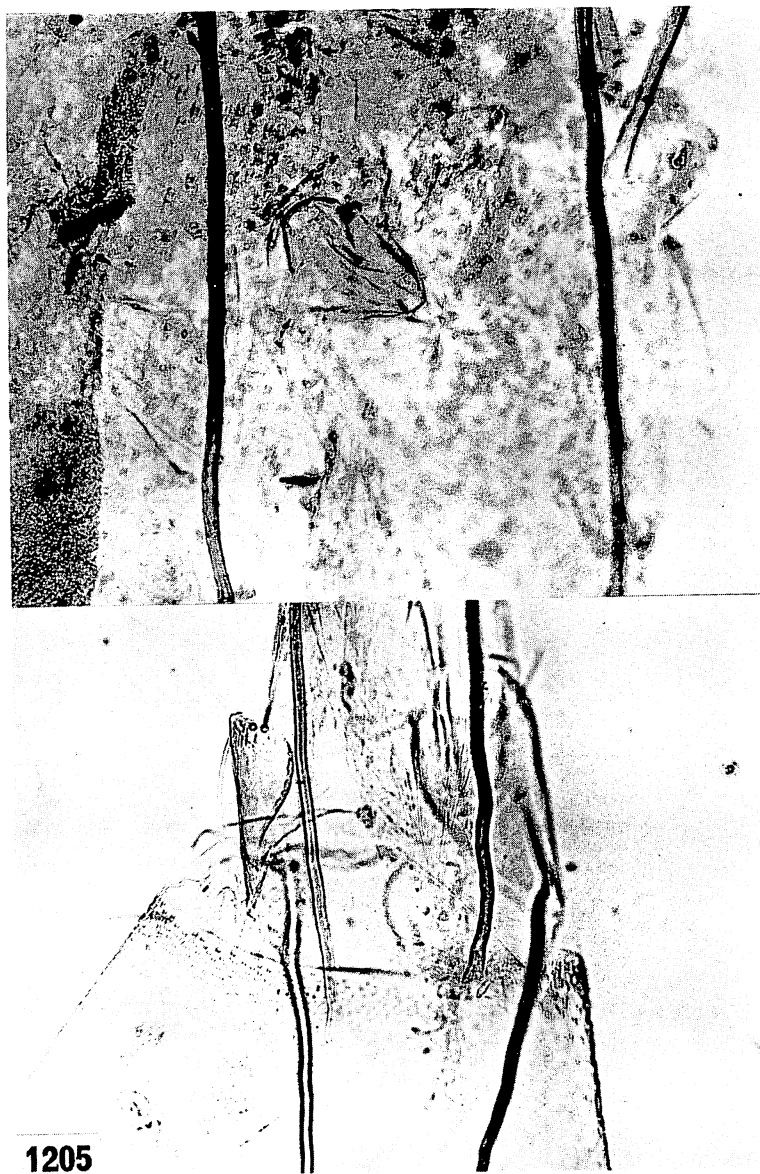


Figure 1205—Ostial areas of two species of *Hyposmocoma* (*Euperissus*) ("*Neelysia*"). Top, *petalifera* (Walsingham), allotype female (BM slide 7722); Haleakala, 5,000 feet. Bottom, *rotifer* (Walsingham), holotype (BM slide 4463); Molokai, 3,000 feet. Note the great reductions in the ostia of these species.

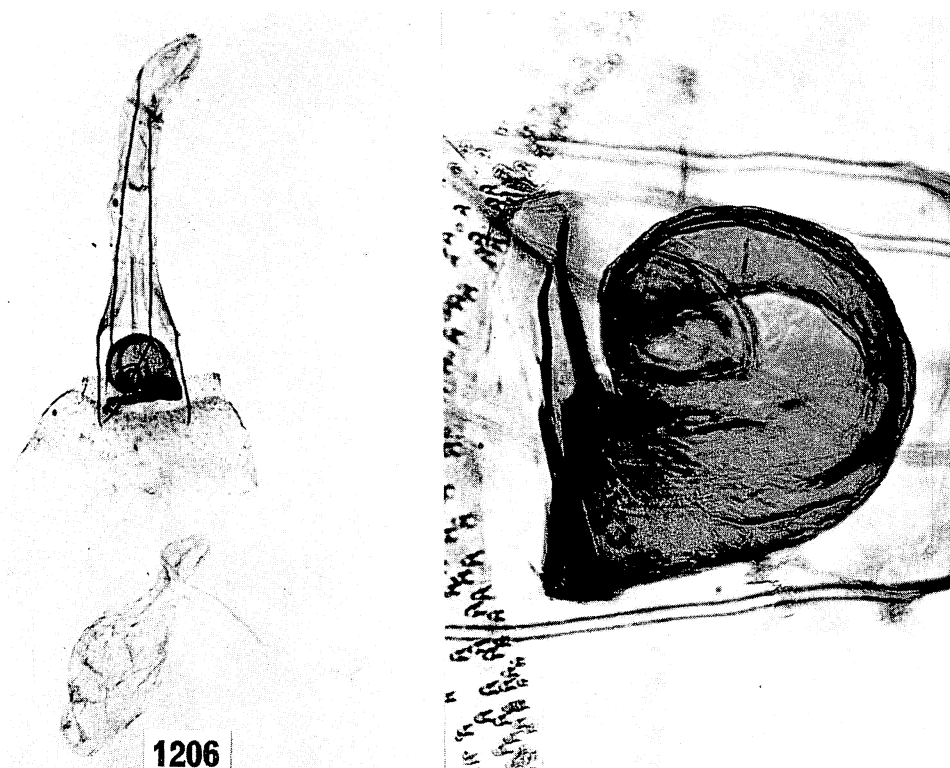
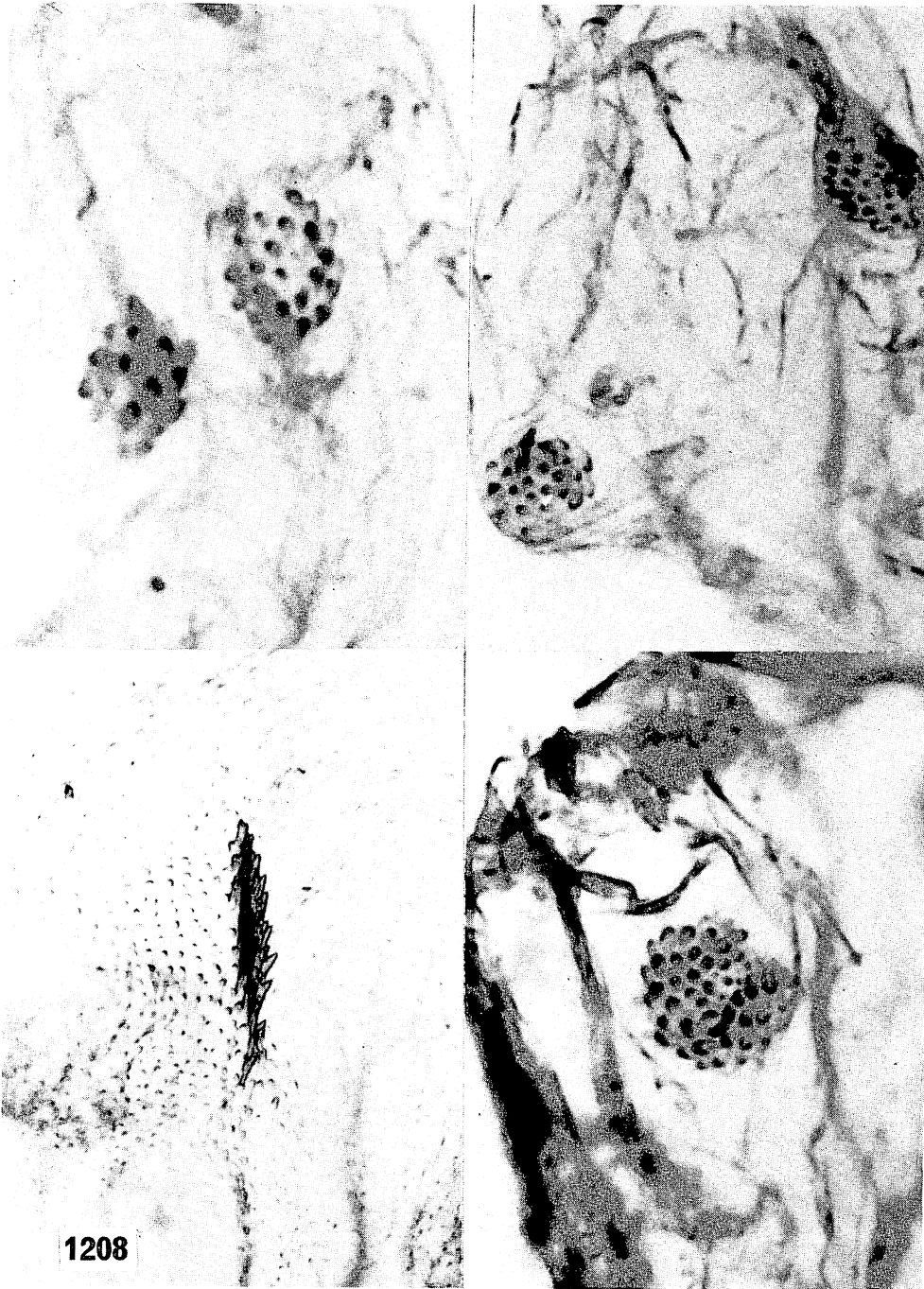


Figure 1206—Female genitalia and enlarged ostium of *Hyposmocoma* (*H.*) new species 23 (slide Z-I-12-66-C); Nihoa Island.



Figure 1207—Signa of female genitalia of *Hypsmocoma*. Top left, (*E.*) *argentea* Walsingham, allotype (BM slide 7961); Molokai, about 4,000 feet. There is only one signum on this and on one other specimen (Busck slide 44; Walsingham specimen 28718). Top right, (*E.*) *arundinicolor* (Walsingham) ("*Hyperdasyella*"), allotype (BM slide 7225); Kauai, 3,000 to 4,000 feet. Bottom left, (*H.*) *canella* Walsingham, allotype (BM slide 7969); Molokai, above 4,000 feet. Bottom right, (*E.*) *fulvida* Walsingham, allotype (BM slide 7993); Molokai, above 3,000 feet.



1208

Figure 1208—Signa of female genitalia of *Hypsometric*. Top left, (*H.*) *indicella* Walsingham, allotype (BM slide 7924); Haleakala, 5,000 feet, Maui; the print is mounted upside down. Top right, (*H.*) *lixivella* Walsingham, holotype female (BM slide 8009); Kauai, 3,000 to 4,000 feet. Bottom left, (*E.*) *longitudinalis* Walsingham, holotype (BM slide 8028); Kaawaloa, Kona, 2,000 feet, Hawaii; there is only one signum. Bottom right, (*H.*) *mimica* Walsingham, allotype (BM slide 8008); Molokai, over 3,000 feet; there are two signa present, but only one is shown here.



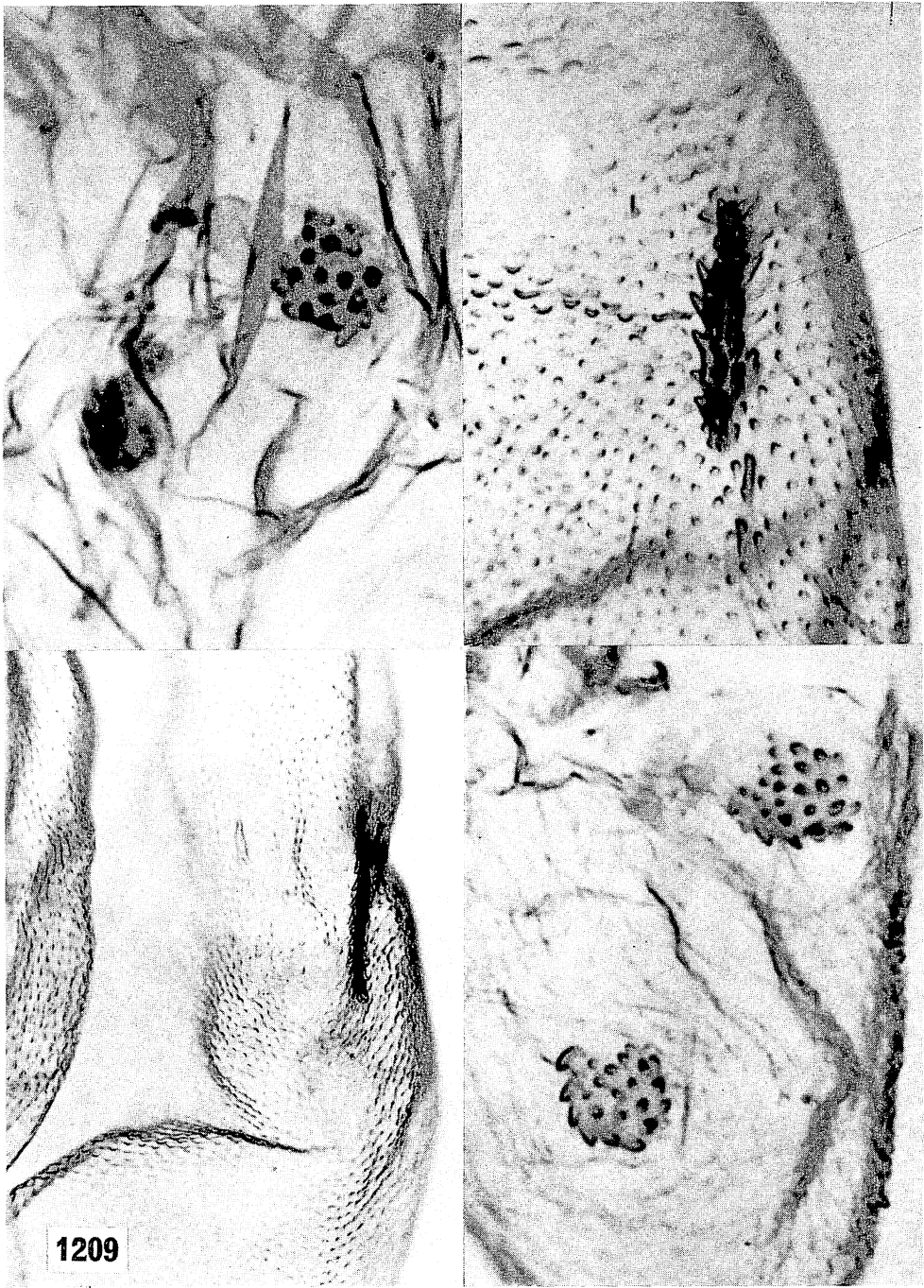


Figure 1209—Signa of female genitalia of *Hypsocoma*. Top left, (*H.*) *parva* (Butler), determined by Walsingham (BM slide 8078); Kona, 4,000 feet, Hawaii. Top right, (*E.*) *radiatella* Walsingham, holotype (BM slide 8022); Kona, 3,000 feet; there is only one signum. Bottom left, (*E.*) *roseofulva* Walsingham, allotype (BM slide 8001); Kauai, 3,000 to 4,000 feet; there is only one signum. Bottom right, (*H.*) *saliaris* Walsingham, holotype (BM slide 8010); Kona, 4,000 feet, Hawaii.



1210

Figure 1210—Signa of female genitalia of *Hypsmocoma*. Top left, (*H.*) *schismatica* Walsingham, paratype (BM slide 8080); Kaholuamano, 4,000 feet, Kauai; there are two signa, but the one at right is out of focus. Top right, (*H.*) *subflavidella* Walsingham, allotype (BM slide 7915); Haleakala, 5,000 feet, Maui; there is a signum on either side and a spermatophore within the bursa. Bottom, (*E.*) *vicina* Walsingham, allotype (BM slide 7992); Waianae Mts., 1,700 feet, Oahu; there are two signa, but one is directly behind the other in this mount.

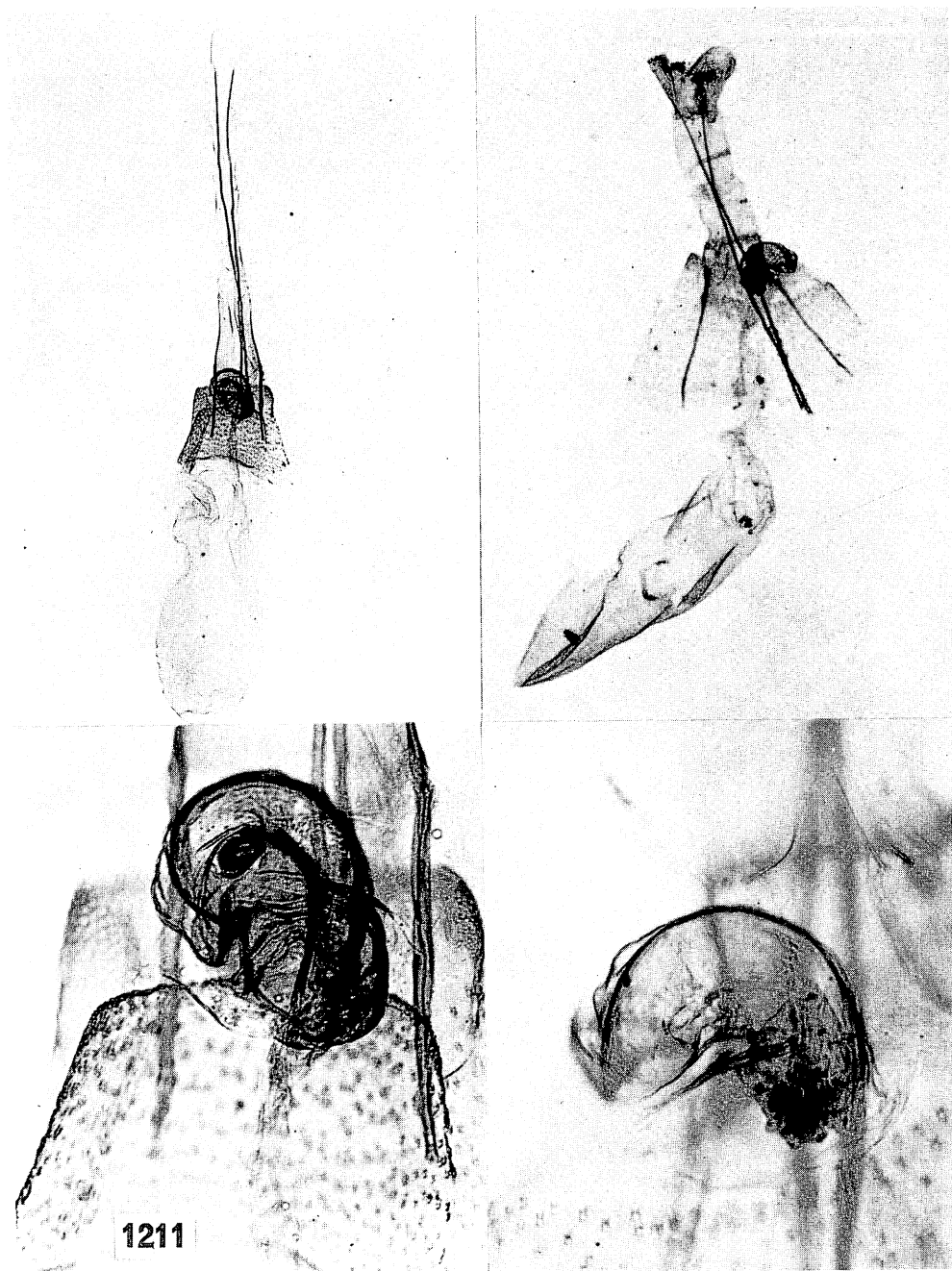


Figure 1211—Female genitalia of *Hypsoscoma*. Left, (*H. prophantis* Meyrick, lectotype (BM slide 9570 Clarke); Honolulu, Oahu; signa absent. Right, (*H. flavipalpis* (Walsingham) ("*Agonismus*"), holotype (BM slide 4309); Haleakala, 4,000 feet, Maui; signa absent. The print of the complete genitalia at top has been reversed.

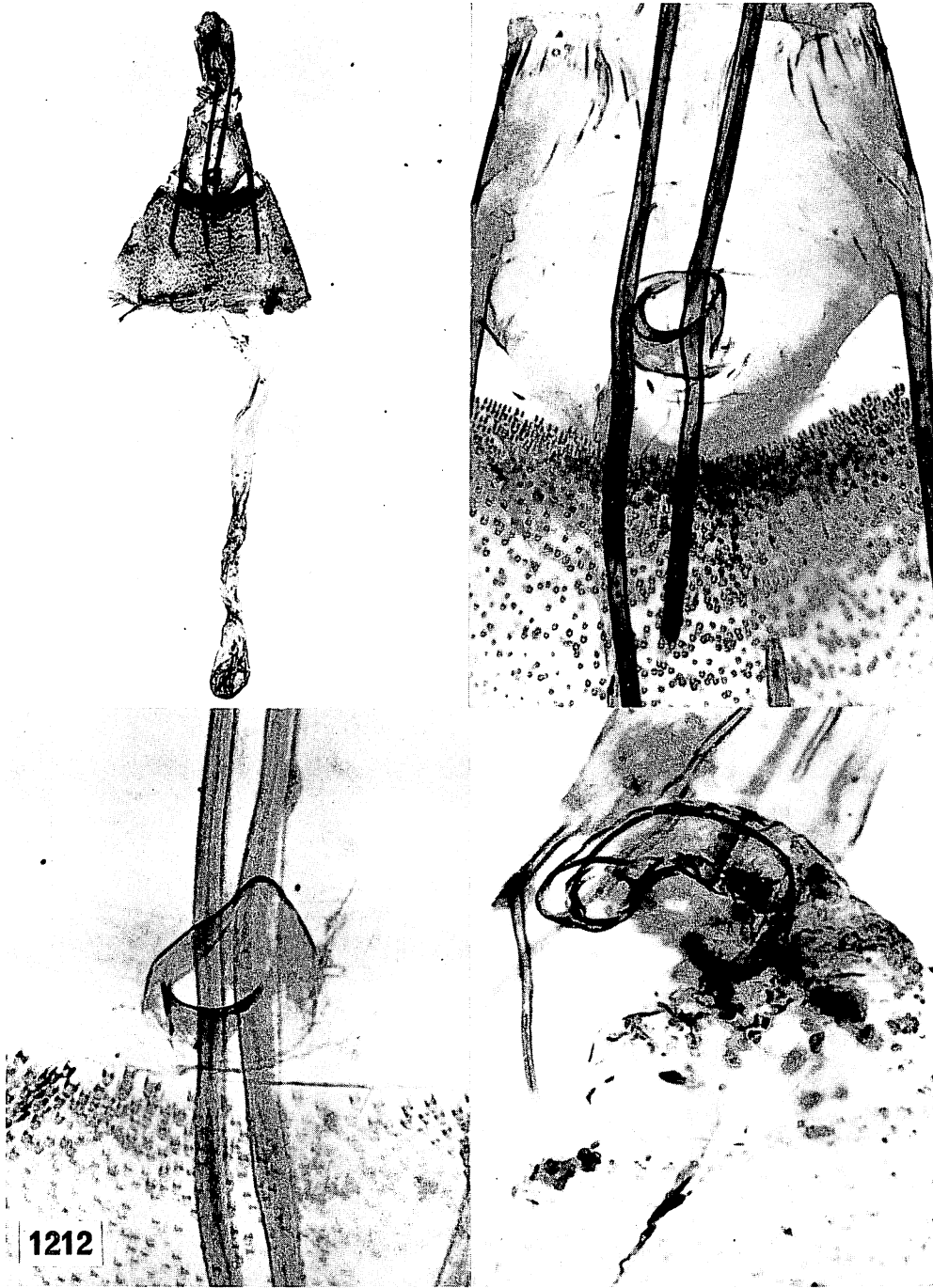


Figure 1212—Female genitalia of *Hyposmocoma*. Top, left and right, (*E.* *ekaha* (Swezey) ("*Euhyposmocoma*"), allotype female (slide Z-IX-3-61-4); Halawa Valley, Oahu. Bottom left, ostium of another specimen of *ekaha* (Busck slide 163); Oahu. Bottom right, ostium of (*H.* *longisquamella* (Walsingham) ("*Elachista*"), holotype (BM slide 7176); Kona, 4,000 feet, Hawaii; abdomen partly decomposed.

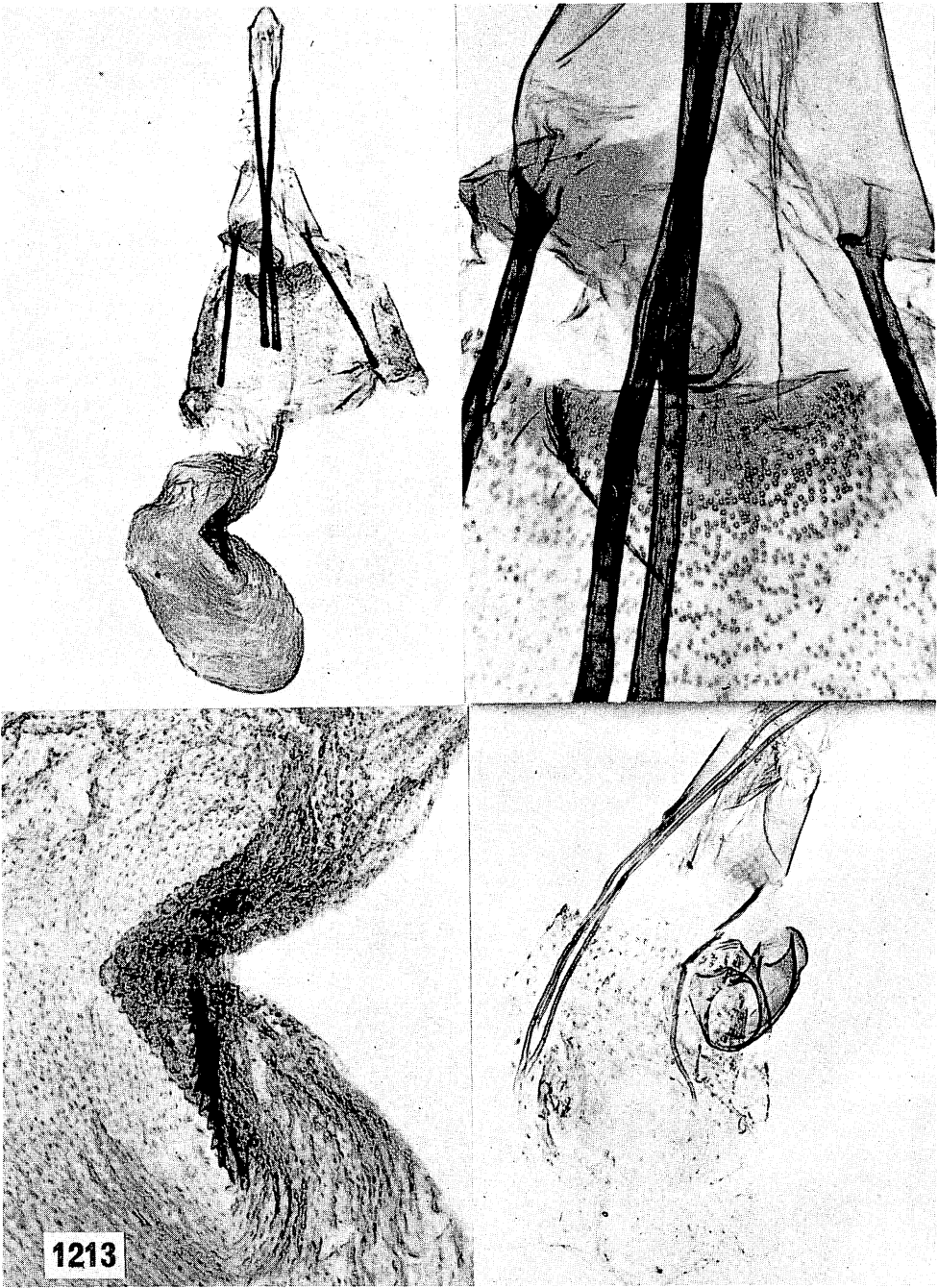


Figure 1213—Female genitalia of *Hypsoscoma*. Top, left and right, and bottom left, (*E.*) *pritchardiae* (Swezey) (“*Bubaloceras*”), paratype (slide Z-IX-5-61-D); Kumuwela, Kauai. Bottom right, ostium of (*H.*) *swezeyi* (Busck) (“*Petrochroa*”); Kaimuki, Honolulu (Busck slide 194).



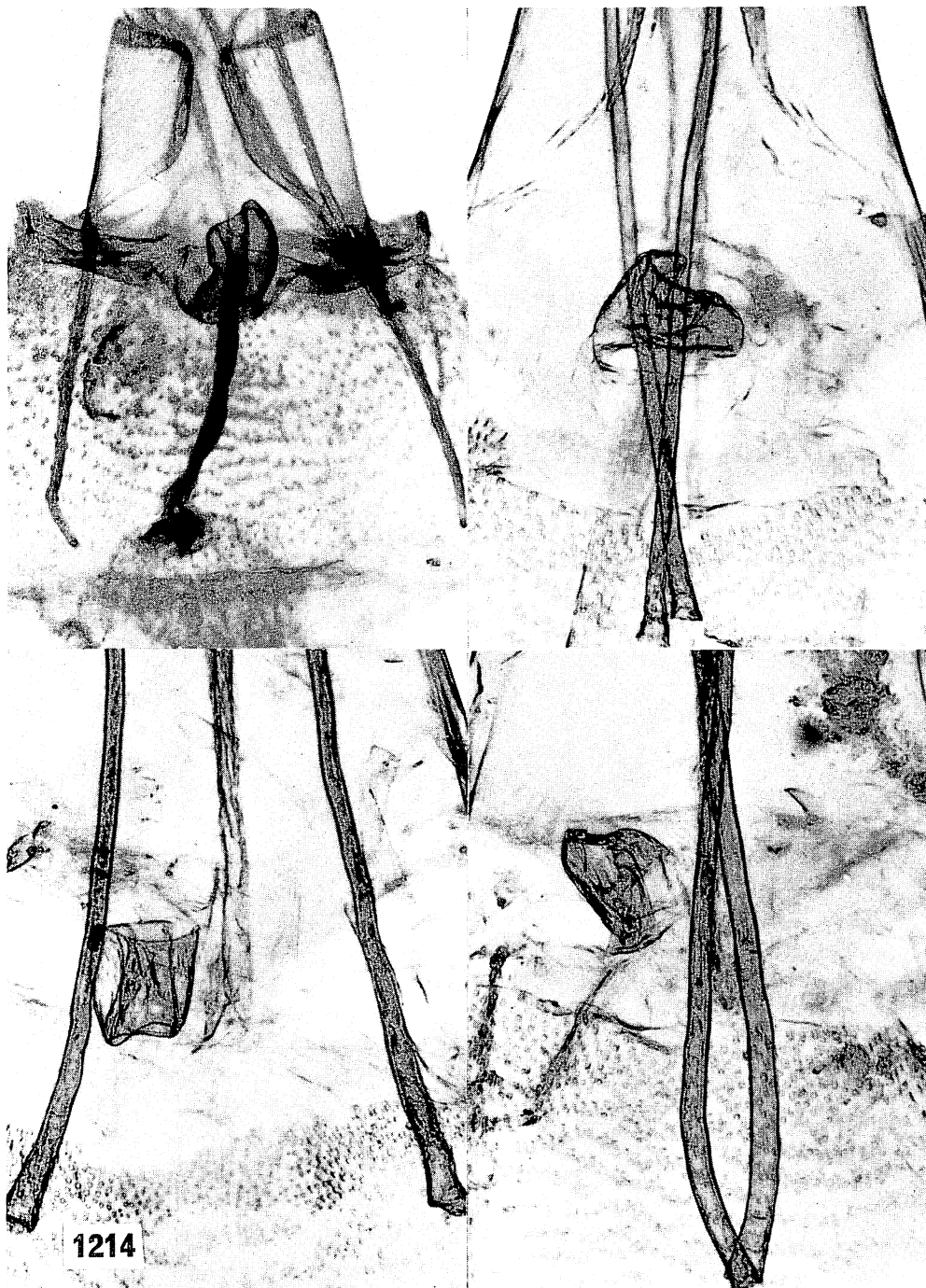


Figure 1214—Female genitalia (ostia) of *Hypsmocoma*. Top left, (*E.*) *arundinicolor* (Walsingham) ("*Hyperdasyella*"), allotype (BM slide 7225); Kauai, 3,000 to 4,000 feet. Note the sclerotized ductus bursae. The bursa is comparatively short and broad, and it has two signa. Top right, (*E.*) *cryptogamiella* (Walsingham) ("*Hyperdasyella*"), allotype (BM slide 7227); Kilauea, Hawaii. It has an elongate bursa and no signa. Bottom left, (*E.*) *semiusta* (Walsingham) ("*Hyperdasyella*"), allotype (BM slide 7228); Kauai, 3,000 to 4,000 feet. There are no signa. Bottom right, (*E.*) *unicolor* (Walsingham) ("*Hyperdasyella*"), allotype (BM slide 7226); forest above Pelekunu, Molokai. The bursa lacks signa.

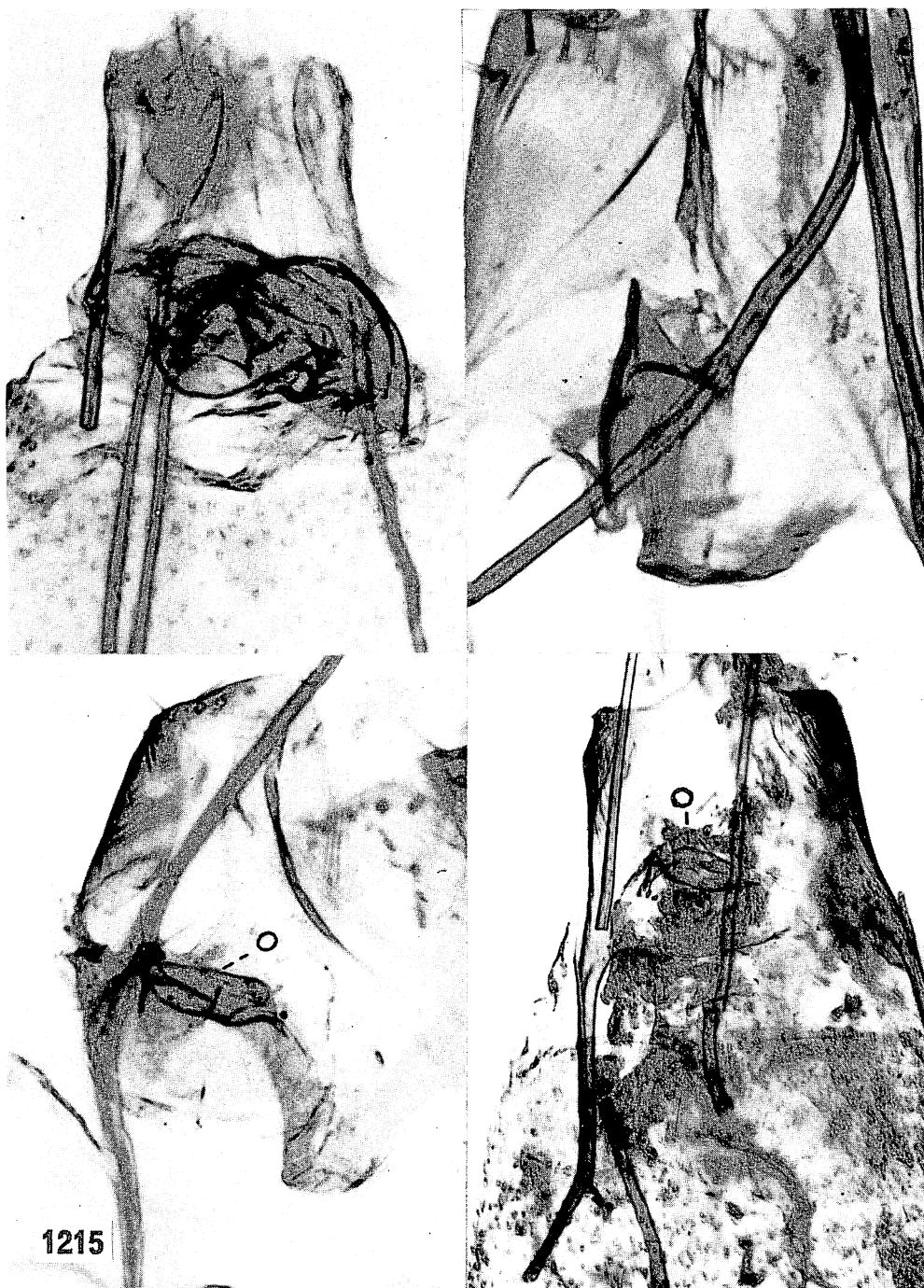


Figure 1215—Ostia of female genitalia of *Hypsoscoma*. Top left, (*H.*) *argentiifera* (Walsingham) ("*Agonismus*"), holotype (BM slide 7171); Kilauea, Hawaii; there are no signa. Top right, (*E.*) *albocinerea* (Walsingham) ("*Aphthonetus*"), holotype (BM slide 4753); Kauai, 3,000 to 4,000 feet. Bottom left, (*E.*) *aspersa* (Butler) ("*Aphthonetus*"), holotype (BM slide 4412); near Honolulu. Bottom right, (*E.*) *bitincta* (Walsingham) ("*Aphthonetus*"), allotype (BM slide 7555); Haleakala, 5,000 feet, Maui. Ostia are marked "O".

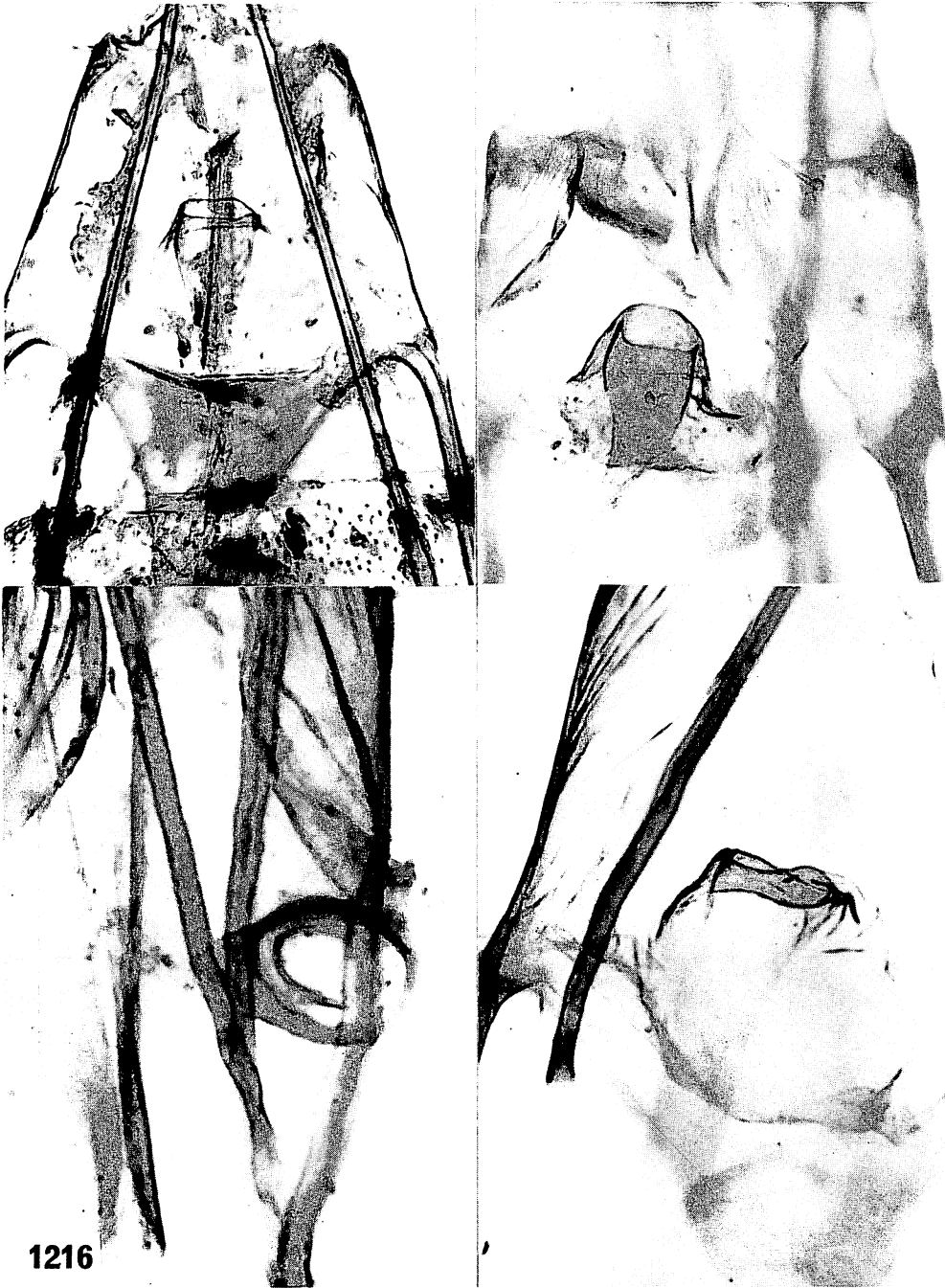


Figure 1216—Ostia of female genitalia of *Hypsmocoma* (*Euperissus*) ("Aphthonetus"). Top left, *diffusa* (Walsingham), paratype (BM slide 7558); Kauai, 3,000 to 4,000 feet. Top right, *eleuthera* (Walsingham), holotype (BM slide 4716). Bottom left, *exsul* (Walsingham), holotype (BM slide 4414); Kilauea, Hawaii. Bottom right, *hirsuta* (Walsingham), holotype (BM slide 4413); Kauai, 3,000 to 4,000 feet.



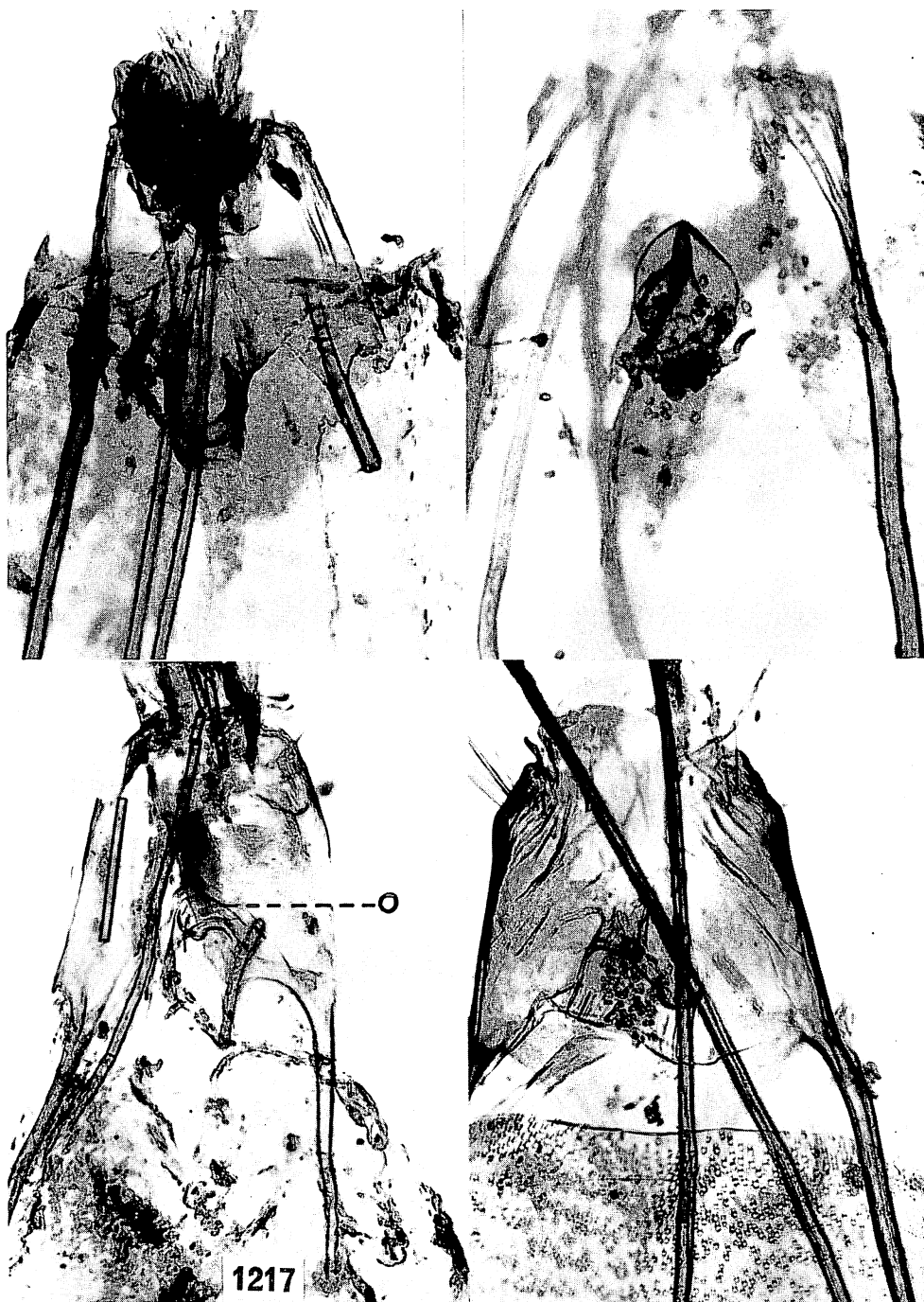


Figure 1217—Ostia of female genitalia of *Hypsomocoma* (*Euperissus*) ("Aphthonetus"). Top left, *humerella* (Walsingham), holotype (BM slide 7556); Haleakala, 5,000 feet, Maui. Top right, *kauaiensis* (Walsingham), allotype (BM slide 7553); Halemanu, 4,000 feet, Kauai. Bottom left, *mediocris* (Walsingham), allotype female (BM slide 7552); Haleakala, 5,000 feet, Maui. Bottom right *prae fracta* (Meyrick), paratype (slide Z-XII-62-2); Kumuwela, Kauai. These specimens show evidence of decomposition.

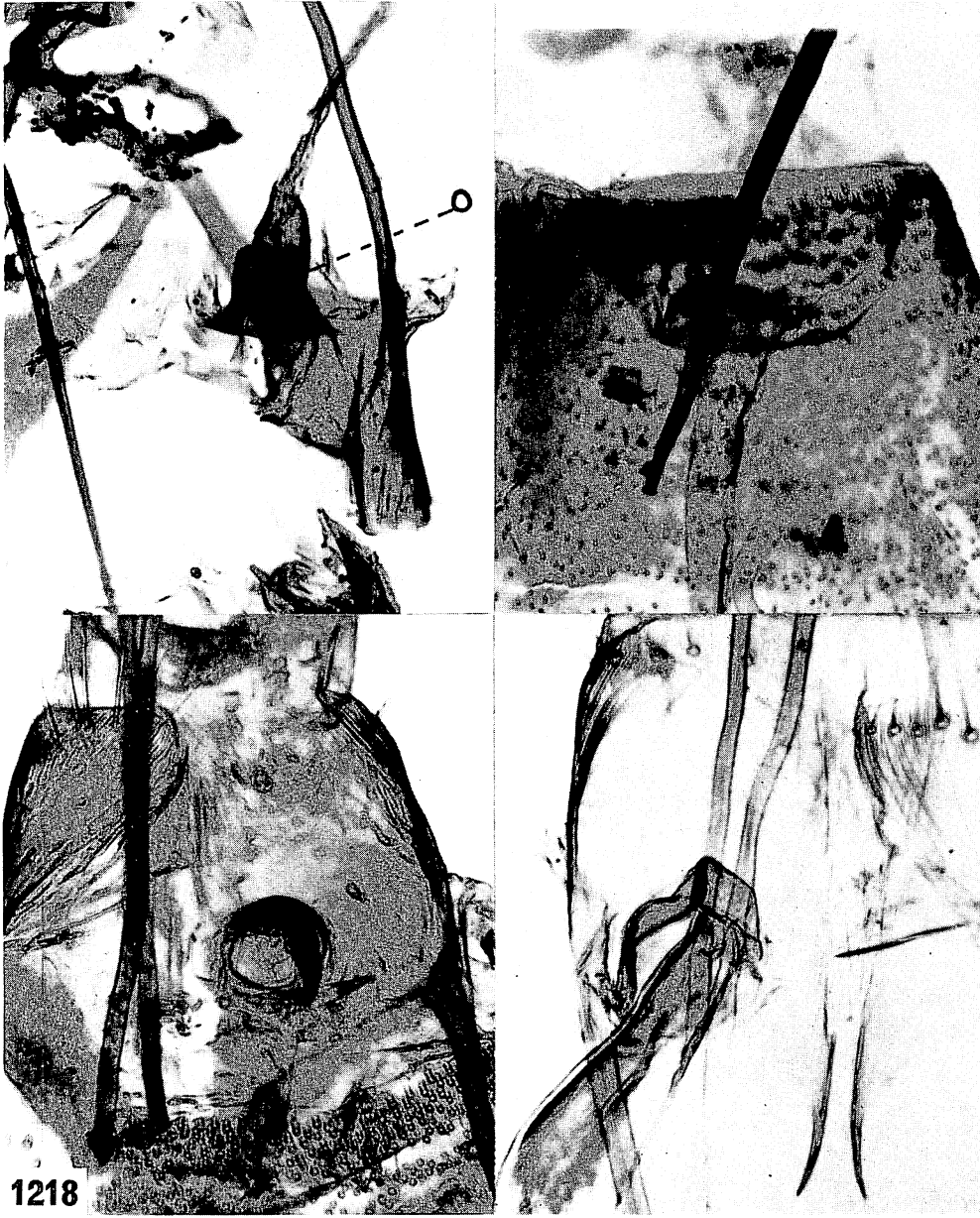


Figure 1218—Female genital ostia of *Hyposmocoma* (*Euperissus*) ("Aphthonetus"). Top left, *puncticiliata* (Walsingham), paratype (BM slide 7560); Kilauea, Hawaii. This specimen was decomposed. The photograph is mounted upside down. Top right, *sagittata* (Walsingham), allotype (BM slide 7557); Kauai, 3,000 to 4,000 feet. Bottom left, *sideroxyloni* (Swezey); paratype (slide Z-IX-5-61-B); Puu Peahinaia, Koolau Mts., Oahu. Bottom right, *veterella* (Walsingham), holotype (BM slide 4715); Halemanu, 4,000 feet, Kauai.

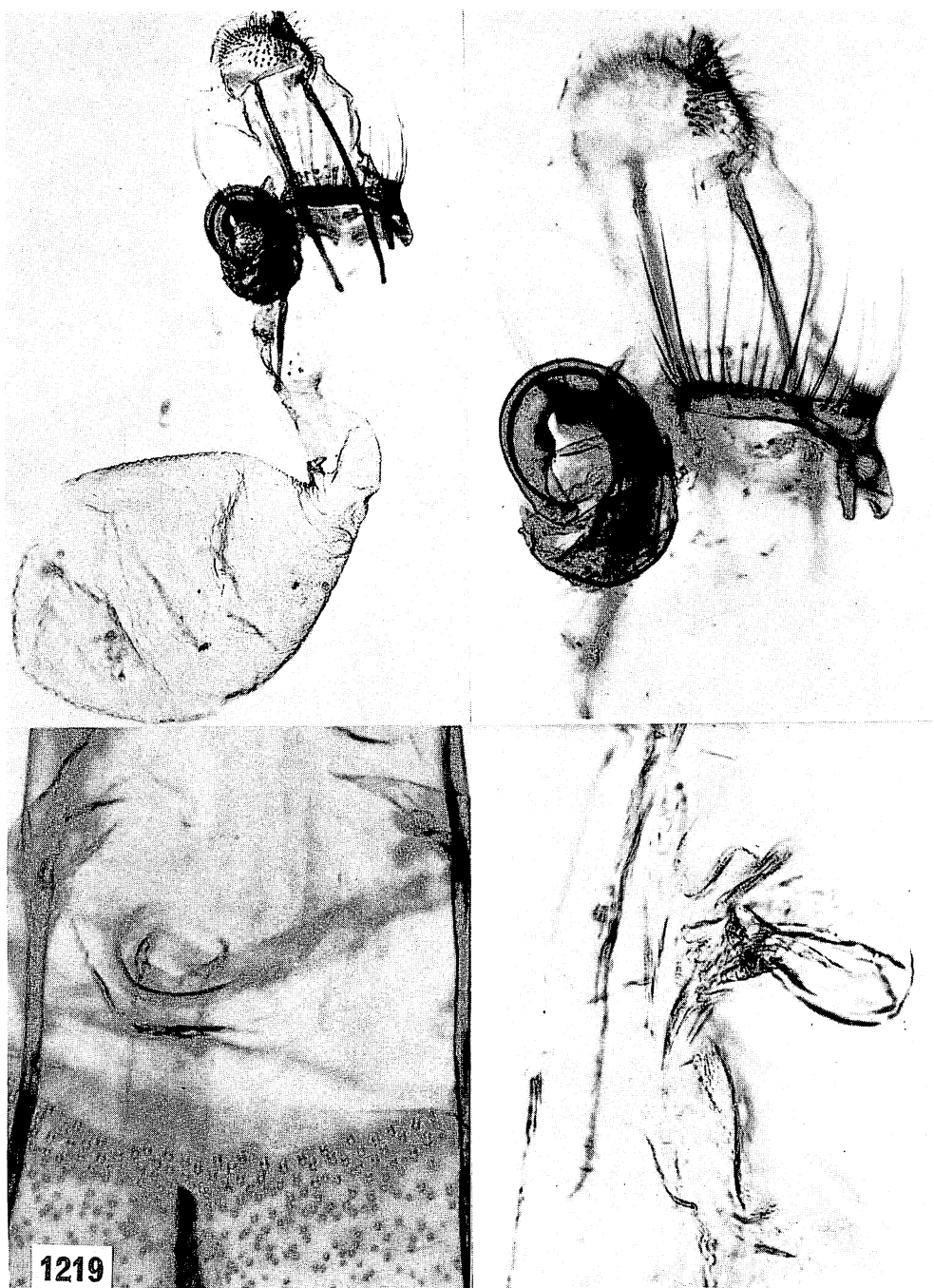
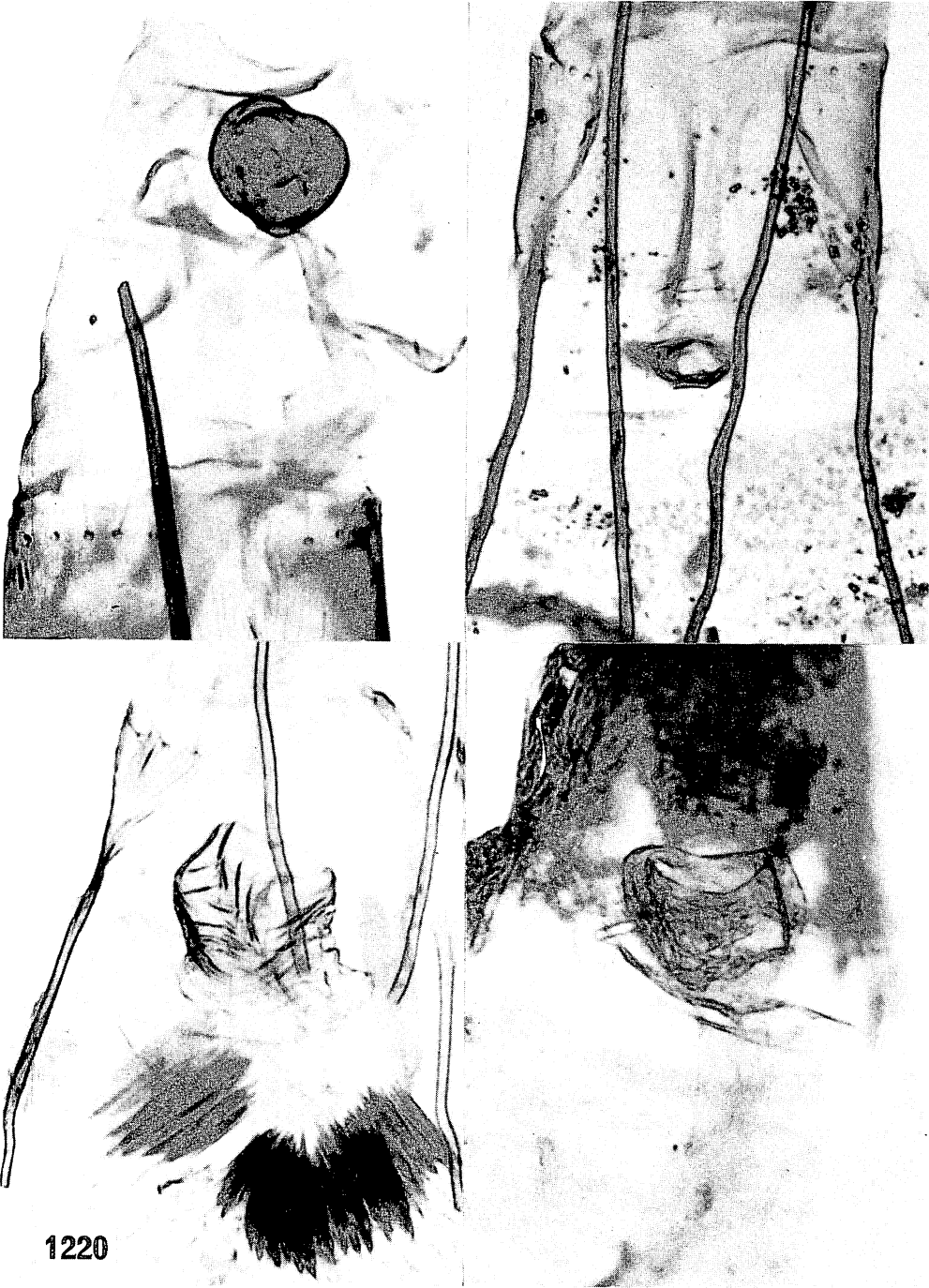


Figure 1219—Female genital ostia of *Hyposmocoma*. Top, left and right, (*H.*) *alveata* (Meyrick), paratype (slide Z-XII-62-2); Mt. Tantalus, Oahu. This species was wrongly placed in “*Neelysia*”; it belongs to *Hyposmocoma sensu stricto*. Bottom left, (*E.*) *agnetella* (Walsingham) (“*Neelysia*”), allotype (BM slide 7714); Olinda, Maui. The long slender bursa lacks signa. Bottom right, (*E.*) *argyresthiella* (Walsingham) (“*Neelysia*”), holotype (BM slide 4465); Koolau Mts., Oahu. There are no signa on the bursa.



1220

Figure 1220—Female genital ostia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top left, *basi vittata* (Walsingham), allotype (BM slide 7715); Haleakala, 5,000 feet, Maui. Most of the ovipositor is broken away. Top right, *cuprea* (Walsingham), allotype (BM slide 7565); Kauai, 3,000 to 4,000 feet. Bottom left, *exaltata* (Walsingham), allotype (BM slide 7717); Haleakala, 4,000 feet, Maui. Bottom right, *fuscofusa* (Walsingham), allotype female (BM slide 7713); Kauai, 3,000 to 4,000 feet. *Caution*: This abdomen was found loose in the box. Although it is thought to be correctly associated, an error might be involved.

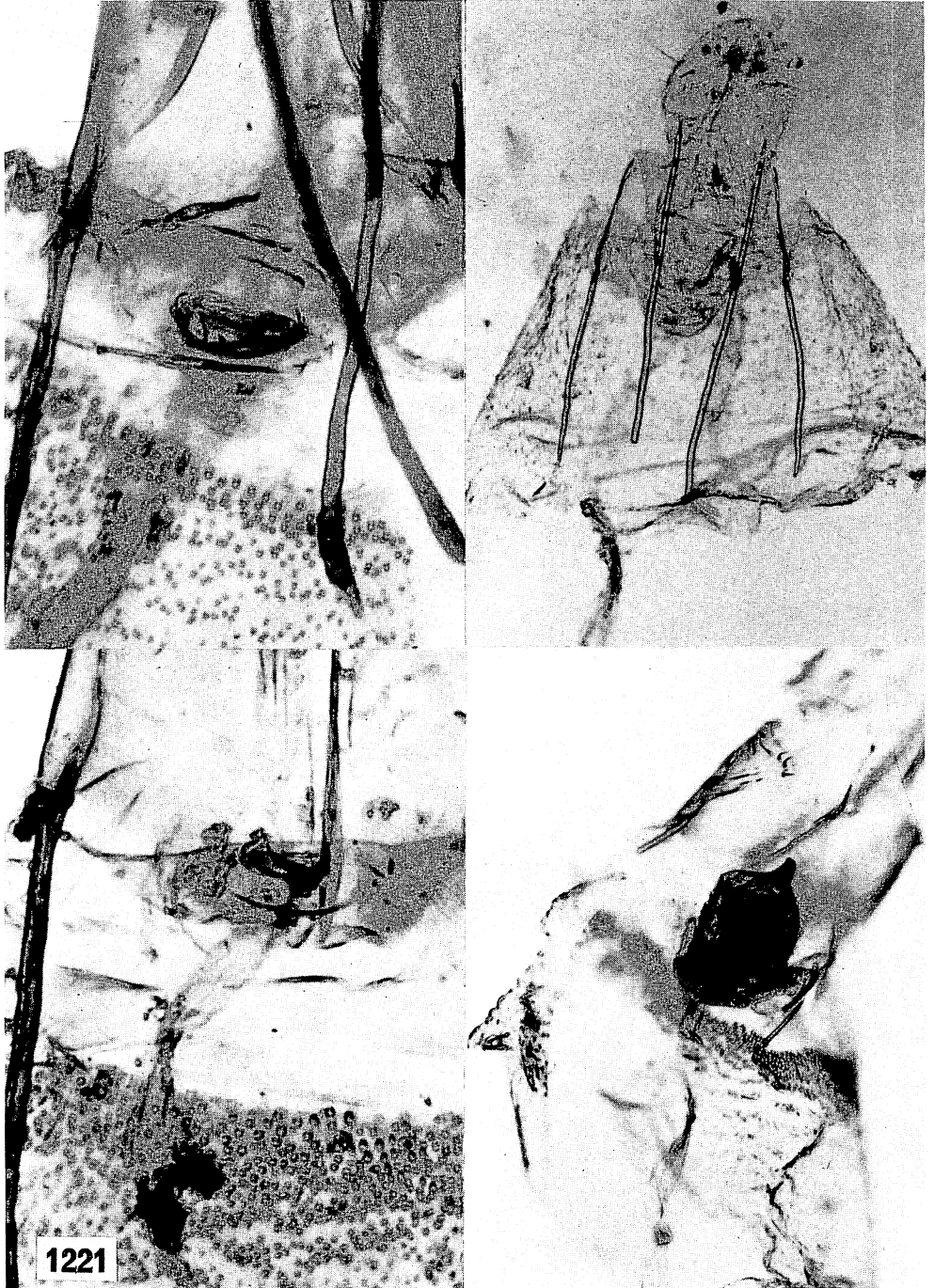


Figure 1221—Female genital ostia of *Hyposmocoma* (*Euperissus*) (“*Neelysia*”). Top left, *lignicolor* (Walsingham), allotype (BM slide 7567); Haleakala, 5,000 feet, Maui. Top right, *mactella* (Walsingham), allotype (BM slide 7723); Kauai, 3,000 to 4,000 feet. Bottom left, *municeps* (Walsingham), paratype (BM slide 7177); Olinda, 4,000 feet, Maui. Bottom right, *nemoricola* (Walsingham), holotype (BM slide 8069); forest above Pelekunu, Molokai.



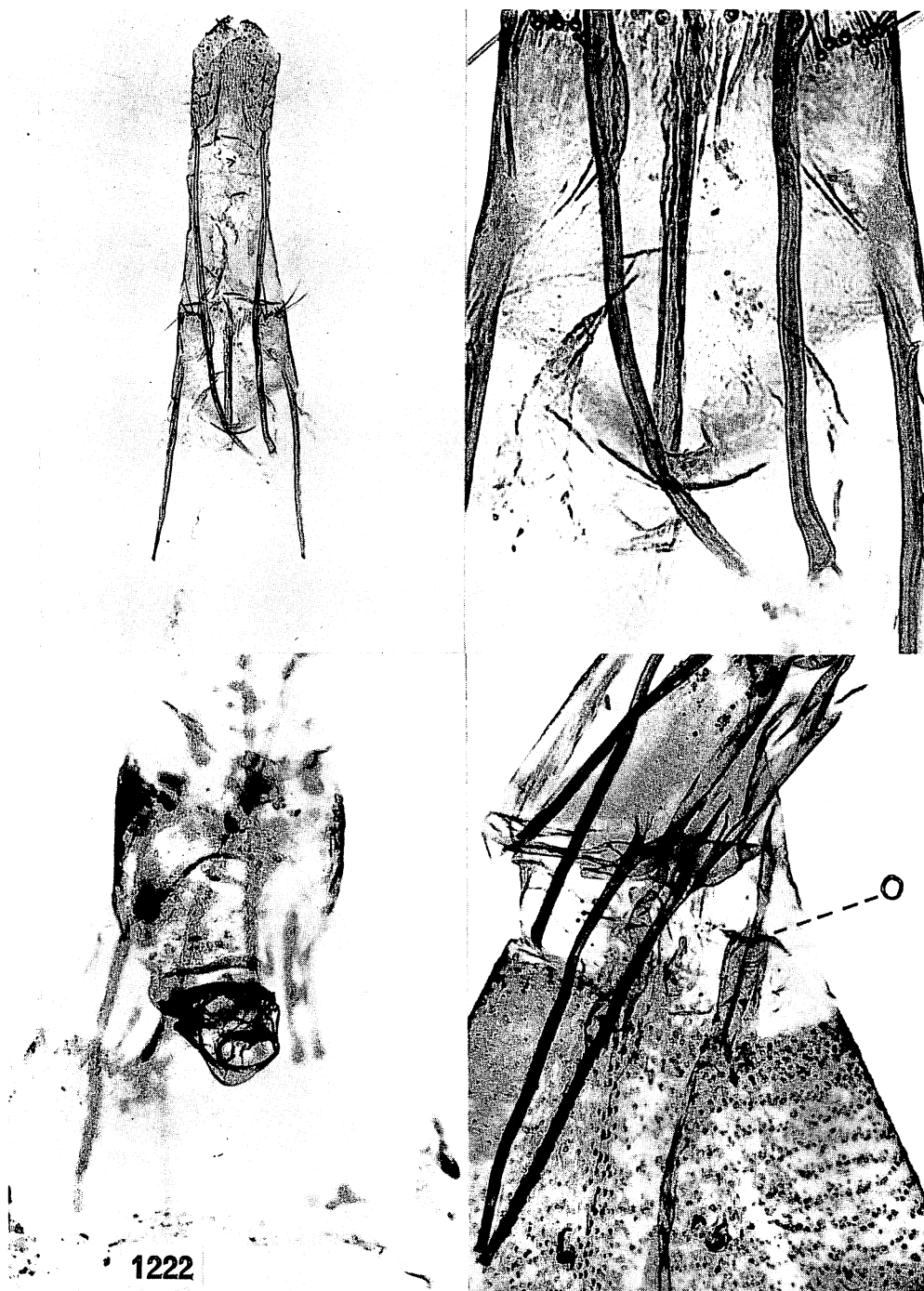


Figure 1222—Female genital ostia of *Hypsoscyma* (*Euperissus*) (“*Neelysia*”). Top left, and right, *palmifera* (Meyrick), allotype (slide Z-I-20-61-1); Pauoa Flats, Koolau Mts., Oahu. Bottom left, *ningorella* (Walsingham), allotype (BM slide 7720); Haleakala, 5,000 feet, Maui. Bottom right, *pallidorella* (Walsingham), holotype (BM slide 7712); Kauai, 3,000 to 4,000 feet. The bursa copulatrix has an ovoid caudal part and a long narrow “stem” cephalad; ostium is marked by “O”.

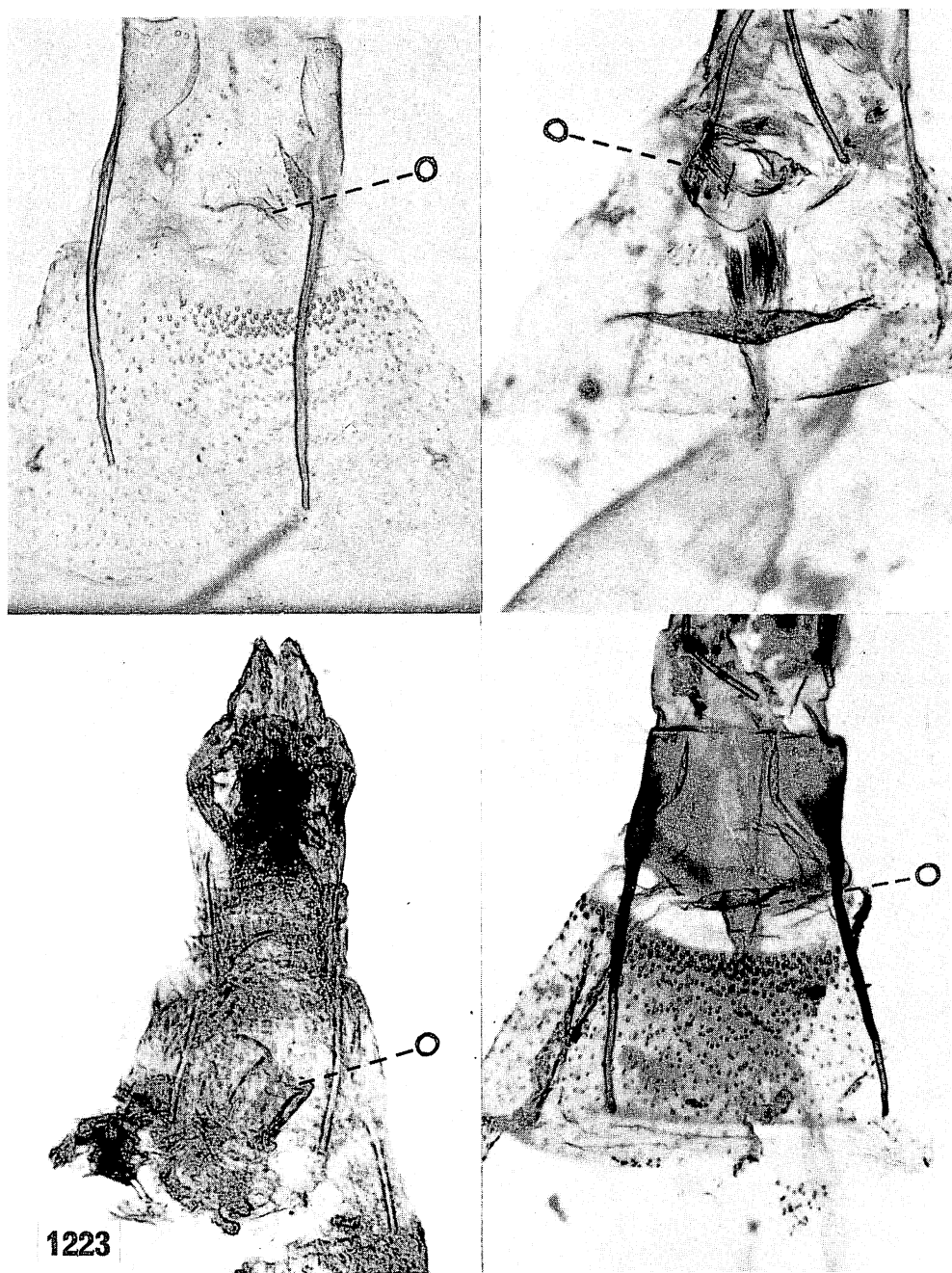


Figure 1223—Female genital ostia of *Hyposmocoma* (*Euperissus*) ("Neelysia"). Top left, *pluviella* (Walsingham), holotype (BM slide 4464); Molokai, about 4,000 feet. Top right, *poeciloceras* (Walsingham), allotype (BM slide 7719); Haleakala, 5,000 feet, Maui. Bottom left, *rediviva* (Walsingham), allotype (BM slide 7721); Kauai, 3,000 to 4,000 feet; partly decomposed. Bottom right, *repandella* (Walsingham), holotype (BM slide 7711); Molokai, over 4,000 feet.

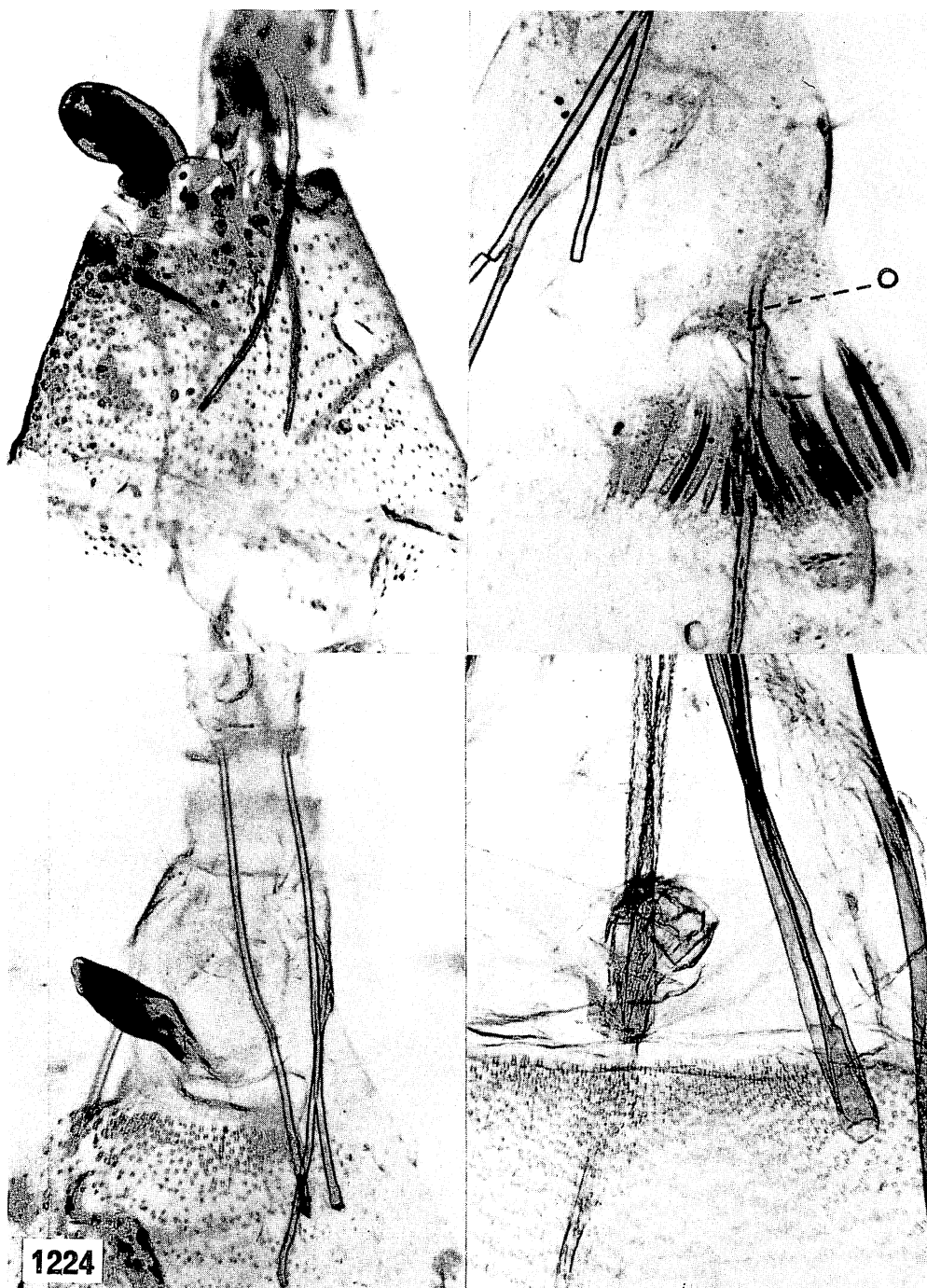


Figure 1224—Female genital ostia of *Hypsmocoma*. Top left, (*H.*) *semifusa* (Walsingham), holotype (BM slide 4469); Molokai, about 4,000 feet; partly decomposed. This species was wrongly placed in *Neelysia*; it belongs to *Hypsmocoma sensu stricto*. Top right, (*E.*) *subaurata* (Meyrick) ("*Neelysia*"), allotype female (BM slide 7716); Kaholuamano, 4,000 feet, Kauai. "O" marks the ostium? This is from a poor preparation which may be misleading. Bottom left, (*E.*) *tischeriella* (Walsingham) ("*Neelysia*"), allotype (BM slide 7724); Kaholuamano, 4,000 feet, Kauai. Bottom right, (*E.*) *cristata* (Butler), determined by Walsingham (BM slide 7505); Hilo, 2,000 feet, Hawaii.



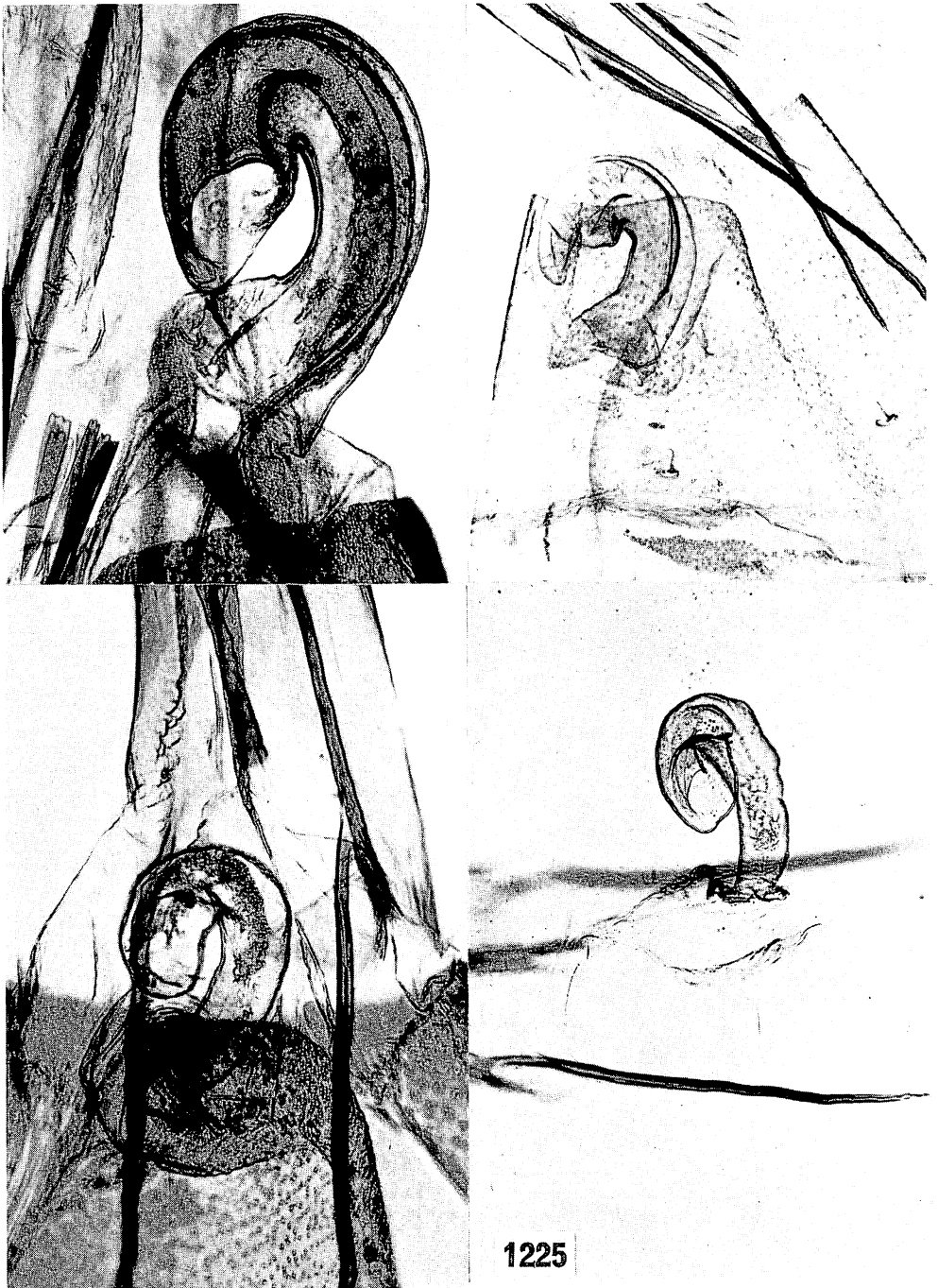


Figure 1225—Female genital ostia of *Hyposmocoma*. Top left, (*H.* *lignivora* (Butler) ("*Diplosara*") (slide Z-XII-62-3); Lanihuli, Oahu. See figure 1097 for the larval case of this female. Top right, an allied species from Hawaii (Busck slide 55; Walsingham specimen 28589). Bottom left, (*H.* *semicolon* (Walsingham) ("*Dysphoria*"), allotype (BM slide 8548); Kauai, 3,000 to 4,000 feet. Bottom right, a paratype of the same species from the same locality (BM slide 1694). This species has a short bursa.

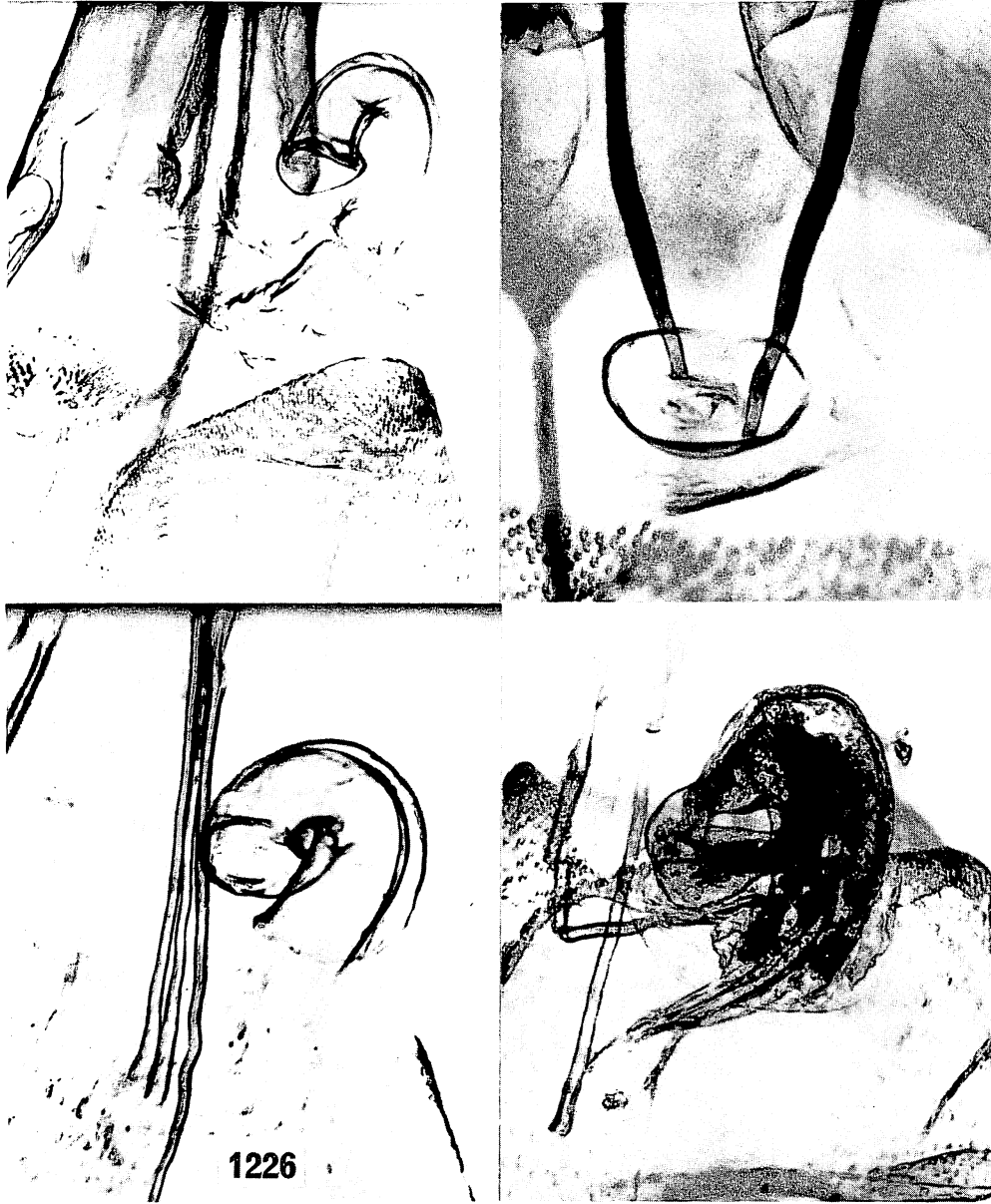


Figure 1226—Female genital ostia of *Hypsoscymoma*. Top left, (*H.*) *abjecta* (Butler), holotype (BM slide 4475); Oahu; photographed from beneath the slide. There are no signa on the bursa. *Caution*: the abdomen was glued on the body; it could have been wrongly associated. Top right, (*E.*) *adelphella* Walsingham, allotype (BM slide 8005); Kona, 4,000 feet, Hawaii. There are no signa. Bottom left, (*H.*) *advena* Walsingham, holotype (BM slide 4532); Molokai, 4,000 feet; no signa. Bottom right, (*H.*) *alliterata* Walsingham, allotype (BM slide 7964); Molokai, above 3,000 feet. There is debris in the ostium as a result of decomposition, and there are no signa.

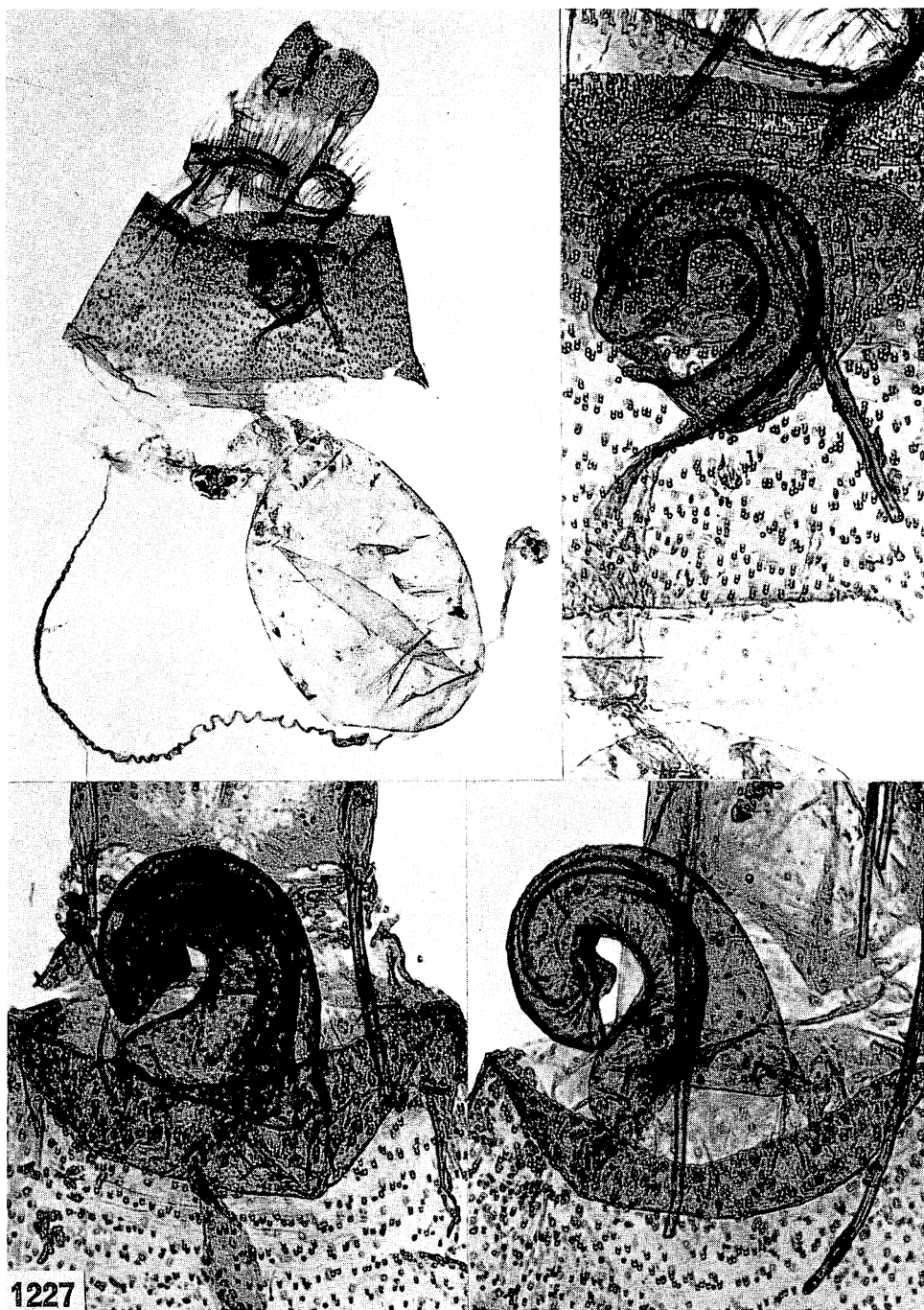


Figure 1227—Female genitalia of *Hyposmocoma*. Top, left and right, (*H.*) *albonivea* Walsingham, holotype (BM slide 14306); Waianae Mts., Oahu; note the short ovipositor. Bottom left, (*H.*) *saccophora* Walsingham, holotype (BM slide 14301); Mt. Kaala, 3,000 feet, Oahu. Bottom right, the same species from a specimen collected at Waimanalo, Oahu, by Dr. Swezey (BM slide 14300).

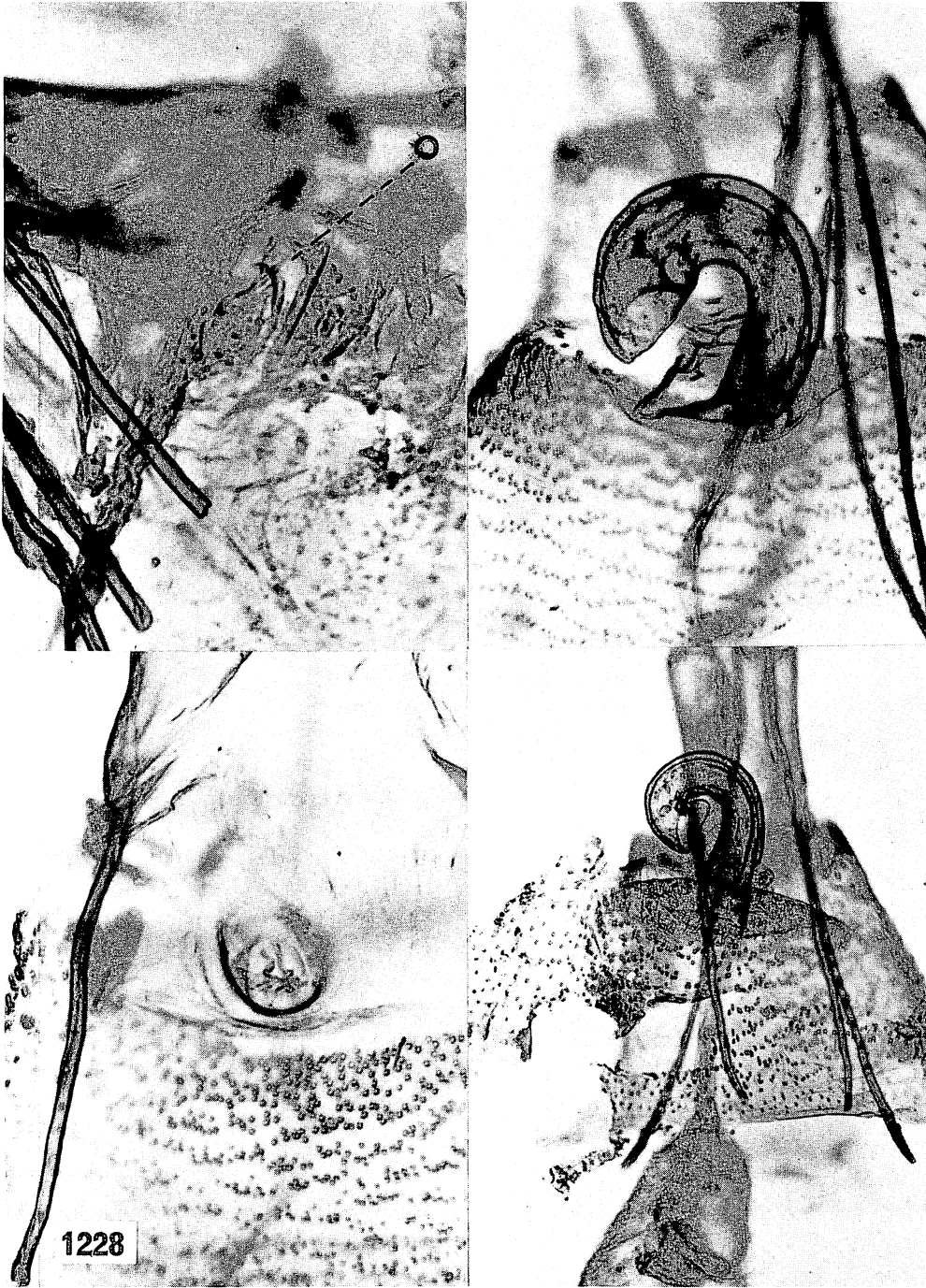


Figure 1228—Female genital ostia of *Hypsometric*. Top left, (*E.*) *alticola* Meyrick, paralectotype (BM slide 8061); Honolulu, Oahu; abdomen decomposed; ostium marked by "O". Top right, (*H.*) *arenella* Walsingham, allotype (BM slide 8013); Kona, 3,000 feet, Hawaii. Bottom left, (*E.*) *argentea* Walsingham, allotype (BM slide 7961); Molokai, about 3,000 feet; the bursa has a signum. Bottom right, (*H.*) *auripennis* (Butler), determined by Walsingham (BM slide 8062); Haleakala, 5,000 feet, Maui.

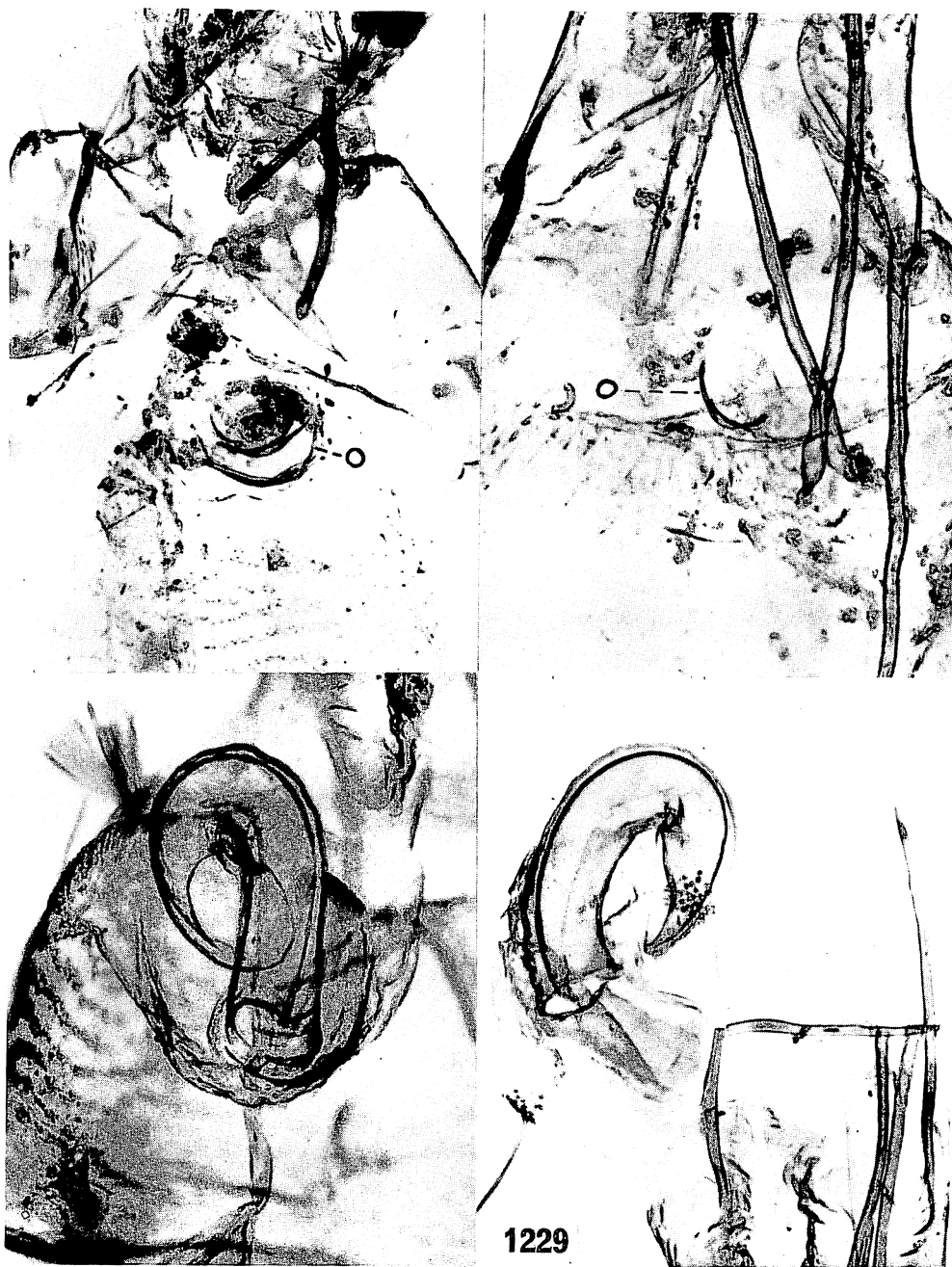


Figure 1229—Female genital ostia of *Hyposmocoma*. Top left, *(E.) auroargentea* Walsingham, allotype (BM slide 7916); Haleakala, 5,000 feet, Maui; partly decomposed. Top right, *(E.) barbata* Walsingham, holotype (BM slide 7175); Molokai, above 3,000 feet. Bottom left, *(H.) bilineata* Walsingham, paratype (BM slide 7920); Waianae Mts., 2,000 to 3,000 feet, Oahu. Although this was called the female type by Walsingham, it is the same sex as his holotype which he wrongly considered to be a male. Bottom right, same species, holotype female (BM slide 4112) (originally determined to be a male) from the same locality. Ostia are marked "O".

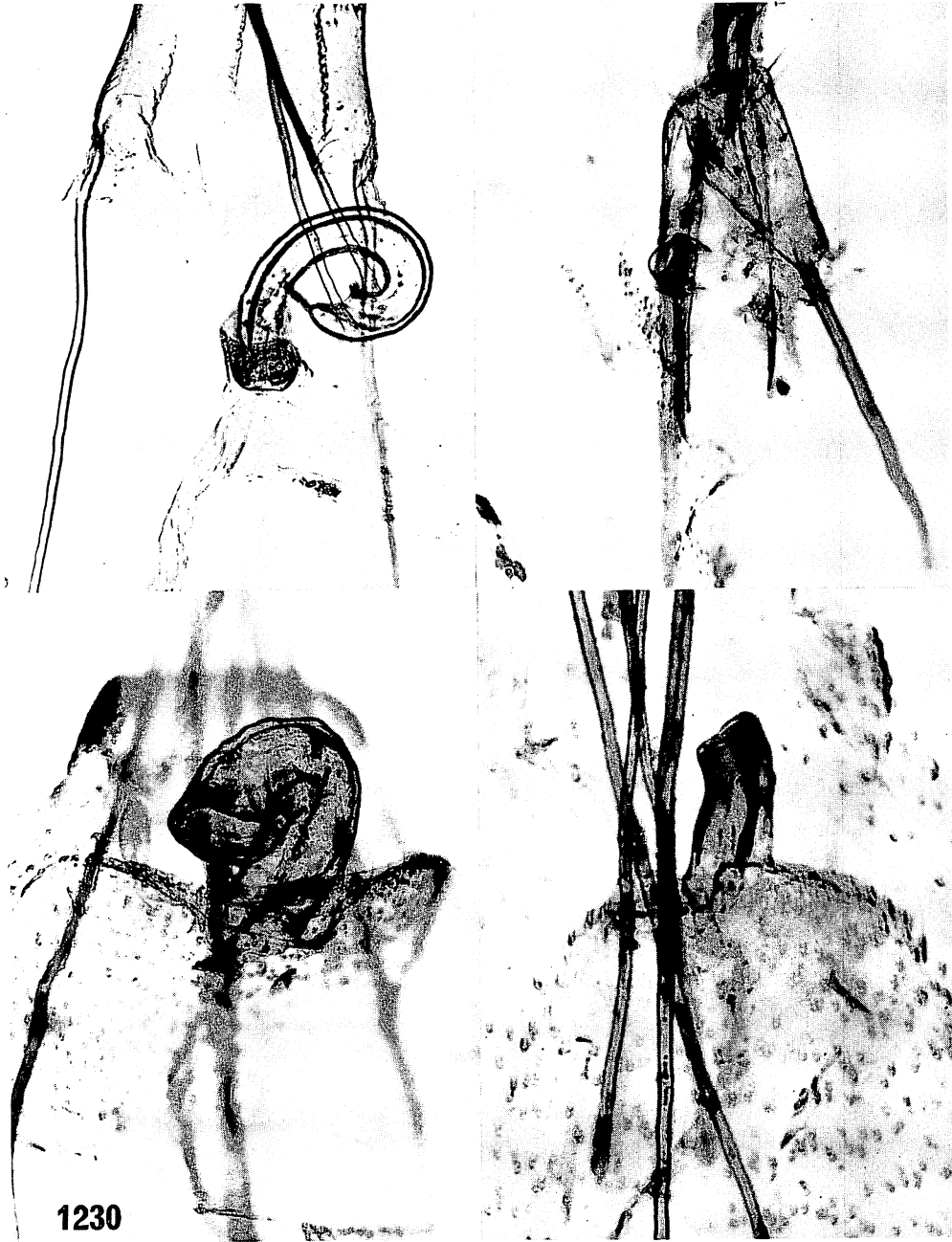


Figure 1230—Female genital ostia of *Hyposmocoma*. Top left, (*H.*) *blackburnii* Butler, "cenotype" (BM slide 1690); Olinda, 4,000 feet, Maui. Top right, (*E.*) *brevisirigata* Walsingham, allotype (BM slide 8021); Kauai, 3,000 to 4,000 feet. Bottom left, (*H.*) *butalidella* Walsingham, allotype (BM slide 7925); Haleakala, 5,000 feet, Maui. Bottom right, (*H.*) *canella* Walsingham, allotype (BM slide 7969); Molokai, over 4,000 feet.



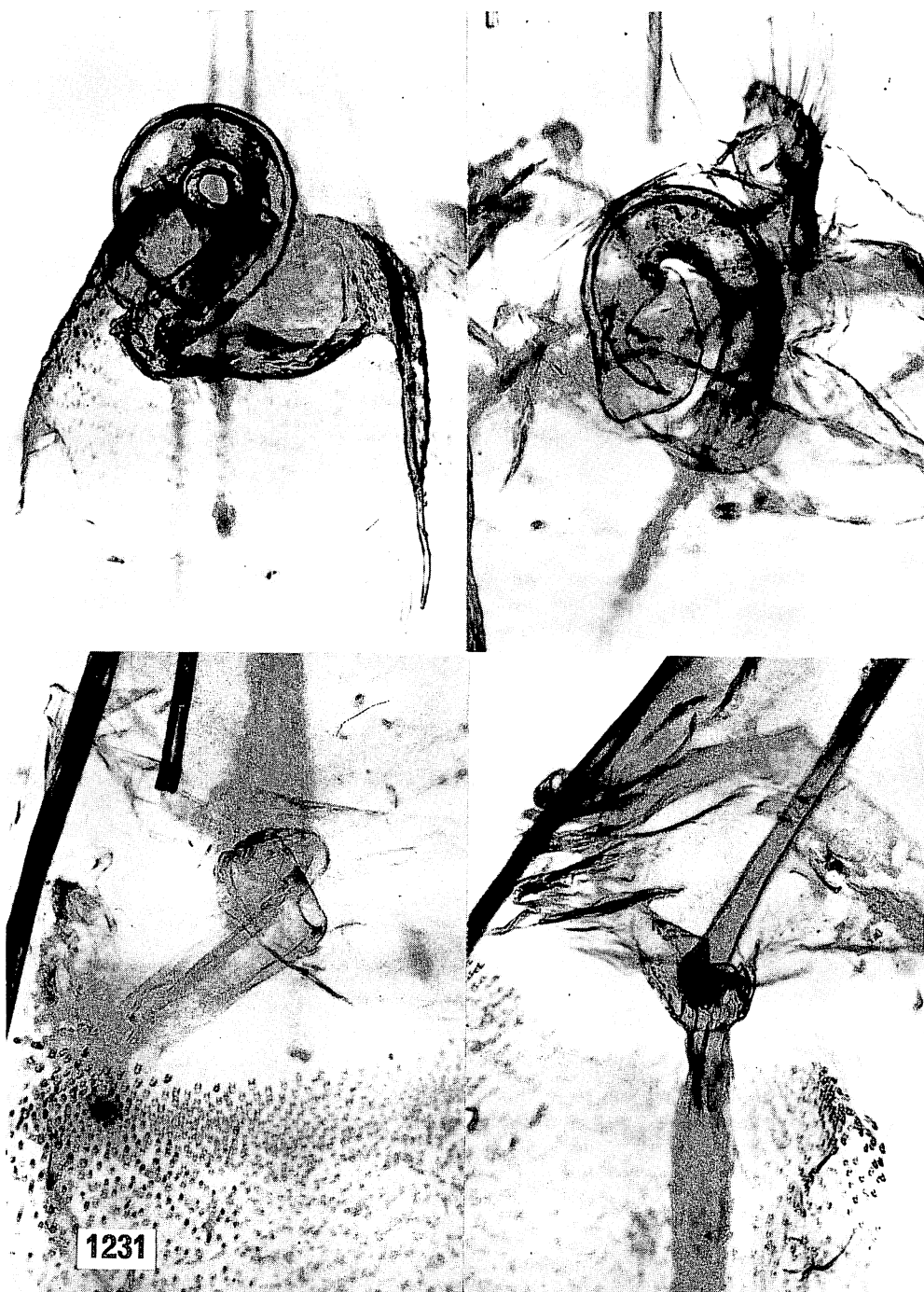


Figure 1231—Ostia of *Hyposmocoma* female genitalia. Top left, (*H.*) *candidella* (Walsingham), formerly considered a form of *lupella*, allotype (BM slide 8066); Kona, 3,000 feet, Hawaii. Top right, (*H.*) *carbonenotata* Walsingham, allotype (BM slide 7963); Kauai, 3,000 to 4,000 feet. This has a short ovipositor; also note the setose processes. Compare *empedola*, *marginenotata*, and *vinicolor*. Bottom left, (*E.*) *chilonella triocellata* Walsingham, allotype (BM slide 8029); Molokai, 4,000 feet. The bursa is strongly constricted submedially. Bottom right, (*E.*) *chilonella venosa* Walsingham, allotype (BM slide 8058); Kona, 2,000 feet. The bursa is elongate and distinct from that of *triocellata*.

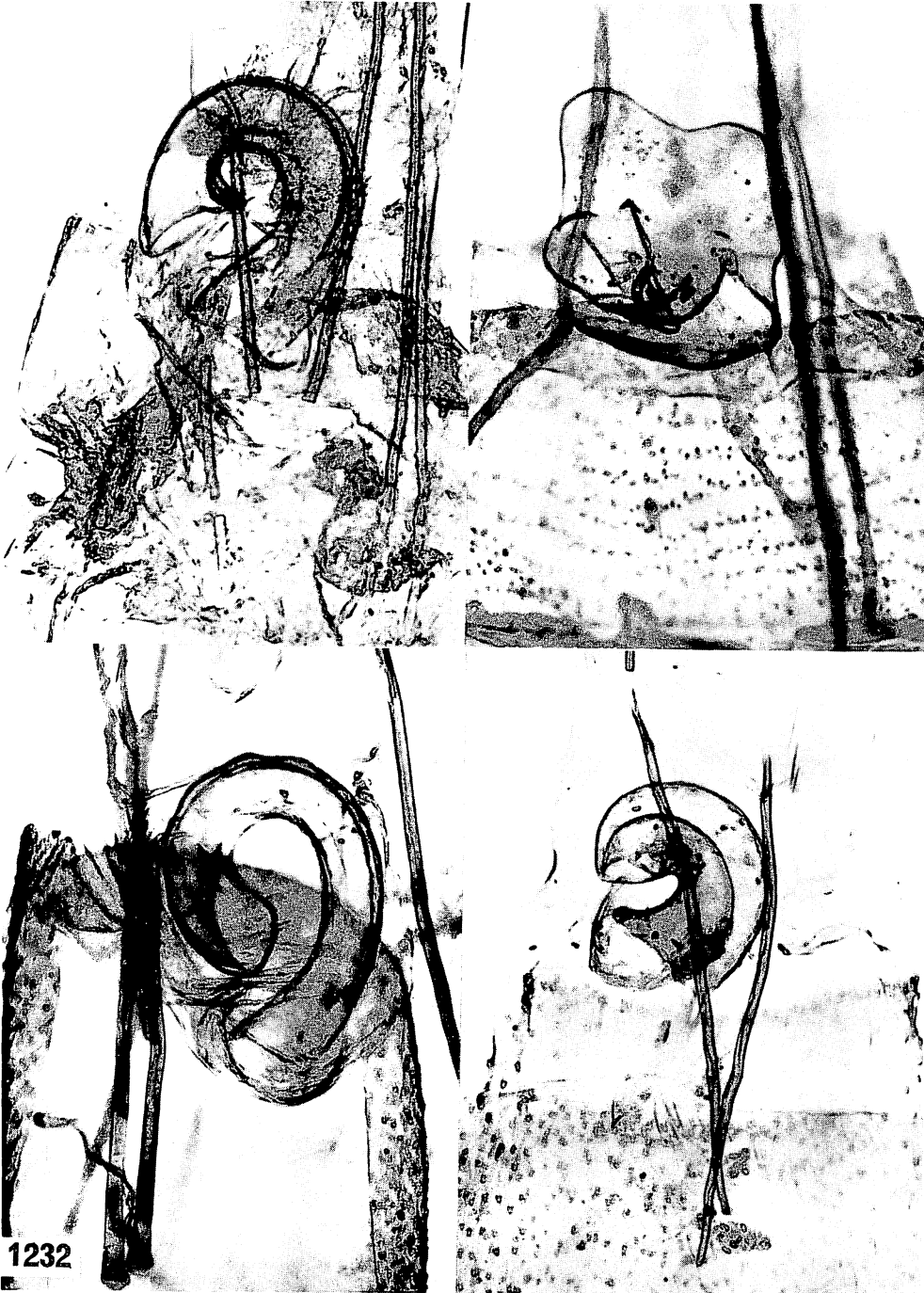


Figure 1232—Female genital ostia of *Hypsmocoma* (*Hypsmocoma*). Top left, *cincta* Walsingham, holotype (BM slide 7060); Halemanu, 4,000 feet, Kauai. Top right, *cinereosparsa* Walsingham, allotype (BM slide 7970); Kauai 3,000 to 4,000 feet. Note its unusual structure. Bottom left, *commensella* Walsingham, allotype (BM slide 7906); Kilauea, Hawaii. Bottom right, *continuella* Walsingham, holotype (BM slide 7062); Haleakala, 5,000 feet, Maui.



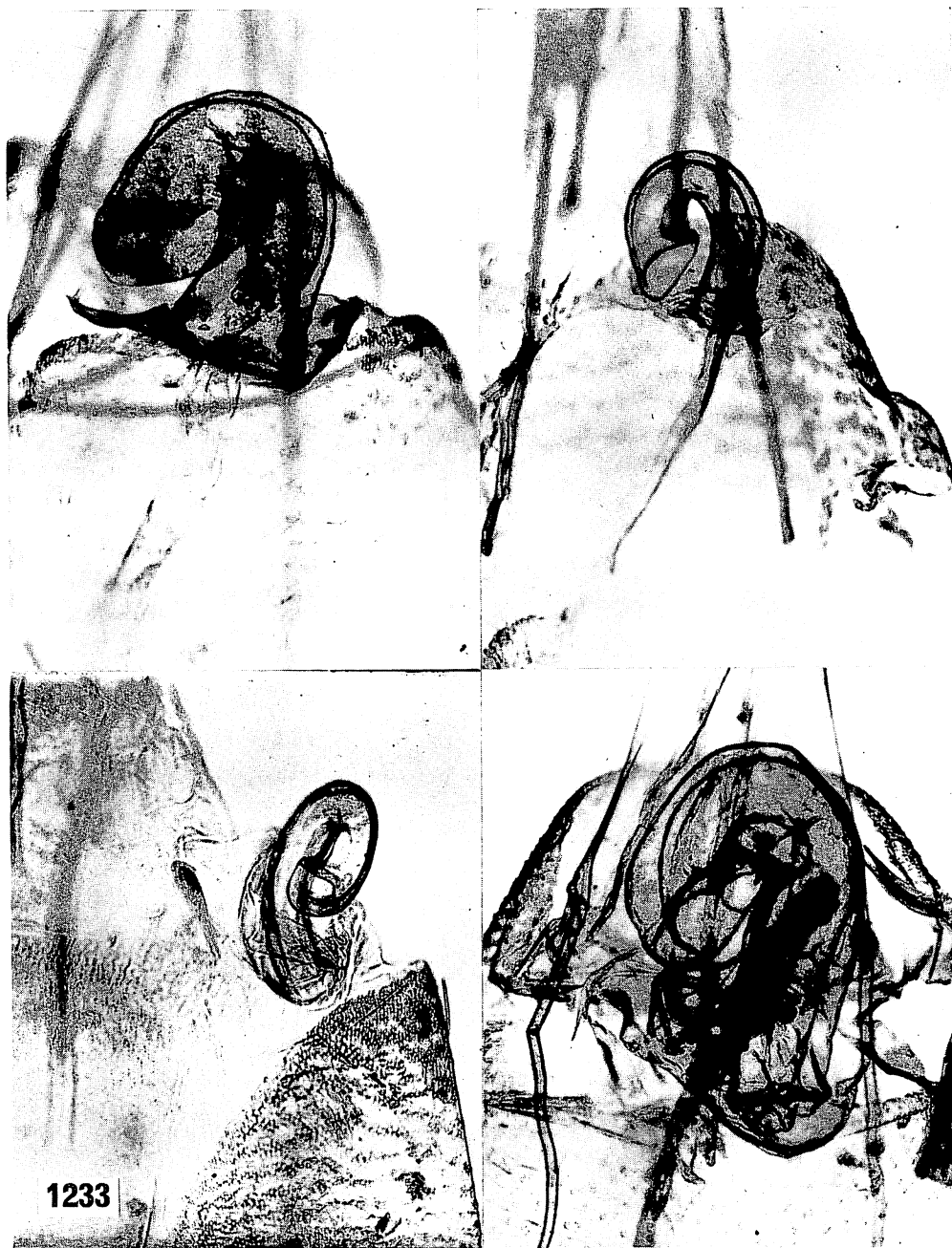


Figure 1233—Female genital ostia of *Hypsoscyma* (*Hypsoscyma*). Top left, *corvina* (Butler), paratype (BM slide 8067); Haleakala, Maui. Top right, *costimaculata* Walsingham, allotype (BM slide 7918); Molokai, above 3,000 feet. Bottom left, *cupreomaculata* Walsingham, holotype (BM slide 4474); Molokai, 3,000 feet. Bottom right, *discella* Walsingham, holotype (BM slide 7898); Kaholuamano, 4,000 feet, Kauai.

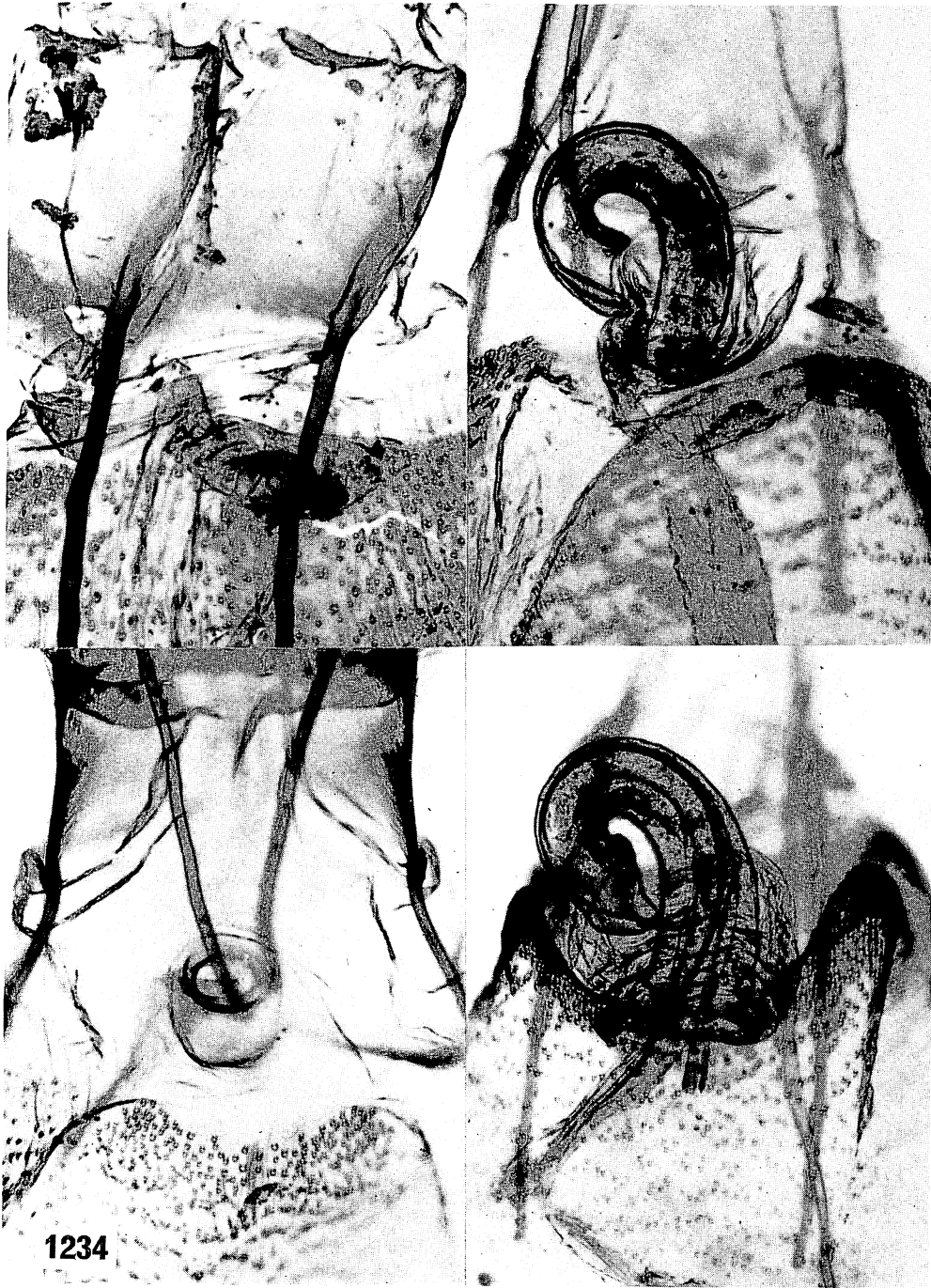


Figure 1234—Ostia of female genitalia of *Hypsoscyma*. Top left, (*E.*) *discolor* Walsingham, holotype (BM slide 7172); Kilauea, Hawaii. *Caution*: the abdomen was glued on the specimen; it may or may not belong to it. Top right, (*H.*) *suffusa* (Walsingham), paratype (BM slide 8087); Kilauea, Hawaii; formerly considered a form of *domicolens*. Bottom left, (*E.*) *emendata* Walsingham, allotype (BM slide 7933); Haleakala, 5,000 feet, Maui. Bottom right, (*H.*) *empedota* Meyrick, paralectotype (BM slide 8068); Koolau Mts., near Honolulu. Note the lateral processes; compare *carbonotata*, *empedota*, *marginotata*, and *vinicolor*.

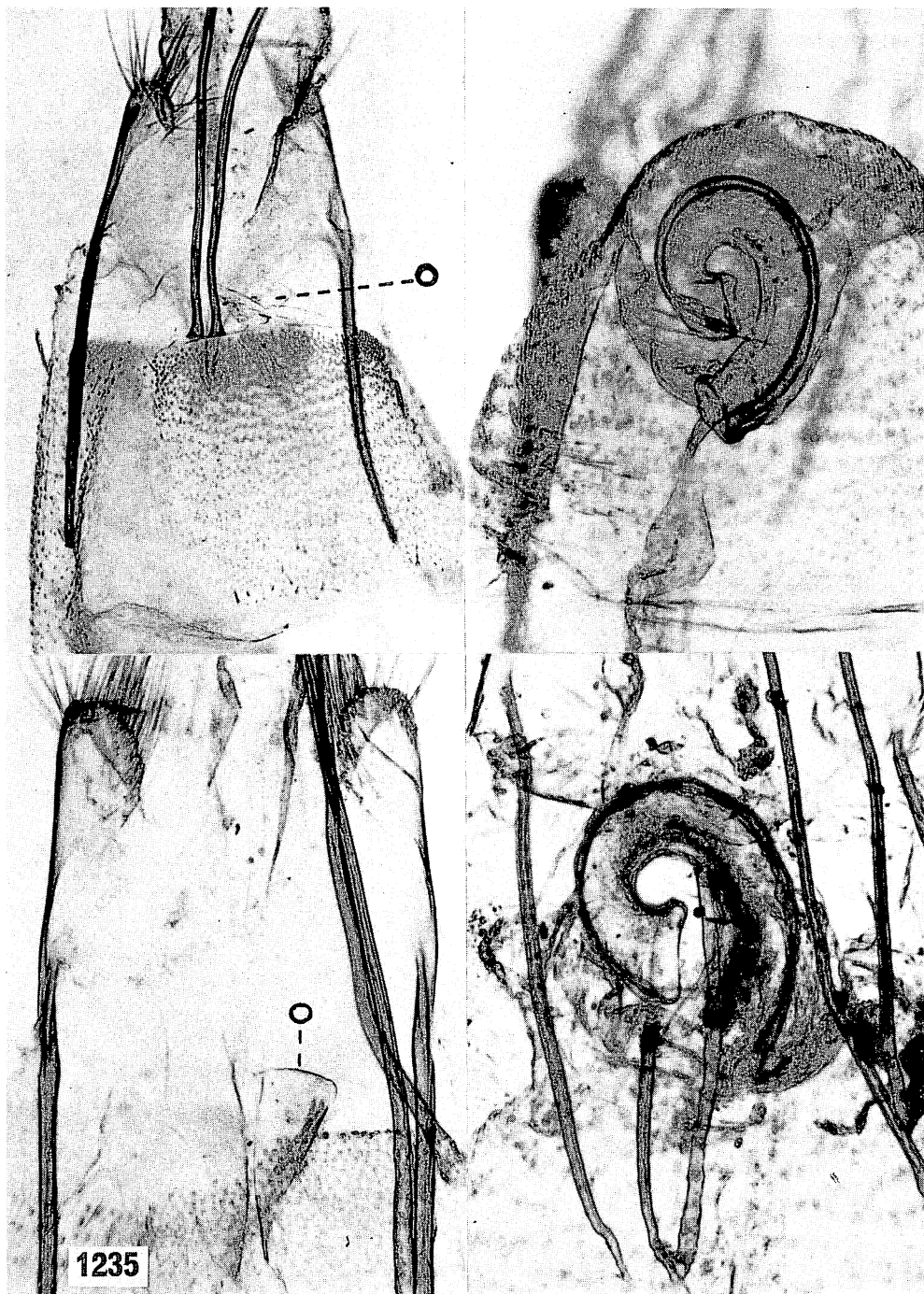


Figure 1235—Female genital ostia of *Hypsmocoma*. Top left, (*E.*) *erismatias* Meyrick, undesignated paratype? (BM slide 8073); Nuuanu, Oahu. Top right, (*H.*) *evanescens* Walsingham, allotype (BM slide 7921); Haleakala, 5,000 feet, Maui. Bottom left, (*E.*) *exornata* Walsingham, allotype (BM slide 7896); Kilauea, Hawaii. Bottom right, (*H.*) *ferricolor* Walsingham, holotype (BM slide 7066); Hualalai, Kona, 5,000 feet, Hawaii; abdomen partly decomposed. Ostia marked "O".

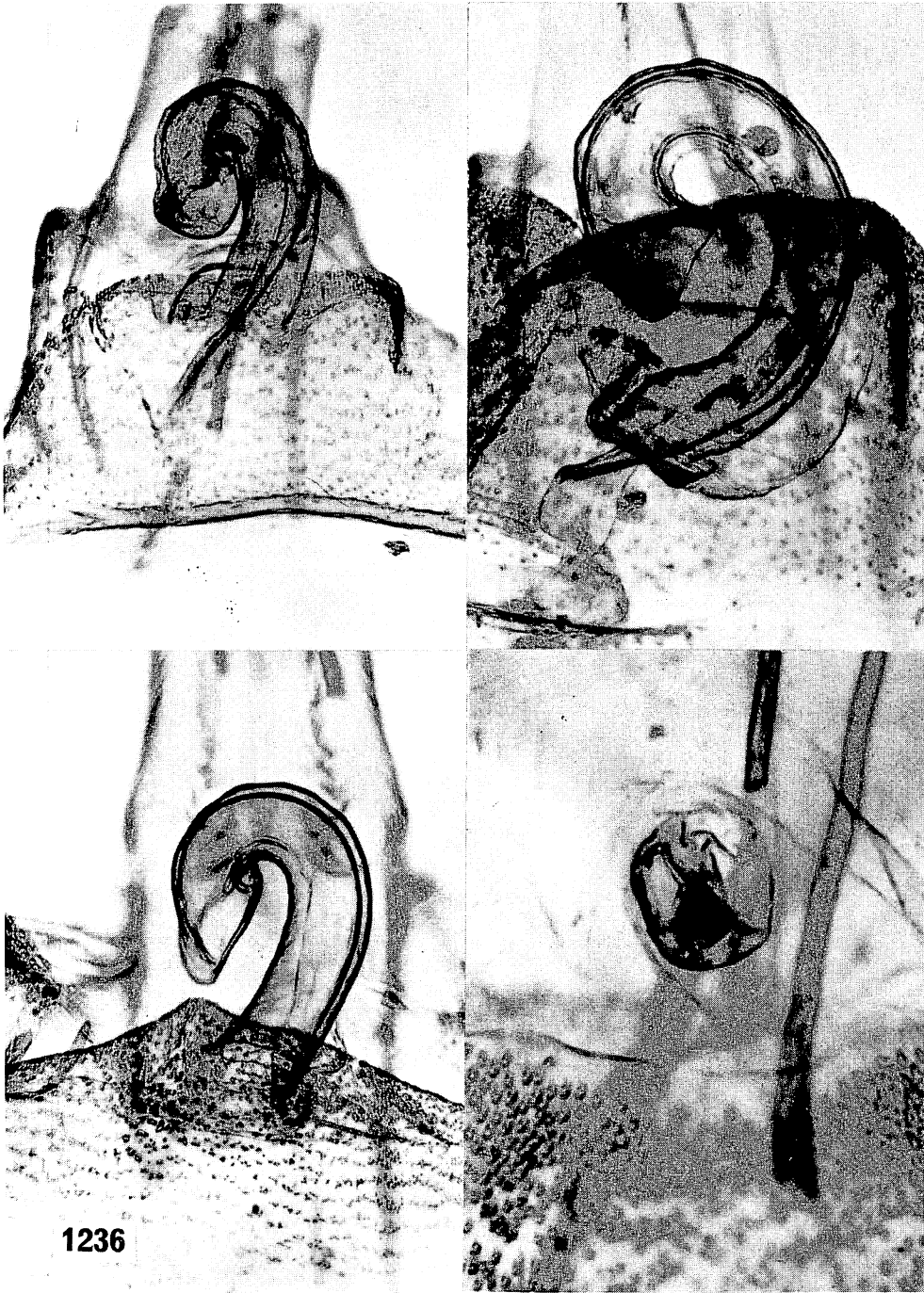
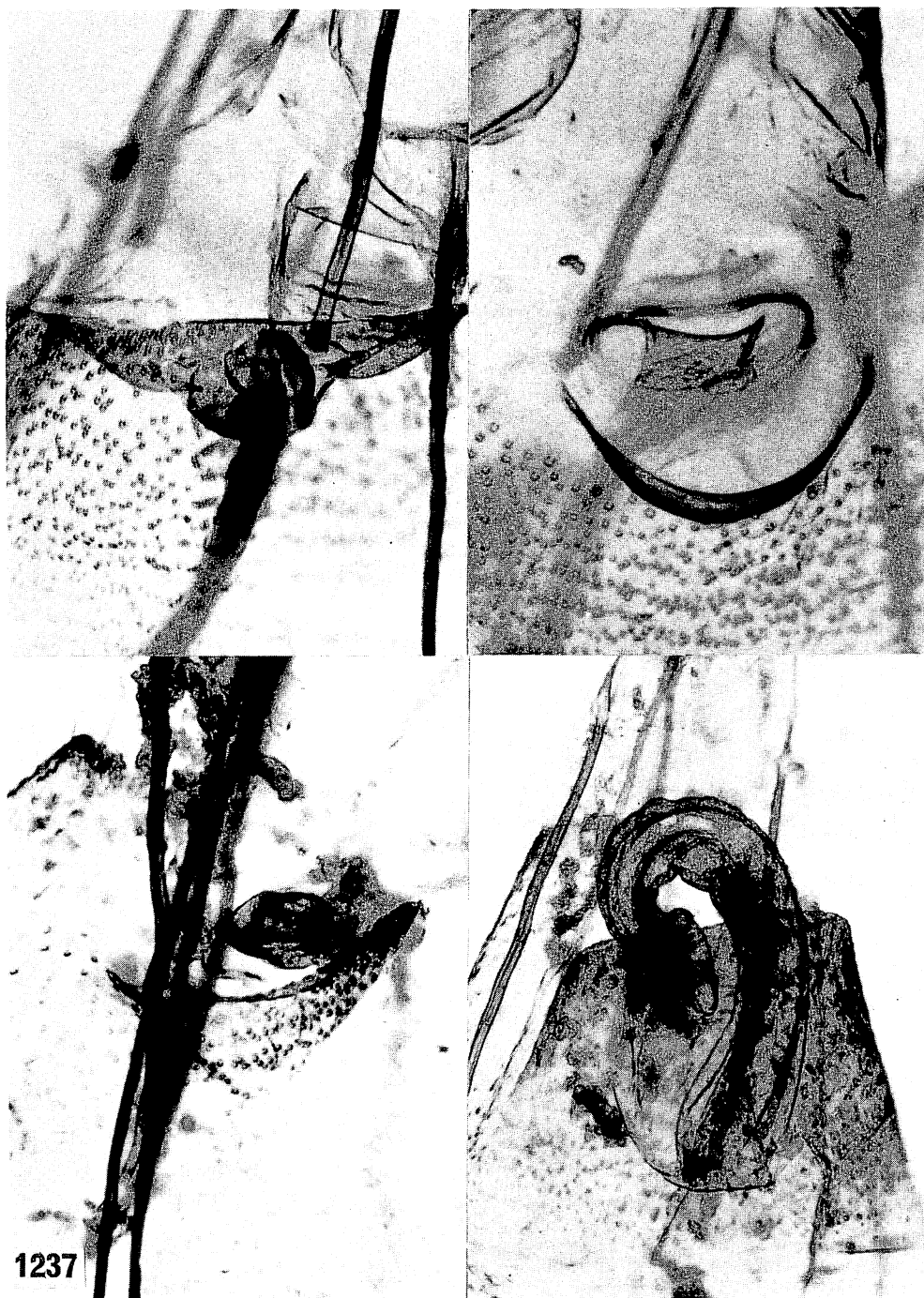


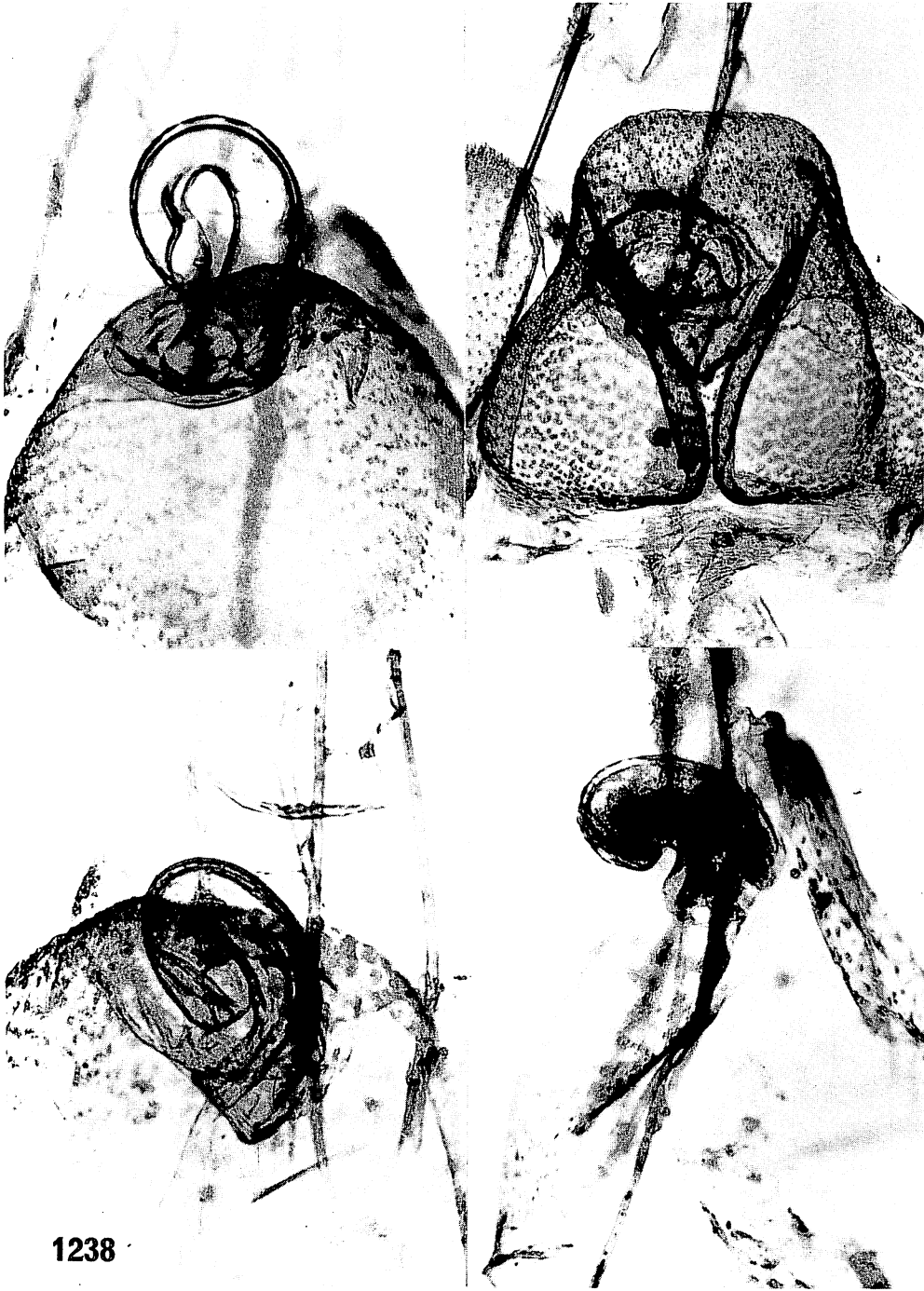
Figure 1236—Female genital ostia of *Hypsometrica*. Top left, *(H.) fervida* Walsingham, paratype (BM slide 8065); Molokai, above 3,000 feet. Top right, *(H.) fractinubella* Walsingham, allotype (BM slide 7942); Olinda, 4,000 feet, Maui. Bottom left, *(H.) fractistriata* Walsingham, holotype (BM slide 8023); Waianae Mts., Oahu. Bottom right, *(E.) fractivittella* Walsingham, holotype (BM slide 7063); Kauai, 3,000 to 4,000 feet.





1237

Figure 1237—Female genital ostia of *Hyposmocoma*. Top left, (*E.*) *fulvida* Walsingham, allotype (BM slide 7993); Molokai, above 3,000 feet. There are two signa. Top right, (*E.*) *fulvocervina* Walsingham, allotype (BM slide 8000); Kaholuamano, 4,000 feet, Kauai. Bottom left, (*E.*) *fuscopurpurea* Walsingham, allotype (BM slide 7929); Haleakala, 5,000 feet, Maui; abdomen partly decomposed. Bottom right, (*H.*) *fuscotogata* Walsingham, holotype (BM slide 7173); Molokai, above 3,000 feet; abdomen partly decomposed.



1238

Figure 1238—Female genital ostia of *Hyposmocoma* (*Hyposmocoma*). Top left, *geminella* Walsingham, allotype (BM slide 7954); Halemanu, 4,000 feet, Kauai. Top right, *genitalis* Walsingham, allotype (BM slide 8544); Olinda, 4,000 feet, Maui. The seventh sternum is highly unusual in that the ostium is dorsad of the sclerotization of the sternum; compare other figures. Bottom left, *haleakalae* (Butler), holotype (BM slide 7067); Haleakala, about 4,000 feet, Maui. Bottom right, *illuminata* Walsingham, allotype (BM slide 7917); Haleakala, 5,000 feet, Maui.

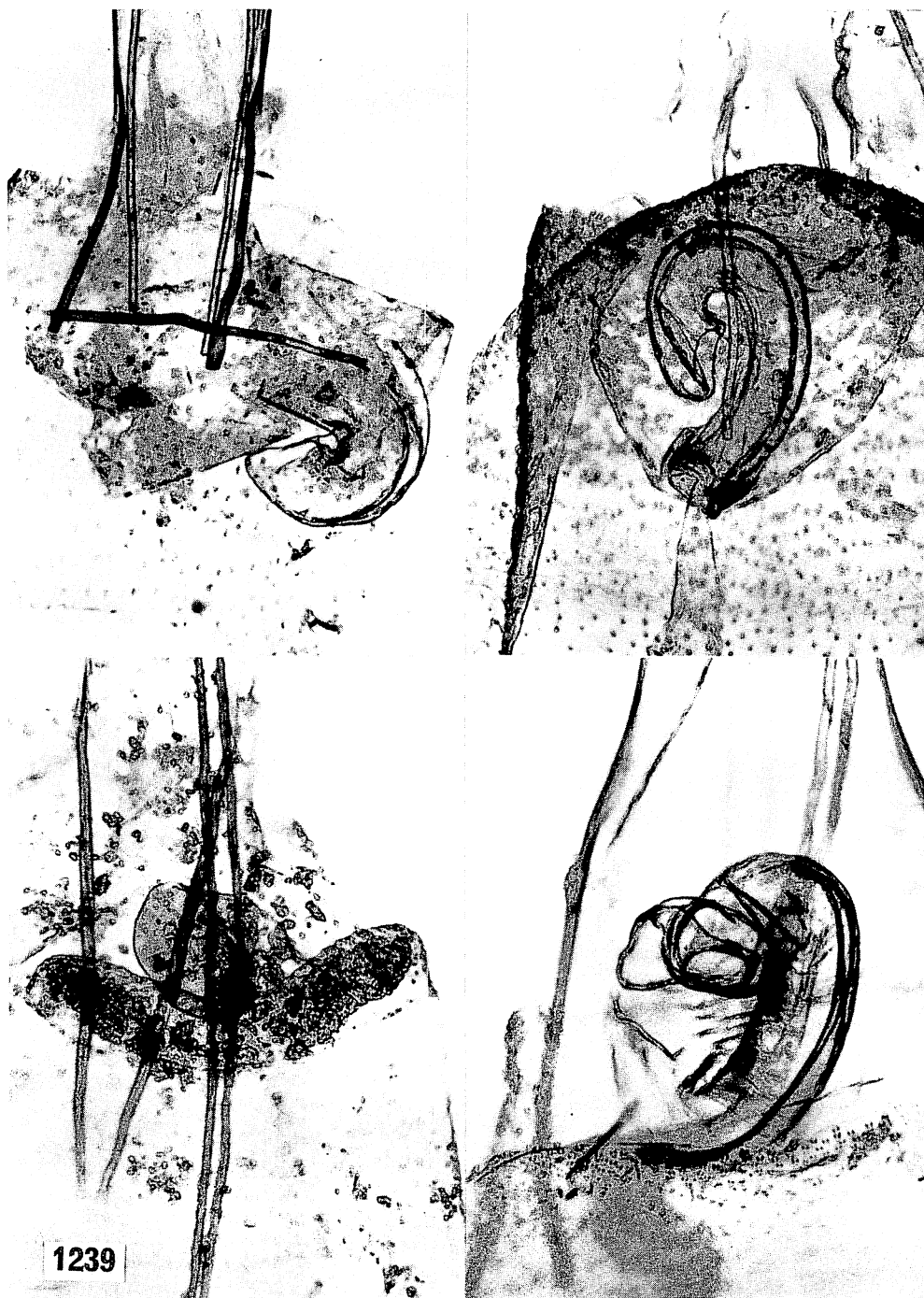


Figure 1239—Ostia of female genitalia of *Hyposmocoma* (*Hyposmocoma*). Top left, *indicella* Walsingham, allotype (BM slide 7924); Haleakala, 5,000 feet, Maui. The bursa contains two signa. Top right, *intermixta* Walsingham, holotype (BM slide 7064); Molokai, about 4,000 feet. Bottom left, *inversella* Walsingham, paratype (BM slide 7057); Waianae Mts., 2,000 feet, Oahu; abdomen partly decomposed. Bottom right, *iodes* Walsingham, allotype (BM slide 8007); Molokai, above 4,000 feet.



Figure 1240—Female genital ostia of *Hypsmocoma* (*Hypsmocoma*). Top left, *lacertella* Walsingham, allotype (BM slide 7930); Olinda, 4,000 feet, Maui. Top right, *lactea* Walsingham, allotype (BM slide 7962); Kauai, 3,000 to 4,000 feet. Bottom left, *lactioretella* Walsingham, holotype (BM slide 7065); Olinda, 4,000 feet, Maui. This species has a short ovipositor. Bottom right, *lebetella* Walsingham, allotype (BM slide 7904); Olinda, 4,000 feet, Maui.



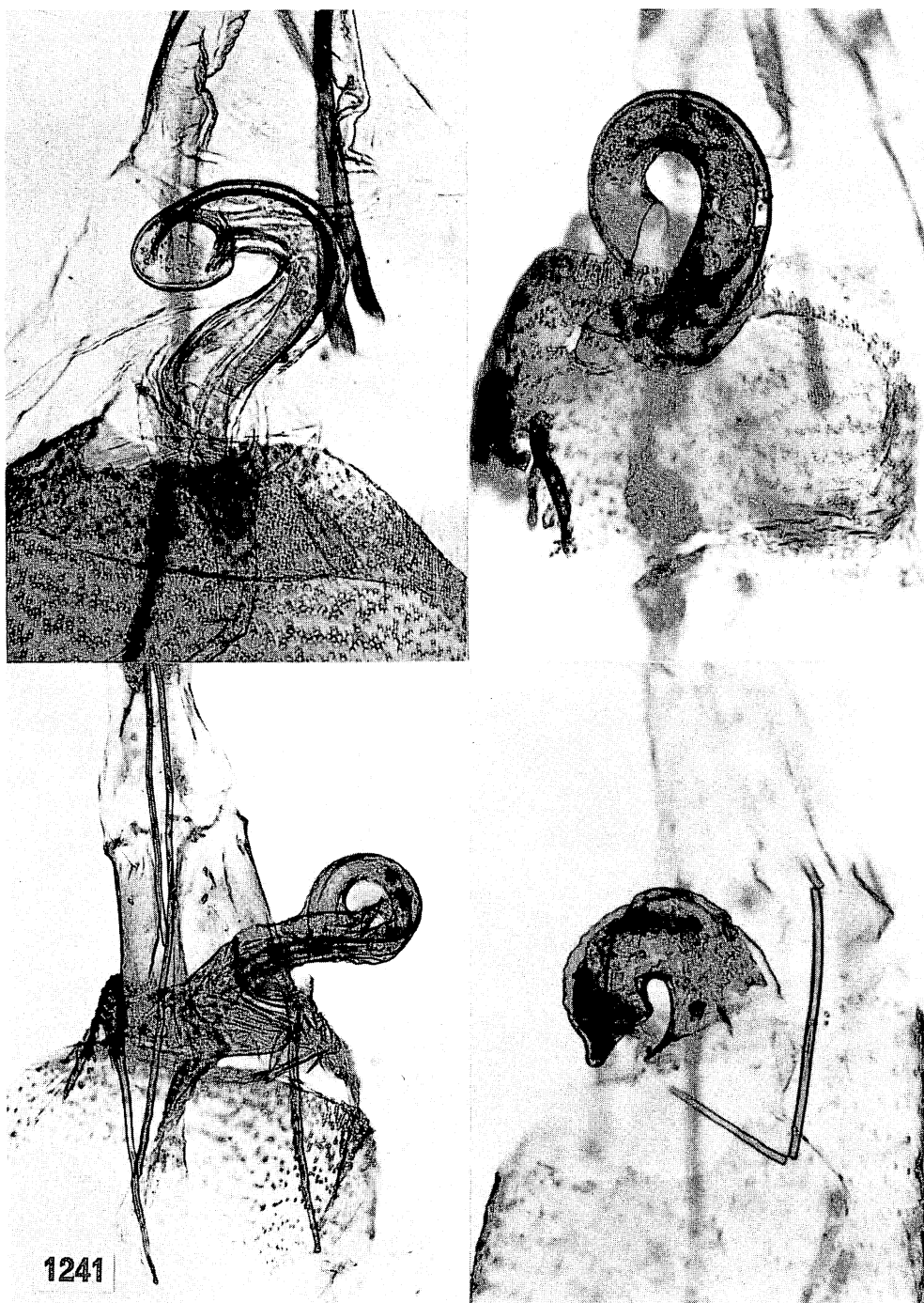


Figure 1241—Female genital ostia of *Hypsmocoma* (*Hypsmocoma*). Top left, *leporella* Walsingham, allotype (BM slide 8546); Lihue, 4,000 feet, Kauai. Top right, *lineata* Walsingham, allotype (BM slide 7928); Haleakala, 5,000 feet, Maui. Bottom left, *lituraia* Walsingham, paratype (BM slide 8071); Kona, 4,000 feet, Hawaii. Bottom right, *lixiviella* Walsingham, holotype (BM slide 8009); Kauai, 3,000 to 4,000 feet. The bursa contains two signa.

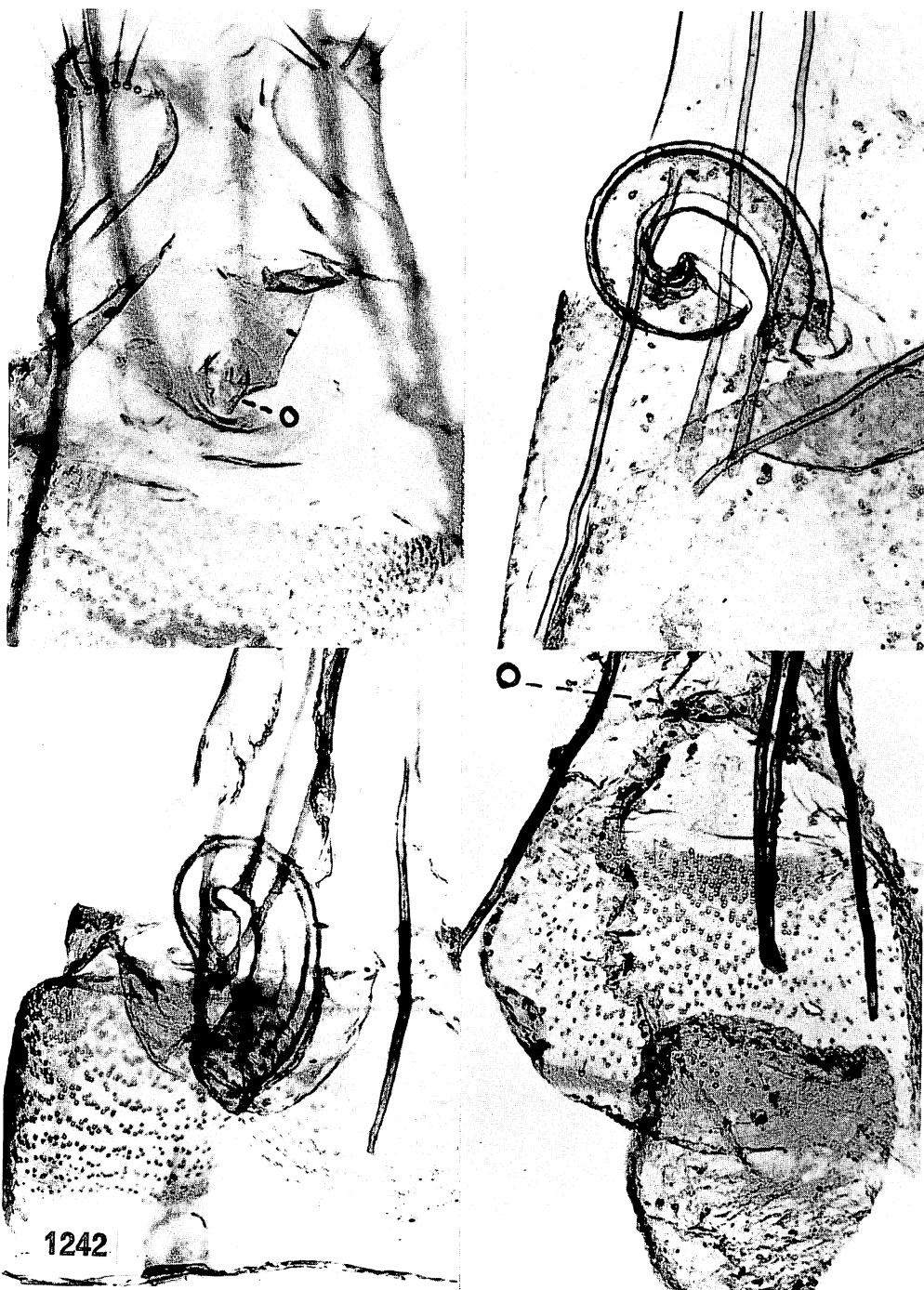


Figure 1242 Female genital ostia of *Hypsoscocoma*. Top left, (*E.*) *longitudinalis* Walsingham, holotype (BM slide 8028); Kaawalea, Kona, above 2,000 feet, Hawaii. The bursa contains one elongate signum. Top right, (*H.*) *lucifer* Walsingham, holotype (BM slide 7061); Molokai, above 4,000 feet. *Caution*: the abdomen was found glued to the type. Bottom left, (*H.*) *ludificata* Walsingham, allotype (BM slide 7927); Haleakala, 5,000 feet, Maui. Bottom right, (*E.*) *lugens* Walsingham, allotype (BM slide 8485); Haleakala, 5,000 feet, Maui.

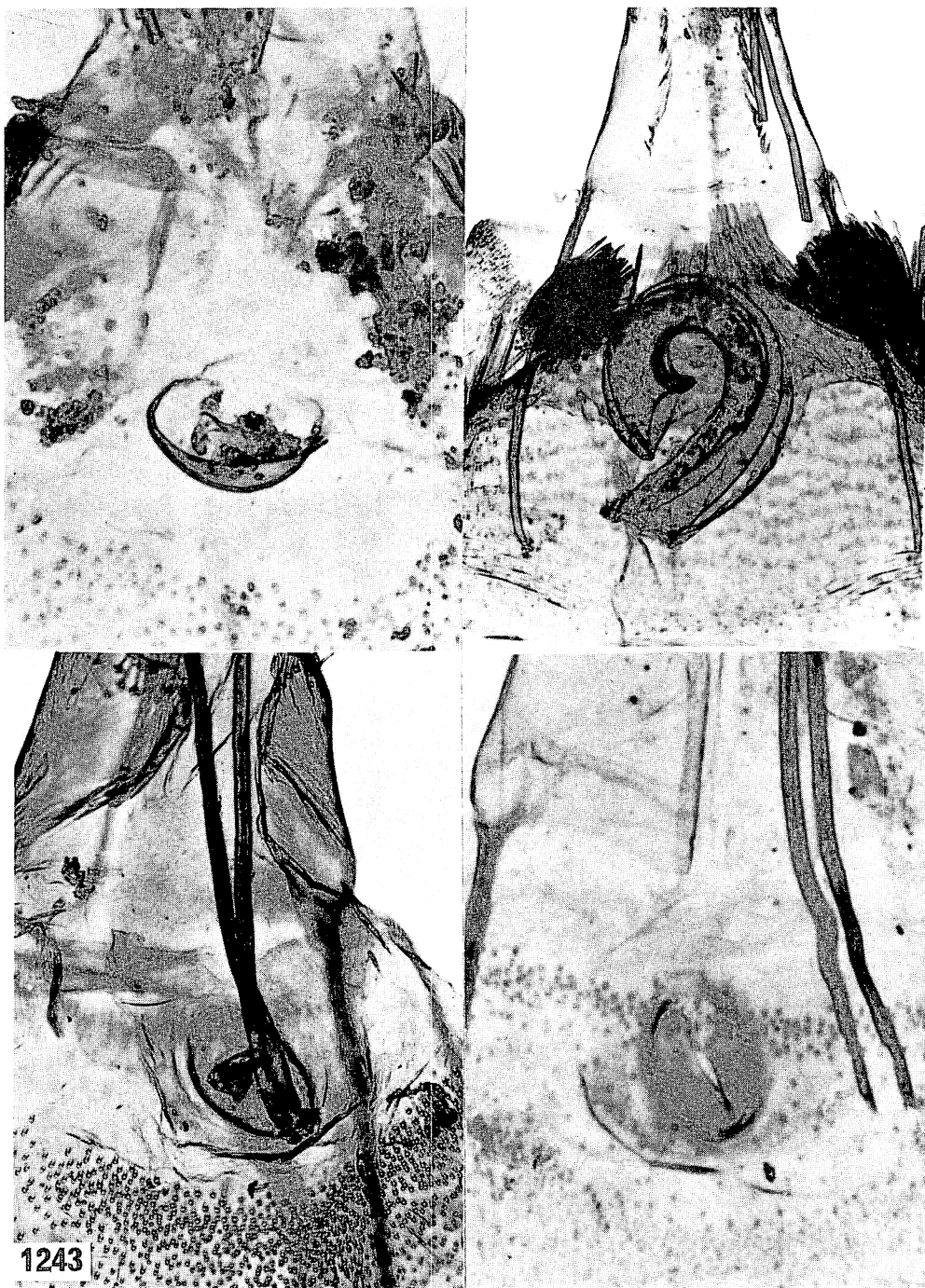


Figure 1243—Female genital ostia of *Hypsomocoma*. Top left, (*E.*) *lunifer* Walsingham, paratype (BM slide 7058); Haleakala, 5,000 feet, Maui; partly decomposed. Top right, (*H.*) *lupella* Walsingham, allotype (BM slide 7910); Kaholuamano, 4,000 feet, Kauai. Bottom left, (*E.*) *maestella* Walsingham, allotype (BM slide 8531); Kaholuamano, Kauai. Bottom right, same species, paratype (Busck slide 72) with an unobstructed view of the ostium; Kauai.

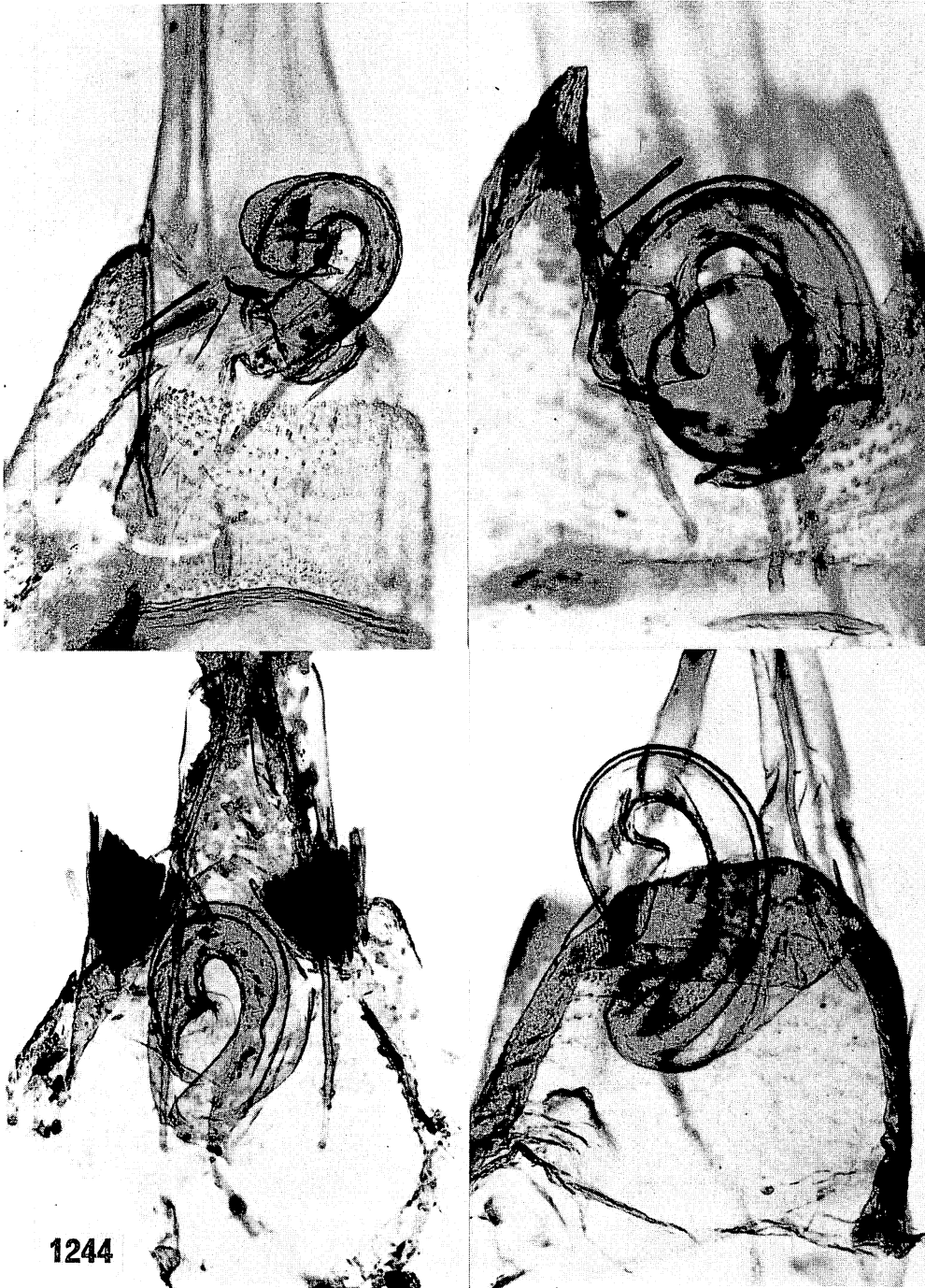


Figure 1244—Female genital ostia of *Hypsoscoma* (*Hypsoscoma*). Top left, *malornata* Walsingham, paratype (BM slide 8074); Molokai, 3,000 feet. Top right, *marginotata* Walsingham, allotype (BM slide 7931); Kauai, 3,000 to 4,000 feet. Note the prolongations of the sides of the seventh sternum; compare *carbonotata*, *empedota*, and *vinicolor*. Bottom left, *mediella* Walsingham, holotype (BM slide 7911); Waianae Mts., Oahu; partly decomposed. Bottom right, *mediospurcata* Walsingham, allotype (BM slide 7913); Kilauea, Hawaii.





Figure 1245—Female genital ostia of *Hypsomocoma* (*Hypsomocoma*). Top left, *metallica* Walsingham, allotype (BM slide 7923); Kilauea, Hawaii. Top right, *metrosiderella* Walsingham, allotype (BM slide 8004); Halemanu and Kaholuamano, 4,000 feet, Kauai. Bottom left, *mimica* Walsingham, allotype (BM slide 8008); Molokai, above 3,000 feet; partly decomposed. There are two signa on the bursa. Bottom right, *modesta* Walsingham, allotype (BM slide 7971); Kauai, 3,000 to 4,000 feet.



Figure 1246—Female genital ostia of *Hypsoscocoma* (*Hypsoscocoma*). Top left, *nephelodes* Walsingham, holotype (BM slide 8014); Waianae Mts., 3,000 feet, Oahu. Top right, *nigralbida* Walsingham, allotype (BM slide 7897); Kauai, 3,000 to 4,000 feet. Bottom left, *nividorsella* Walsingham, allotype (BM slide 8547); Kauai, 3,000 to 4,000 feet. Bottom right, a paratype of the same species from the same locality (BM slide 8077).

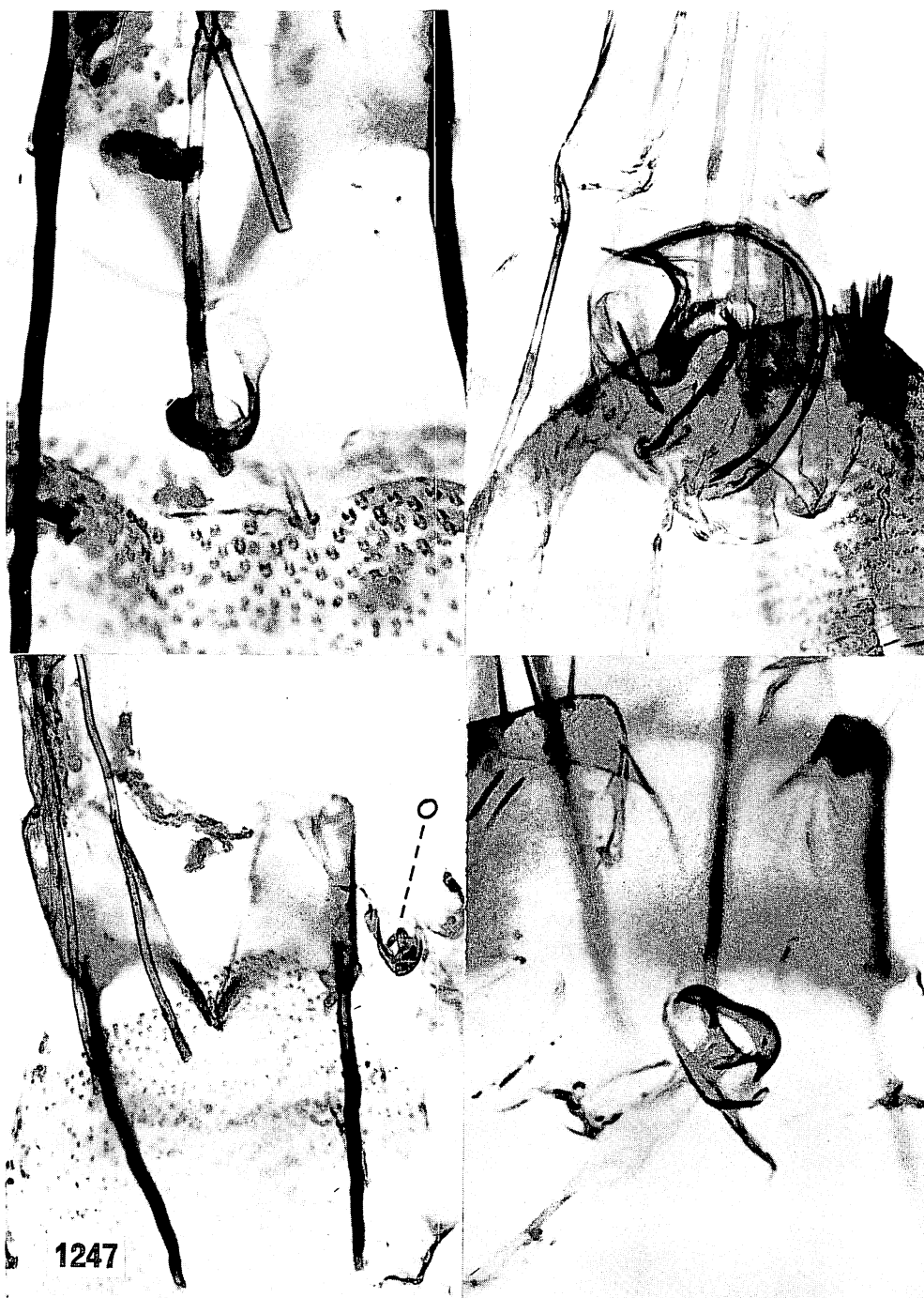


Figure 1247—Female genital ostia of *Hypsmocoma*. Top left, (*E.*) *nigrodentata* Walsingham, allotype (BM slide 7965); Kauai, 3,000 to 4,000 feet. Top right, (*H.*) *notabilis* Walsingham, allotype (BM slide 7903); Molokai, above 3,000 feet. Bottom left, (*E.*) *obliterata* Walsingham, allotype (BM slide 7966); Kauai, 3,000 to 4,000 feet. *Caution*: abdomen found loose in box; it may or may not be correctly associated. The ostium, "O", is damaged. Bottom right, (*E.*) *obscura* Walsingham, allotype (BM slide 7998); Olinda, 4,000 feet, Maui.

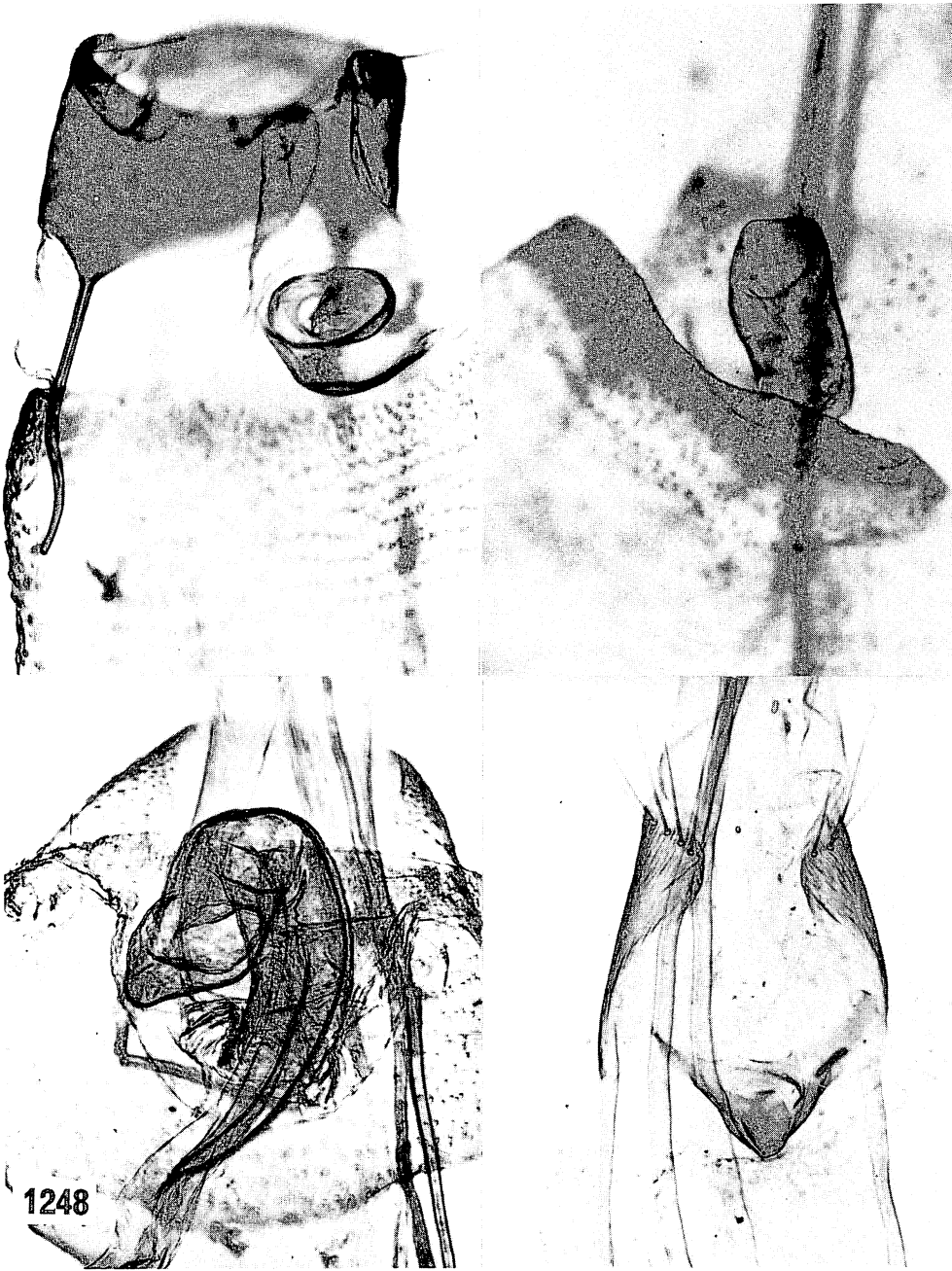


Figure 1248—Female genital ostia of *Hypsoscocoma*. Top left, *(E.) ocellata* Walsingham, allotype (BM slide 7932); Kaholuamano, 4,000 feet, Kauai. Top right, *(H.) ochreocervina* Walsingham, allotype (BM slide 8002); Waianae Mts., about 3,000 feet, Oahu. Bottom left, *(H.) ochreociliata* Walsingham, allotype (BM slide 8549); Kilauea, Hawaii. Bottom right, *(E.) palmivora* Meyrick, paratype (Busck slide 136); Kumuwela, Kauai.



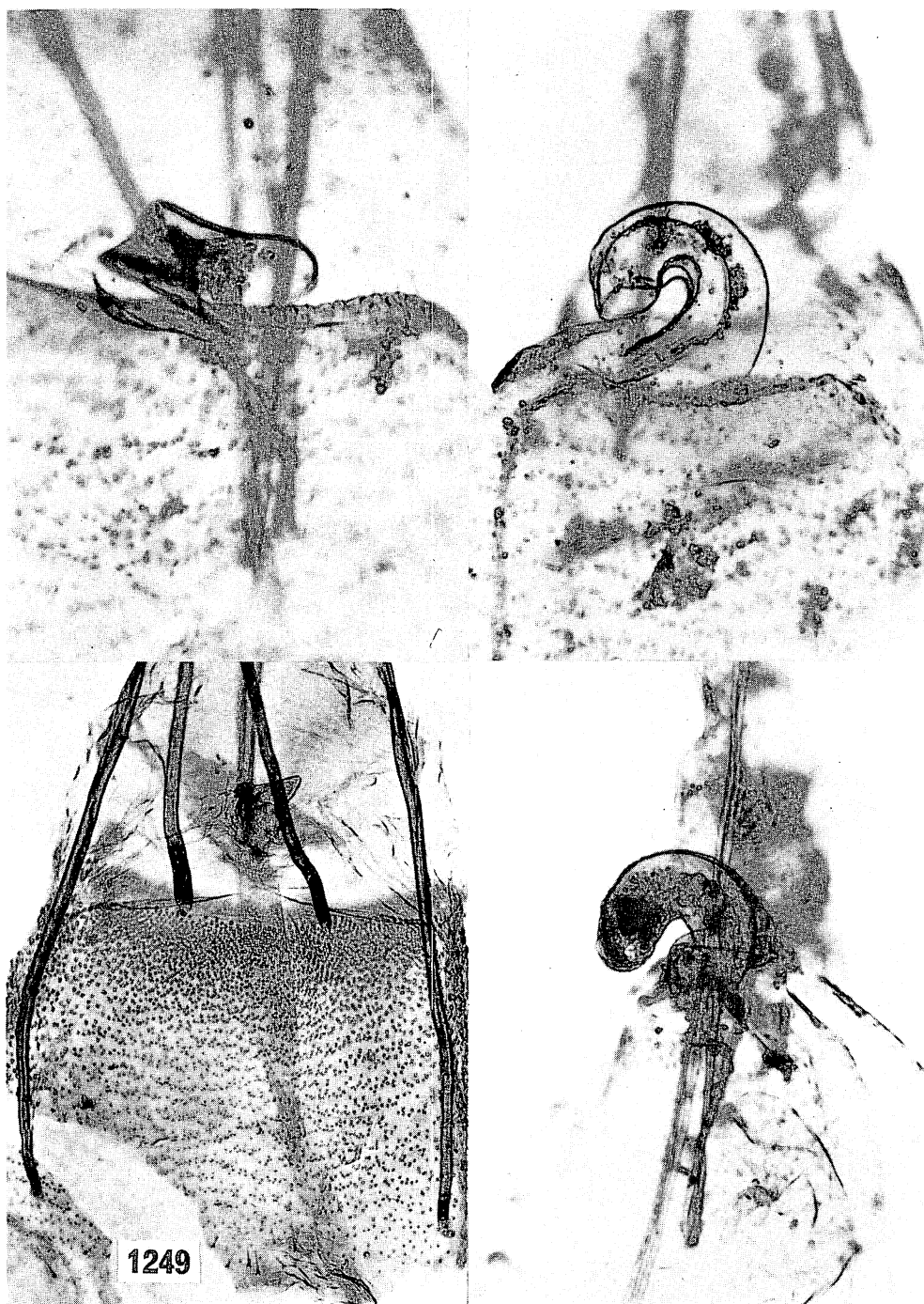


Figure 1249—Female genital ostia of *Hyposmocoma*. Top left, (*H.*) *paradoxa* Walsingham, allotype (BM slide 8003); Kauai, 3,000 to 4,000 feet. Top right, (*H.*) *parda* (Butler), determined by Walsingham (BM slide 8078); Kona, 4,000 feet, Hawaii. There are two rounded signa on the bursa. Bottom left, (*E.*) *chilonella percondita* Walsingham, allotype (BM slide 8059); Lihue, 4,000 feet, Kauai. Bottom right, (*H.*) *phalacra* Walsingham, holotype (BM slide 8012); Kauai, 3,000 to 4,000 feet; partly decomposed.

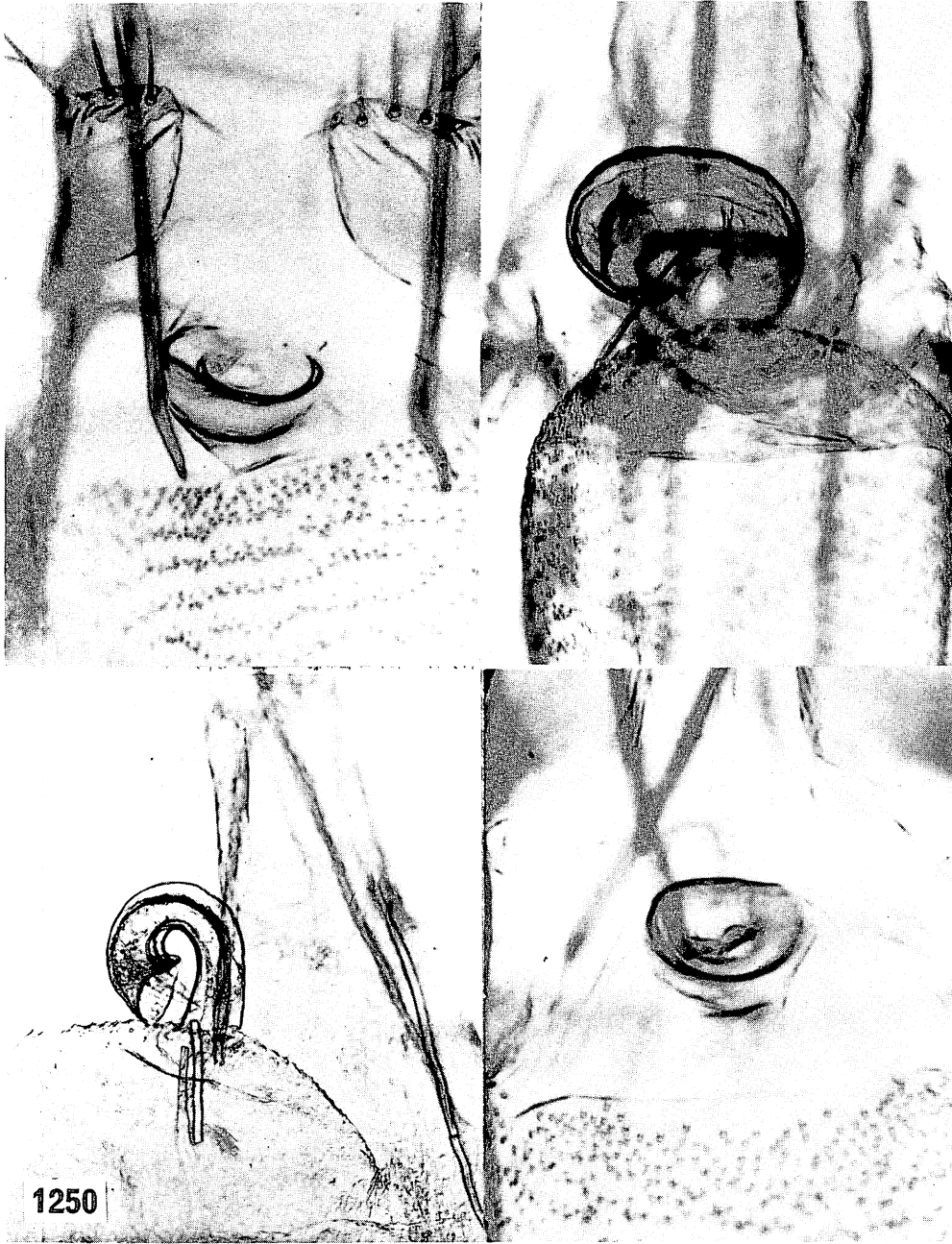


Figure 1250—Female genital osita of *Hypsmocoma*. Top left, *(E.) phantasmatella* Walsingham, allotype (BM slide 7956); Kaholuamano, 4,000 feet, Kauai. Top right, *(H.) picticornis* Walsingham, allotype (BM slide 7955); Molokai, above 3,000 feet. Bottom left, *(H.) progressa* Walsingham, holotype (BM slide 4471); Haleakala, below 4,000 feet, Maui. Bottom right, *(E.) pucciniella* Walsingham, allotype (BM slide 7937); Kilauea, Hawaii.

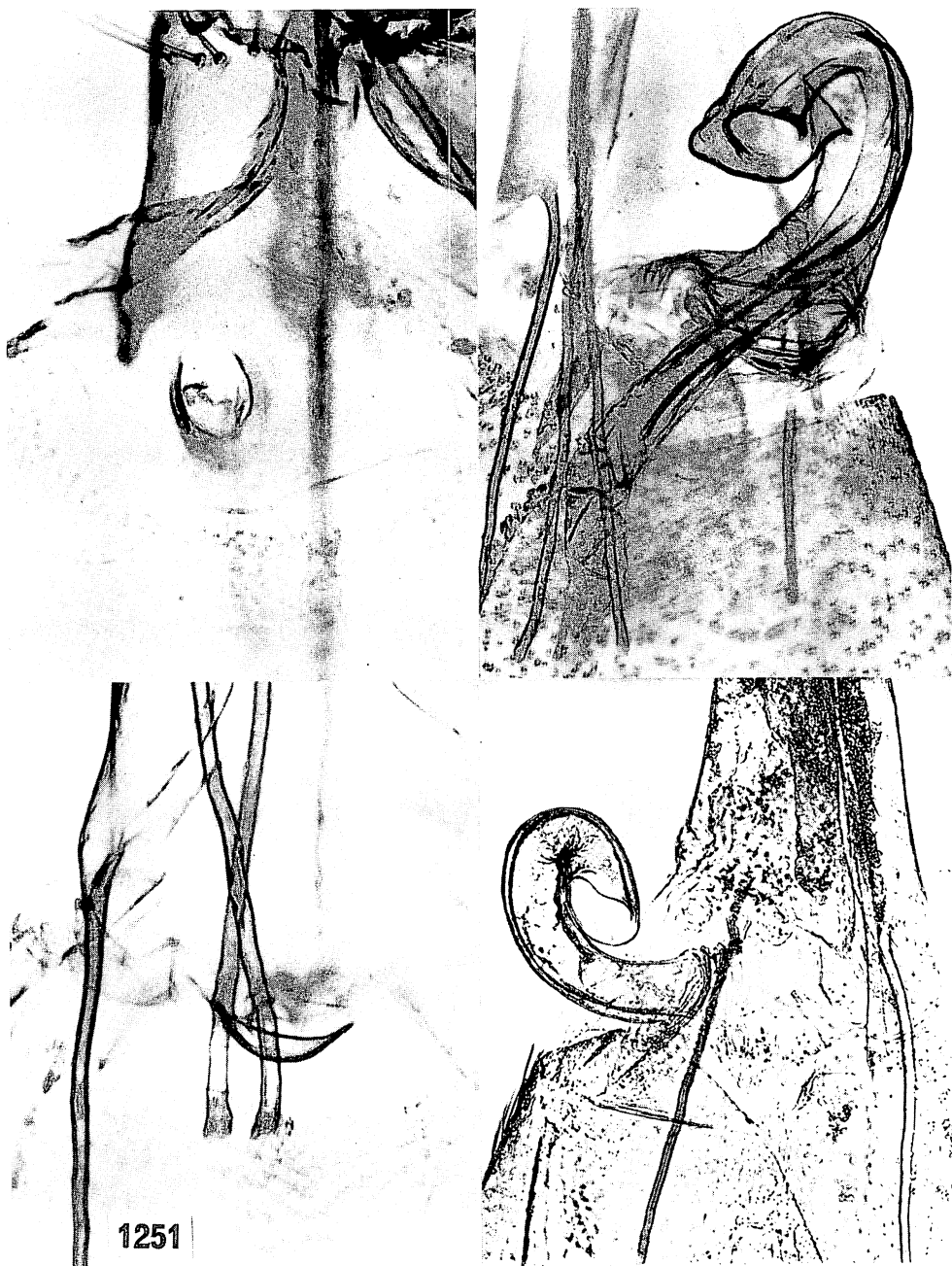
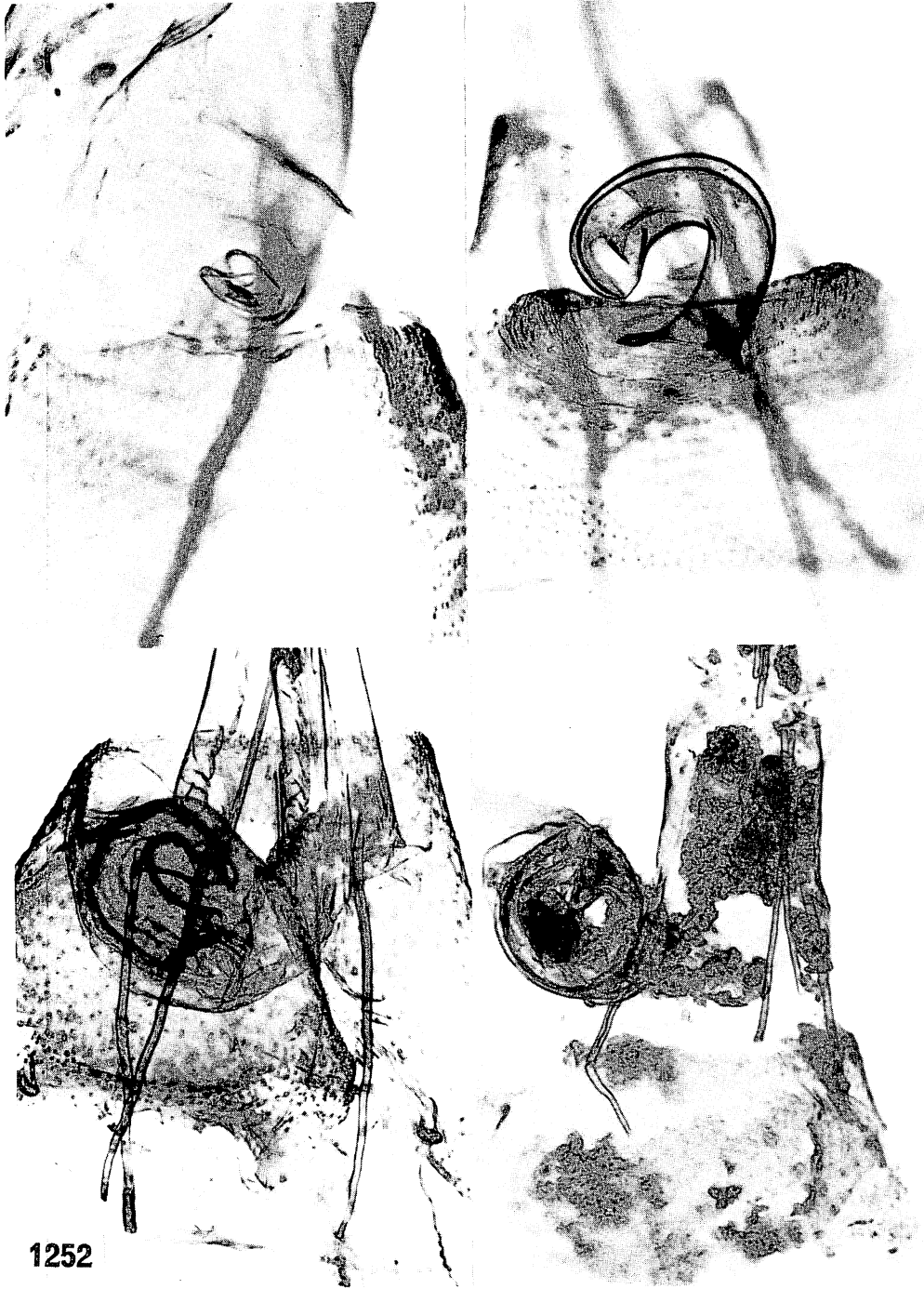


Figure 1251—Female genital ostia of *Hypsmocoma*. Top left, *(E.) quadripunctata* Walsingham, allotype (BM slide 7974); Kauai, 3,000 to 4,000 feet. Top right, *(H.) quinquemaculata* Walsingham, allotype (BM slide 8006); Kona, 4,000 feet, Hawaii. Bottom left, *(E.) radiatella* Walsingham, holotype (BM slide 8022); Kona, 3,000 feet, Hawaii. There is one elongate signum. Bottom right, *(H.) rhabdophora* Walsingham, holotype (BM slide 4531); Molokai, above 4,000 feet.



1252

Figure 1252—Female genital ostia of *Hypsmocoma*. Top left, (*E.*) *roseofulva* Walsingham, allotype (BM slide 8001); Kauai, 3,000 to 4,000 feet; there is one elongate signum on the bursa. Top right, (*H.*) *rubescens* Walsingham, holotype (BM slide 8015); Kauai, 3,000 to 4,000 feet. Bottom left, (*H.*) *sabulella* Walsingham, holotype (BM slide 7912); Halemanu, 4,000 feet, Kauai. Bottom right a species confused with *saccophora* as a paratype (BM slide 8079); Kauai, 3,000 to 4,000 feet; partly decomposed. Bursa sub-8-shaped with a constriction near the cephalic third. This is very different from Oahu material; compare figure 1227 of the holotype of *saccophora*.



Figure 1253—Female genital ostia of *Hyposmocoma*. Top left, (*H.*) *saliaris* Walsingham, holotype (BM slide 8010); Kona, 4,000 feet, Hawaii. There are two round signa on the bursa. Top right, (*E.*) *scandens* Walsingham, allotype (BM slide 7999); Kauai, 3,000 to 4,000 feet. The ovipositor is moderately short. Bottom left, (*E.*) *scepticella* Walsingham, allotype (BM slide 7940); Olinda, 4,000 feet, Kauai; there are no signa. Bottom right, (*H.*) *schismatica* Walsingham, paratype (BM slide 8080); Kaholuamano, 4,000 feet, Kauai. There are two round signa on the bursa. The ostium is improperly positioned; it is viewed from the edge.



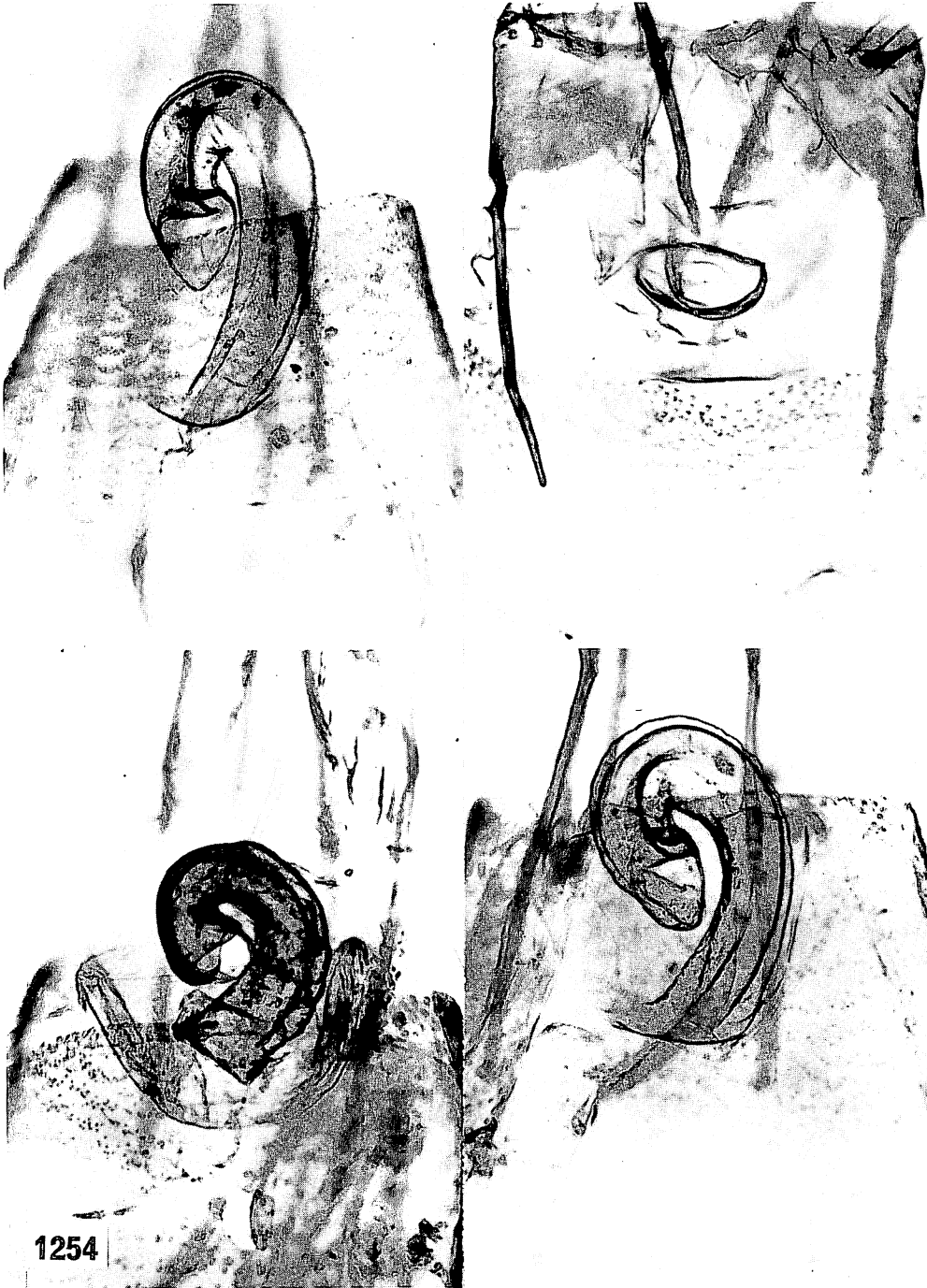


Figure 1254—Female genital ostia of *Hypsoscocoma*. Top left, (*H.*) *scolopax* Walsingham, allotype (BM slide 8016); Kauai, 3,000 to 4,000 feet. Top right, (*E.*) *semifusca* Walsingham, allotype (BM slide 7895); Kona, 3,000 feet, Hawaii. Bottom left, (*H.*) *sideritis* Walsingham, holotype (BM slide 7997); Olinda, 4,000 feet, Maui. Bottom right, (*H.*) *somatodes* Walsingham, allotype (BM slide 8019); Kona, 4,000 feet, Hawaii.

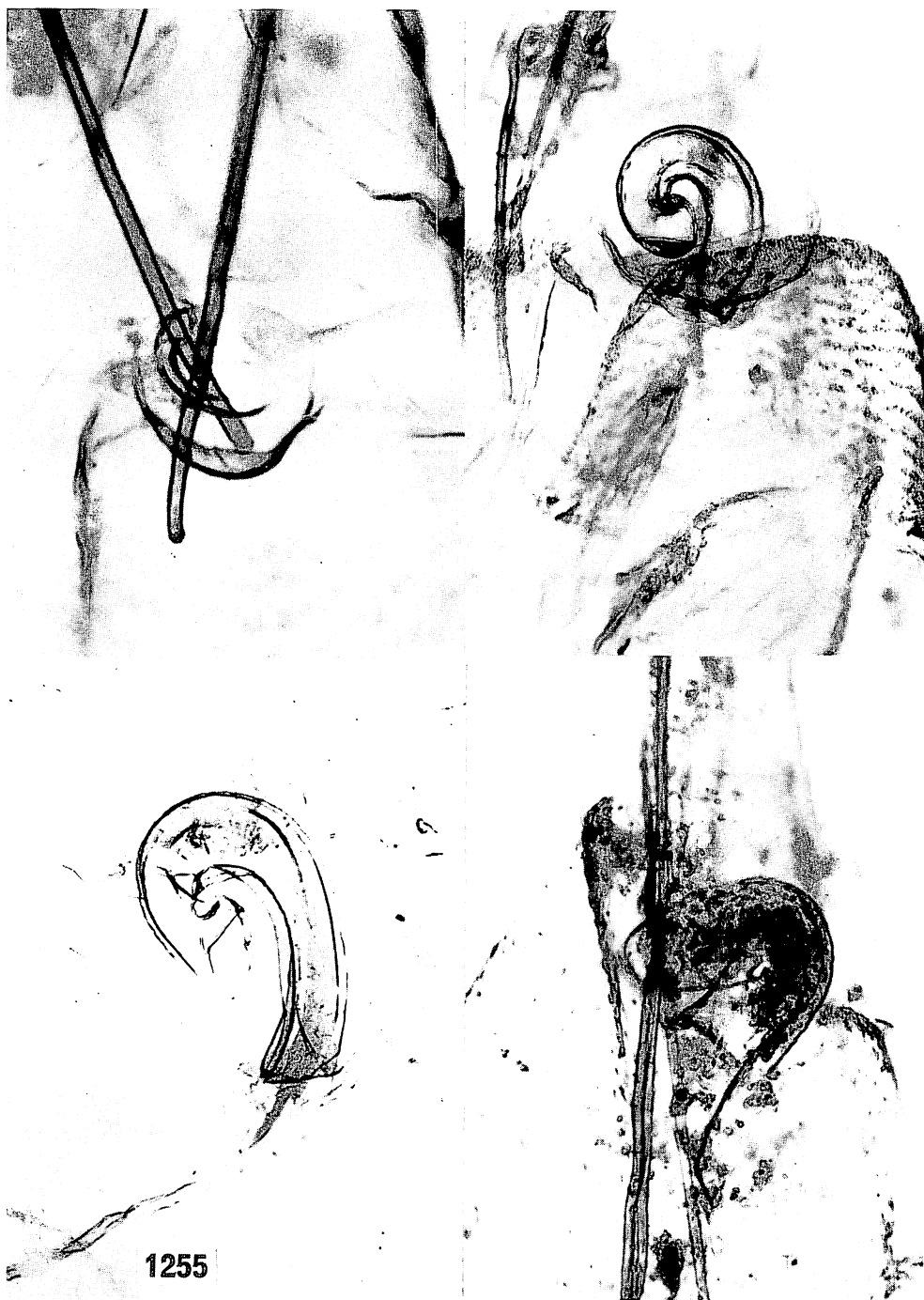


Figure 1255—Female genital ostia of *Hypsomocoma*. Top left, (*E.*) *stigmatella* Walsingham, holotype (BM slide 7941); Molokai, about 4,500 feet. The ovipositor is moderately short; there is no signum. Top right, (*H.*) *straminella* Walsingham, holotype (BM slide 7922); Kona, 4,000 feet, Hawaii. Bottom left, (*H.*) *subcitrella* Walsingham, holotype (BM slide 4492); Kaholuamano, 4,000 feet, Kauai. Bottom right, (*H.*) *subflavidella* Walsingham, allotype (BM slide 7915); Haleakala, 5,000 feet, Maui; partly decomposed.

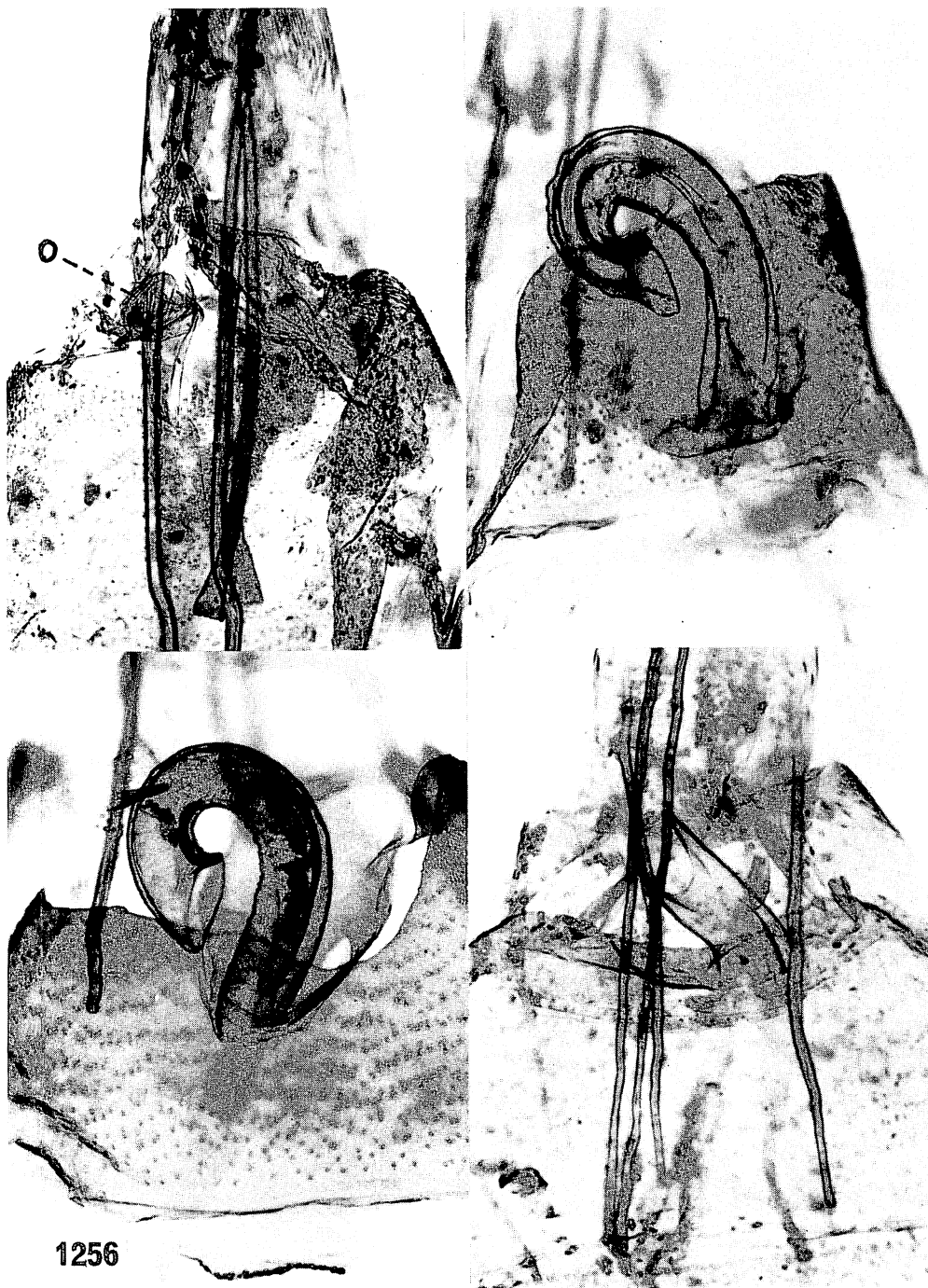


Figure 1256—Female genital ostia of *Hypsmocoma*. Top left, (*E.*) *subnitida* Walsingham, allotype (BM slide 8060); Kilauea, Hawaii; partly decomposed; ostium marked "O". Top right, (*H.*) *subscolopax* Walsingham, allotype (BM slide 8017); Kilauea, Hawaii. Bottom left, (*H.*) *suffusella* (Walsingham), paratype (BM slide 8082); Kaholuamano, 4,000 feet, Kauai. Bottom right, (*H.*) *syrrhaptus* Walsingham, allotype (BM slide 8088); Halemanu, 4,000 feet, Kauai.



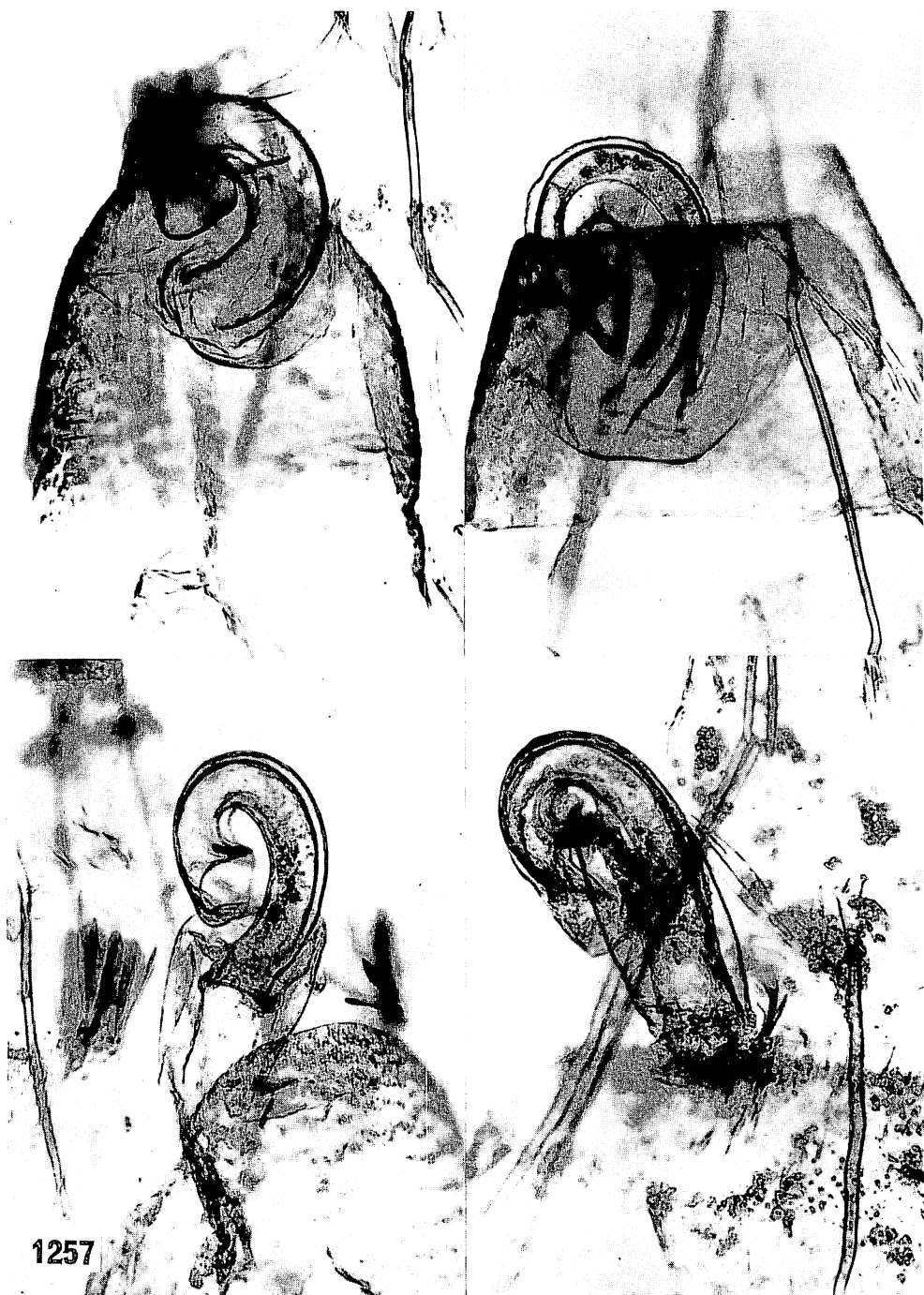


Figure 1257—Female genital ostia of *Hyposmocoma*. Top left, (*H. tenuipalpis* Walsingham, allotype (BM slide 7905); forest above Pelekunu, Molokai. Top right, (*H. tetraonella* Walsingham, allotype (BM slide 8018); Kona, 3,000 to 5,000 feet, Hawaii. Bottom left, (*H. thoracella* Walsingham, allotype (BM slide 7914); Lanai, 2,000 feet. Bottom right, (*H. tomentosa* Walsingham, holotype (BM slide 7068); Kona, 3,000 feet, Hawaii.

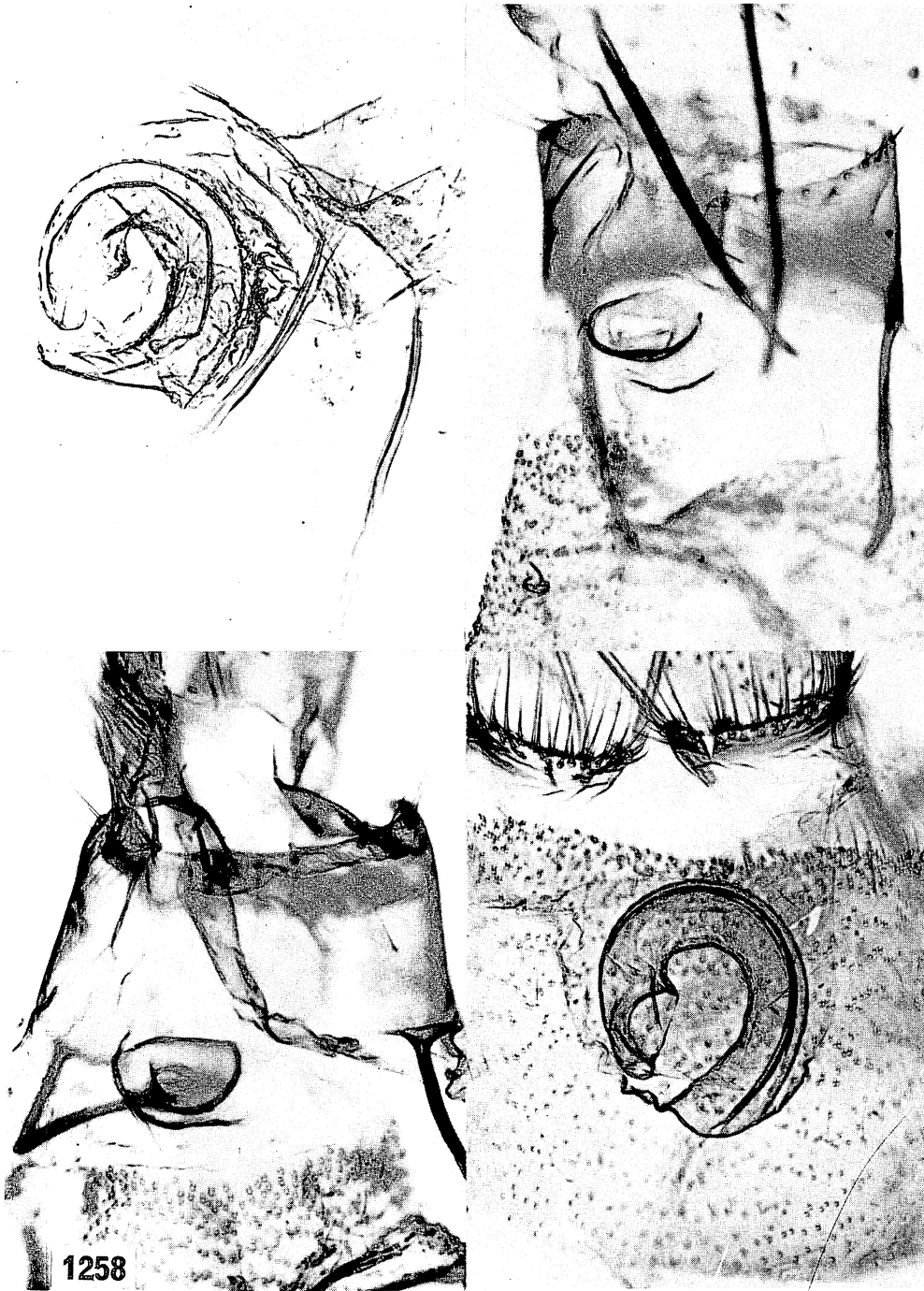


Figure 1258—Female genital ostia of *Hypsocoma*. Top left, (*H.*) *torquata* Walsingham, holotype (BM slide 4092); Kauai, 3,000 to 4,000 feet; partly decomposed. This was labeled a male by Walsingham. Top right, (*E.*) *tricincta* Walsingham, holotype (BM slide 7936); Kona, 2,000 feet, Hawaii. The ovipositor is short. Bottom left, (*E.*) *trilunella* Walsingham, paratype (BM slide 8089); Haleakala, 5,000 feet, Maui. Bottom right, (*H.*) *trimaculata* Walsingham, allotype (BM slide 8543); Waianae Mts., 2,000 feet, Oahu. The ovipositor is short.

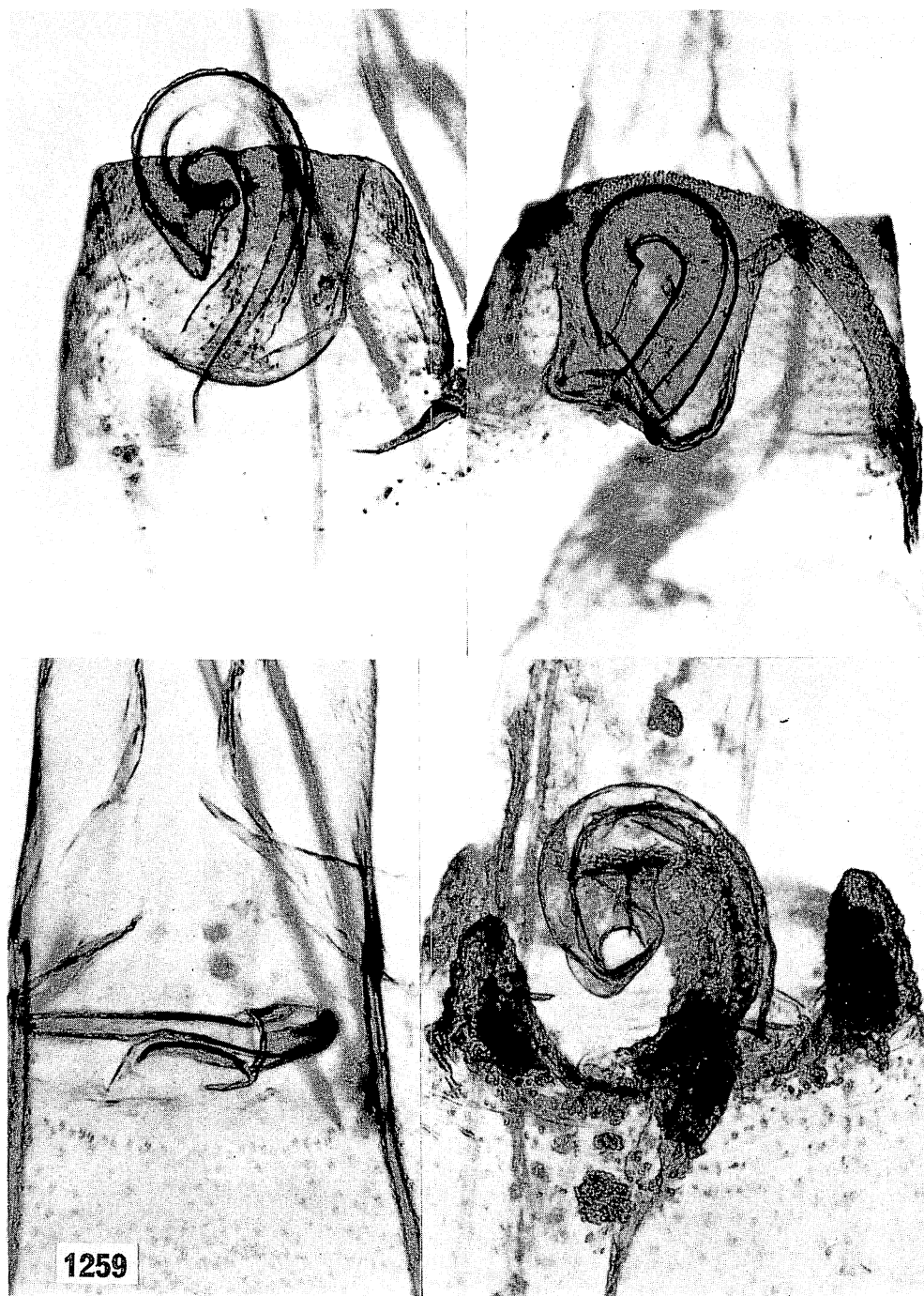


Figure 1259—Female genital ostia of *Hypsoscocoma*. Top left, (*H. turdella* Walsingham, holotype (BM slide 8020); Lanai, 2,000 feet. Top right, (*H. unistriata* Walsingham, allotype (BM slide 7926); Molokai, 4,000 feet. Bottom left, (*E. vicina* Walsingham, allotype (BM slide 7992); Waianae Mts., 1,700 feet, Oahu. Bottom right, (*H. vinicolor* Walsingham, paratype (BM slide 7059); Waianae Mts., 3,000 feet, Oahu. Note the sclerotized extensions of sternite seven, and compare with *carbonenotata*, *empedota*, and *marginenotata*.

Subfamily **GELECHIINAE** (Stainton)

*Gelechidae* Stainton, 1854:75, Sauveur and Fologne, 1863:103.

*Gelechina*: Herrich-Schäffer, 1857:58.

*Gelechiidae*: Anonymous, 1858:83. Meyrick, 1883:122, redefinition. Spuler, 1898:30.

*Gelechianae*: Walsingham, 1890:144.

*Gelechiinae*: Spuler, 1898:31.

*Gelechiadae*: Walsingham, 1907*b*:478; 1909 (1909–1915):18.

Busck, 1903*b*, North American fauna, with keys.

Meyrick, 1904*c*:255–441, Australian fauna, with key to genera; 1925*b*, in *Genera Insectorum*, with world key to genera; many other papers.

Turner, 1919, Australian fauna.

Gaede, 1937, In *Lepidopterorum Catalogus*, world catalog.

LeMarchand, 1947, European fauna.

Diakonoff, 1954*b*, key to New Guinea genera.

Sattler, 1973, definitive catalog of generic and suprageneric names.

Although the Gelechiinae is a very large, cosmopolitan group with many hundreds of species on the continents surrounding the Pacific, only one genus (the progenitor of *Merimnetria*) succeeded in crossing the sea and becoming established in Hawaii before the coming of man. With the assistance of man, however, about 10 additional genera, including several species of major economic importance, have become established in the islands.

Traditionally, the members of this group have been considered to have the termen of the hindwing concave or sinuously concave in what is known as “typically gelechiid” shape. However, this characteristic is shared by only part of the subfamily—many species have the hindwing termen convex and thus quite differently shaped. When well-developed, the concave outline of the hindwing termen (which often has the apex strongly produced) is a conspicuous, easily recognized character, as in figures 1263 and 1294. Most of the Hawaiian species do have the hindwing termen concave, and, in Hawaii, a small moth whose proboscis is squamose and whose hindwing termen is concave can be placed directly in the Gelechiinae.

Most of the characters which have been used to define the group are so variable that they have little or no use when applied to the world fauna. A workable definition of the Gelechiinae has not yet been prepared. It is sometimes stated that veins 6 and 7 in the hindwing are usually basally approximated or stalked, but in many genera these veins are well separated. Hindwing veins 3 and 4 are also often connate or stalked, but they are well separated on many species. Generally vein 1c is not developed as a tubular vein at the margin of the hindwing, and in most species in Hawaii 1c is obsolete. Among other Hawaiian Gelechiidae, vein 1c is developed near the margin of the hindwing in the Oecophorinae, Ethmiinae, Xyloryctinae, and Blastobasinae. It is obsolete in the Chrysopeleiinae and the Momphinae, but may or may not be present in the Cosmopteriginae. There is great diversity in the structure of the male genitalia from simple to complex; some males have extraordinary genitalia.

Meyrick (1904c:256), speaking of the Australian Gelechiinae, said that "from other families the Gelechiadae are most reliably distinguished by the connection of 8 in the hindwing with cell by a more or less evident bar; this is not always easy to observe, but the sinuation or emargination of termen is usually perceptible, and where this fails, the greater width of hindwings relatively to forewings, or the approximation of veins 6 and 7 at base are frequent characters which help to distinguish from the *Oecophoridae*, in which family they never occur." It is difficult to formulate a description of the Gelechiidae, or the Gelechiinae, which may be applied to all faunas.

The suprageneric classification of the Gelechiinae is in an elementary, provisional, confused state of taxonomy. It will be many years before a satisfactory system is contrived. Without attempting to justify or to describe the categories, I have arranged the Hawaiian gelechiids under a series of tribal names.

#### KEY TO THE GENERA OF GELECHIINAE IN HAWAII

1. Ocelli present .....2  
    Ocelli absent .....5
- 2(1). Terminal segment of labial palpus comparatively  
       broad, as in figures 1276 and 1283; forewings with  
       vein 2 arising from cell separate from vein 3 .....3  
       Terminal segment of labial palpus very slender,  
       narrower than the shaft of the antenna (figures  
       1262 and 1268); forewings with vein 2 arising as  
       a branch of 3 and not from cell .....4
- 3(2). Expanse 15 mm. or larger; apex of male abdomen  
       with external dorsal and lateral tufts of yellow  
       setae and hair-scales; uncus broad and hood  
       shaped; valvae simple on dorsal margins .....  
       ..... **Phthorimaea.**  
       Expanse 11 mm. or less; apex of male abdomen  
       lacking yellow tufts; uncus a long, slender, sharply  
       pointed, hooklike process; valvae each with a  
       slender tooth on the dorsal margin before apex  
       ..... **Keiferia.**
- 4(2). Labial palpus with the squamae on second segment  
       expanded beneath and extending far distad of  
       apex of the segment, as in figure 1262; forewing  
       narrowly pointed at apex, as in figure 1263 .....  
       ..... **Dichomeris.**  
       Labial palpus with the squamae on the second  
       segment closely following the contour of the  
       segment and not expanded below and hardly  
       extending beyond apex of segment, as in figure  
       1268; forewings broad at apex, as is figure 1268  
       ..... **Trichotaphe.**

- 5(1). Forewings with 12 veins, veins 7 and 8 stalked . . . . .6  
 Forewings with 10 or 11 veins, veins 7 and 8 fused . . . .10
- 6(5). Hindwing either narrow, bladelike, narrowly pointed and with termen obsolete and wings as in figure 1260 of *Oecia*, or hindwing broad and termen smoothly convex and apex not produced . . . . .7  
 Termen of hindwing slightly to strongly concave, or slightly concave and crenulate, and apex slightly or strongly produced . . . . .8
- 7(6). Hindwing lanceolate, narrower than forewing; second segment of labial palpus elongate-subparallel; as in figure 1260 . . . . .**Oecia**.  
 Hindwing very broad, broader than forewing; second segment of labial palpus with the vestiture on the ventral side strongly elongated into a subtriangular mass, as in figures 1272, 1273 . . . .  
 . . . . .**Crasimorpha**.
- 8(6). Hindwing with apex narrow and conspicuously projected, as in figure 1294; forewing with vein 6 out of 7; pecten present on first antennal segment . . . . .**Sitotroga**.  
 Hindwing with apex only comparatively slightly produced, as in figures 1298 and 1309 of *Pectinophora* and *Merimnetria* (*Aristoteliodes*); forewing with vein 6 free from cell; pecten present or absent on first antennal segment . . . . .9
- 9(8). First antennal segment with a conspicuous pecten of several setae; hindwing broader than forewing, veins 3 and 4 connate or very close at base, and vein 7 very close to 6 at base and strongly arcuate and running close to 6 for about one-third of its length, as in figure 1298 . . . . .**Pectinophora**.  
 First antennal segment lacking an obvious pecten (at most with one or two setae); hindwing not broader than forewing and veins 3 and 4 and 6 and 7 widely separated at origins, as in figures 1309–1311 . . . *Merimnetria* subgenus **Aristoteliodes**.
- 10(5). Forewing with only 10 veins (veins 5 and 6 and 7 and 8 fused), and with veins 2 and 3 separate; hindwing with only 7 veins, vein 6 absent, as in figure 1338 . . . . .**Merimnetria** *sensu stricto*.  
 Forewing with 11 veins (veins 5 and 6 present and separate) and with veins 2 and 3 stalked; hind-

- wing with 8 veins. . . . . 11
- 11(10). Hindwing with veins 3 and 4 and 6 and 7 conspicuously stalked; labial palpi not unusual; as in figure 1340. . . . . **Autosticha.**
- Hindwing with veins 3 and 4 and 6 and 7 connate and not conspicuously stalked; labial palpi very long (those of the male unusually long and bent back over thorax; apical segment with a large, conspicuous brush of long hairs), as in figure 1346 . . . . . **Stoeberhinus.**

Tribe **SYMMOCINI** (Gosmány), **new status**

Gosmány, 1957:326, erected a "new subfamily" of the Gelechiidae, the Symmocinae. In 1963:130 he elevated the group to full "family" status as the Symmocidae in which he included *Oecia*. The group of genera so associated appears entitled to no more than tribal status within the Gelechiinae.

Genus **OECIA** Walsingham

*Macroceras* Staudinger, 1876:150; homonym, not Semper, 1870.

*Oecia* Walsingham, 1897*b*:111. Type-species of both generic names: *Macroceras oecophila* Staudinger (= *Oecia maculata* Walsingham) by monotypy.

Only one species has been assigned to *Oecia*.

**Oecia oecophila** (Staudinger) (figs. 1260, head, wing venation; 634, 637, male genitalia; 635, moth; 1261, female genitalia).

*Macroceras Oecophila* Staudinger, 1876:150.

*Oecia maculata* Walsingham, 1897:111; 1907*b*:649, pl. 25, fig. 4. Swezey, 1916:147. LeMarchand, 1942:84–89, illus. Gosmány, 1963:130, figs. 69–71.

Oahu.

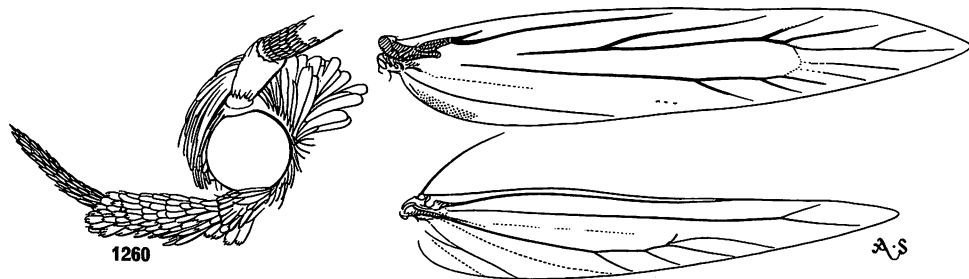


Figure 1260—Head and wing venation of *Oecia oecophila* (Staudinger), holotype (BM slide 4202).

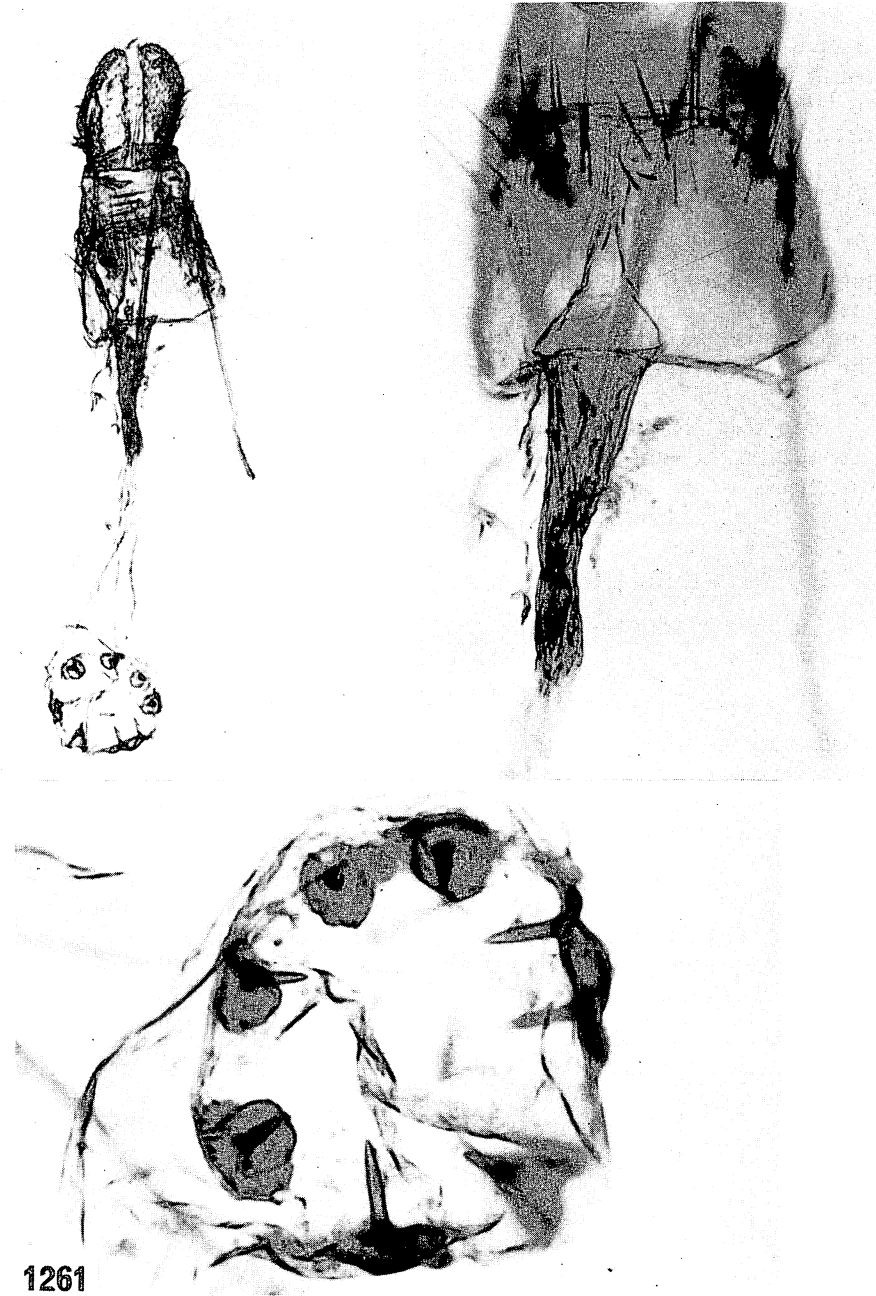


Figure 1261—*Oecia oecophila* (Staudinger), female genitalia from the allotype of the synonymous *maculata* (Walsingham), St. Thomas, U.S. Virgin Islands (BM slide 8145).



Immigrant. Widely distributed in the West Indies, Central and South America, southern Europe north to about the latitude of Paris, north and south Africa, Malaya, Java, Indonesia, and Australia. It was first collected in Hawaii between 1877 and 1884, but I have been unable to ascertain the exact date of the capture of the first specimens. The species has been widely dispersed by commerce.

Parasite: *Apanteles carpatus* (Say)?

A number of the early Hawaiian records attributed to this species belong to *Phereoeca allutella* (Rebel), a tineid, which see. This species is said to have habits similar to those of *allutella* including making larval cases which are, on occasion, found on the walls of buildings as are those of *allutella*. These data require confirmation. I do not have any information concerning its life history in Hawaii. LeMarchand (1942) reported that the larva was unknown.

Gozmány (1963:130) confirms the synonymy of *maculata* Walsingham. He studied the type of *oecophila* (Staudinger), but it was destroyed in the mail during its return to Berlin after being loaned to him for study. LeMarchand (1942:84–89) gave a summary of the knowledge of the species prior to 1942.

### Tribe **DICHOMERINI** (Hampson), **new status**

*Dichomeridae* Hampson, 1918:386.

*Dichomerinae*: LeMarchand, 1947:153.

### Genus **DICHOMERIS** Hübner

*Dichomeris* Hübner, 1818:25; 1826:405.

Type-species: *Dichomeris ligulella* Hübner. Designated by Walsingham, 1911:87 (1909–1915).

For extensive synonymy see T.B. Fletcher, 1929:68. His data require verification. Gaede, 1937:427, world catalog.

This is a large genus with representatives in most continental areas of the world. Many of the species are of economic importance. One widespread species has recently been introduced into Hawaii. It would appear that *Trichotaphe* should be merged with *Dichomeris*.

**Dichomeris acuminatus** (Staudinger) (figs. 1262, head; 1263, wing venation; 1264, moth; 1265, male genitalia; 1266, female genitalia; 1267, larva and pupa).

*Mesophleps* (?) *Acuminatus* Staudinger, in Kalchberg, 1876:148; described from Palermo, Sicily.

*Hypsolophus ianthes* Meyrick, 1887:273. **New synonym.**

*Dichomeris ianthes* (Meyrick) Meyrick, 1913e:172. T. B. Fletcher, 1914:456, fig. 332; 1921 (1920): 89–91, colored plate 21.

*Ypsolophus rusticus* Walsingham, 1892 (1891):525. **New synonym.**

*Ypsolophus ammodxanthus* Meyrick, 1904c:430. **New synonym.**

*Ypsolophus ochrophanes* Meyrick, 1907b:981. Lefroy, 1909c:533. Synonymized with *ianthes* by Meyrick, 1913e:172.

The alfalfa leaf tier.  
Oahu.

Immigrant. This moth was first found in Hawaii by Beardsley at Ewa, Oahu, in July, 1961 [*Proc. Hawaiian Ent. Soc.* 18(1):18, 1962]. A widely distributed species, it is known from India, Burma, and Ceylon southwest to the Seychelles, Mauritius, and Reunion and on to Egypt, east and south Africa, and southern Europe. Eastward from India it extends through Indonesia and Malaysia to Formosa and Australia. It is also found in the West Indies. No doubt it is much more widely distributed than literature and collections reveal.

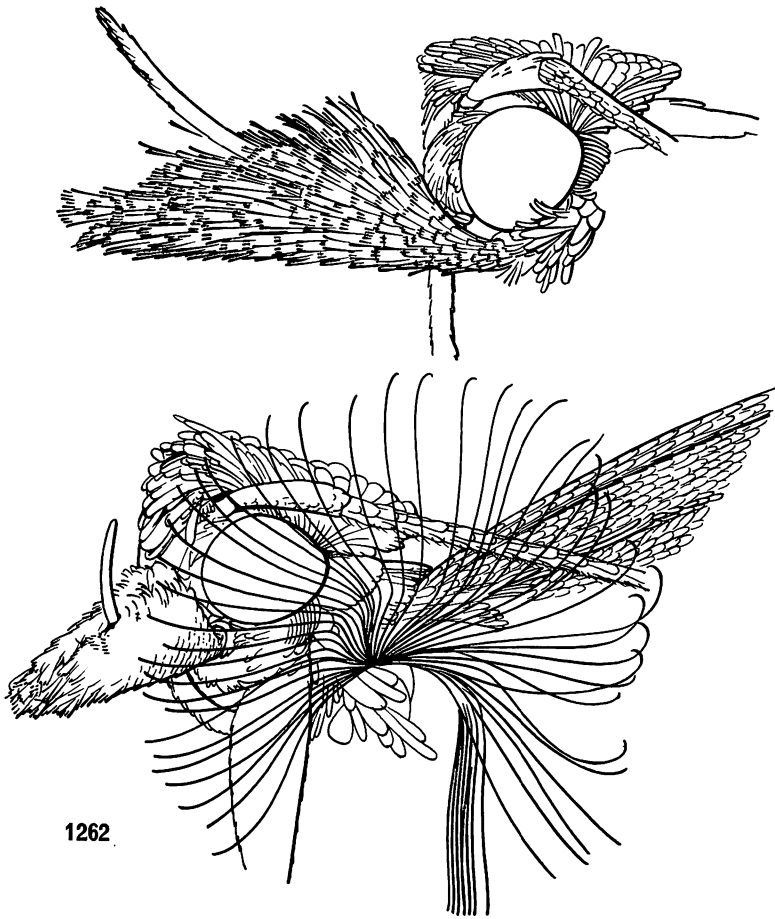


Figure 1262—*Dichomeris acuminatus* (Staudinger). Top, the head of a female. Bottom, the head of a male with the thoracic brush expanded. Specimens reared from alfalfa at Ewa, Oahu. On abraded specimens the palpi may have less protuberant terminal scales on the second segments; such specimens will have different appearances.

Hostplant in Hawaii: *Medicago sativa* (alfalfa). Found elsewhere on *Cyamopsis* (Guar bean), *Desmodium gyroides*, indigo, *Medicago* species, *Cajanus cajan* (pigeon pea), *Sesbania sericea*, various species of *Tephrosia*, and other plants.

Parasite: *Chelonus* (*Microchelonus*) *blackburni* (Cameron).

The forewings of the moth are yellow with fuscous maculae. The male has a remarkable, expandable, fanlike hair tuft on the mesopleura at the base of each forewing. The larvae are leaf-rollers. Their black heads and brown or blackish prothoracic shields contrast strongly in color with their pale green bodies.

The most detailed study made on the biology of this species is that by T. B. Fletcher, 1921 (1920):90-91, color plate 21. His account of the species in India is as follows:

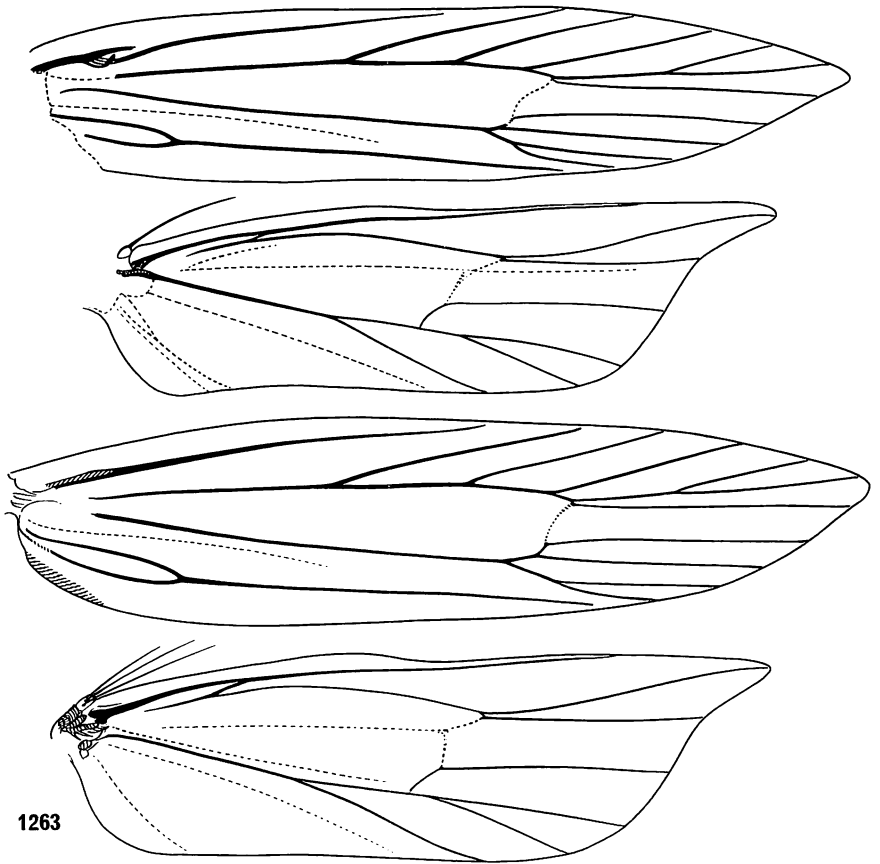
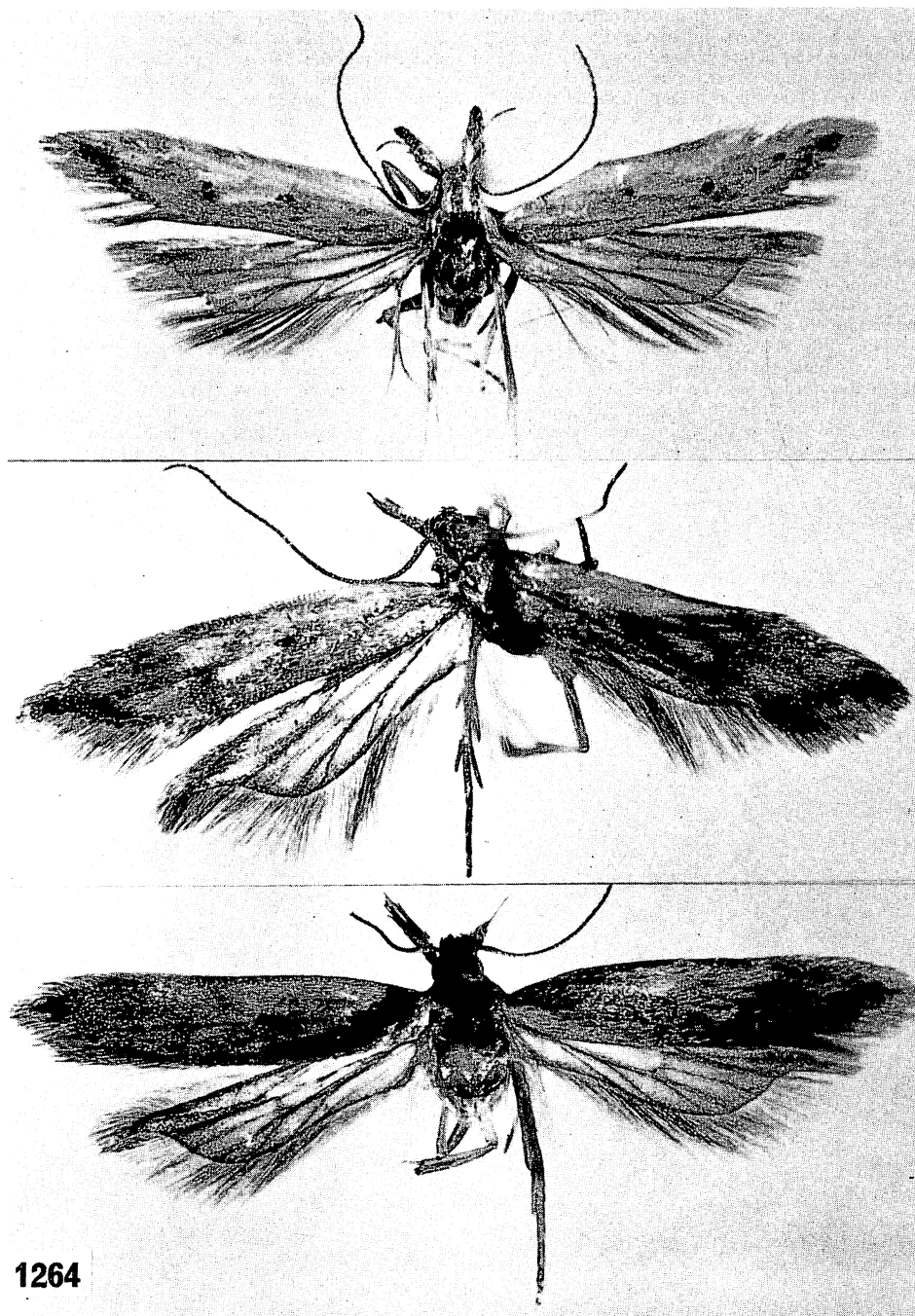


Figure 1263—*Dichomeris acuminatus* (Staudinger). Wing venations of the male, top (slide Z-XII-19-62-4), and female, bottom (slide Z-XII-19-62-5). Specimens from Ewa, Oahu.



1264

Figure 1264—*Dichomeris acuminatus* (Staudinger). Top, a specimen from Paradeniya, Ceylon; expanse 13 mm. Middle, a male (slide Z-XII-19-62-4) and, bottom, a female (slide Z-XII-19-62-5) reared from alfalfa at Ewa, Oahu.

This species is quite of minor importance as a rule but in 1909 it appeared in the Champaran District as a serious pest of Java indigo and did considerable damage, as is instanced in the following report:—"The caterpillars seem to have made a pretty clean sweep of the field attacked; there are very few plants unattacked, practically all have their leaves reduced to a dirty brown powder and many are merely bare sticks," young plants only a few inches high being attacked in August, September and October, the caterpillars webbing up the leaves at the top of the young shoot, feeding on them, checking the growth of the plant.

In confinement, a female moth laid 37 eggs between 8th and 10th October 1909. The egg is elongate-oval, cylindrical with rounded ends, about 0.5 mm. long, light green when laid, gradually becoming yellowish, and pinkish just before hatching. The eggs are usually laid in the groove of the petioles of the raised leaves and nearly always on leaves near the top of the plant. On *guar* eggs were deposited alongside the veins on the under-surface of the leaf. The eggs may be deposited singly or as many as six in one place; when several are laid, they usually lie lengthwise in the groove, touching each other. The larva hatches out after about four days, and does not eat the egg-shell.

The newly-hatched larva is about 0.75 mm. long, cylindrical, light yellow with a greenish tinge; head larger than other segments, shiny, dark red brown; prothoracic shield shiny, reddish-brown; primary hairs comparatively long; five pairs of equally developed prolegs.

The full-grown larva is about 7 mm. long and slightly more than 1 mm. broad, green; head shiny black; prothorax black, with a large shiny black shield; prothoracic legs black, mesothoracic and metathoracic legs green; minute hairs scattered over segments; five pairs of equally developed prolegs.

On hatching from the egg the larvae usually crawl onto the tender top-leaves, fold a leaf, live hidden inside it and so feed. They bite the leaf usually from the edge and go on eating until little is left to afford a shelter, then they leave the leaf and go to another. The leaf thus eaten withers and dries up. As they grow

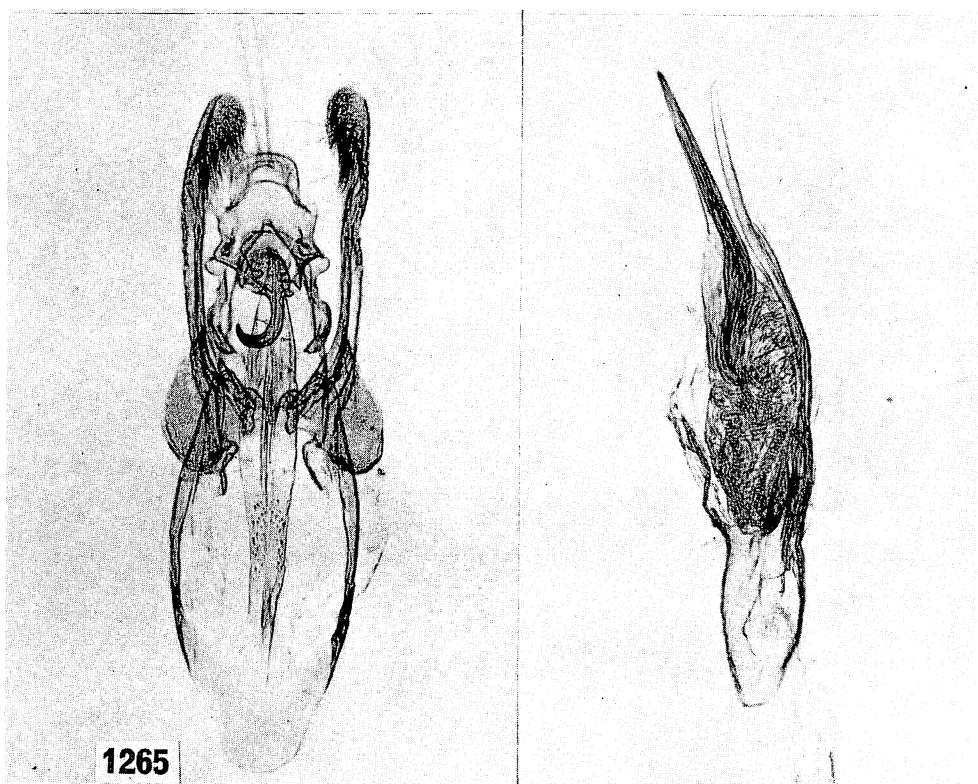


Figure 1265—*Dichomeris acuminatus* (Staudinger). Male genitalia (BM slide 14244); Pusa, India.

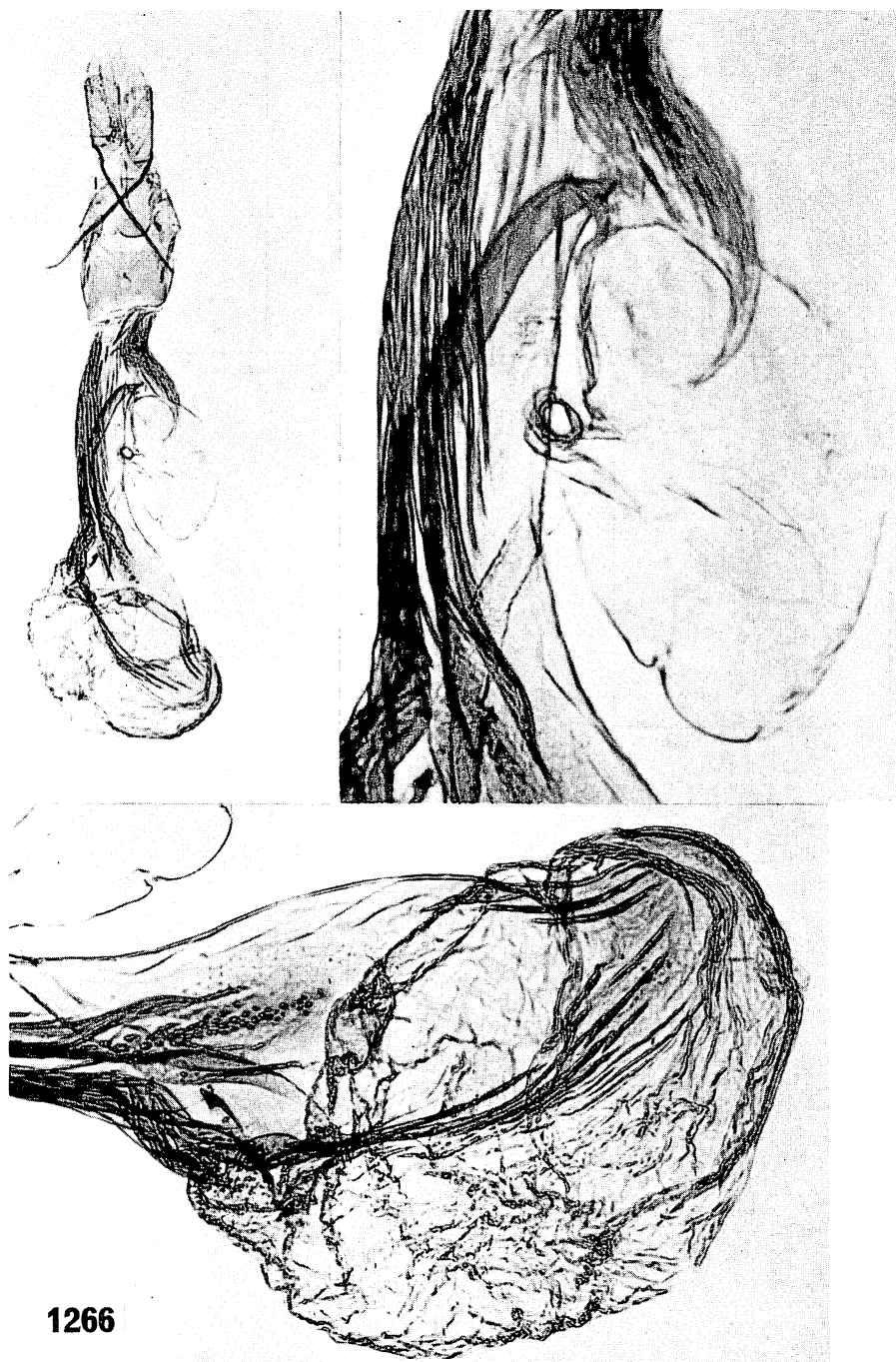


Figure 1266—*Dichomeris acuminatus* (Staudinger). Female genitalia (BM slide 14207) from the lectotype female; St. Denis, Reunion Island.

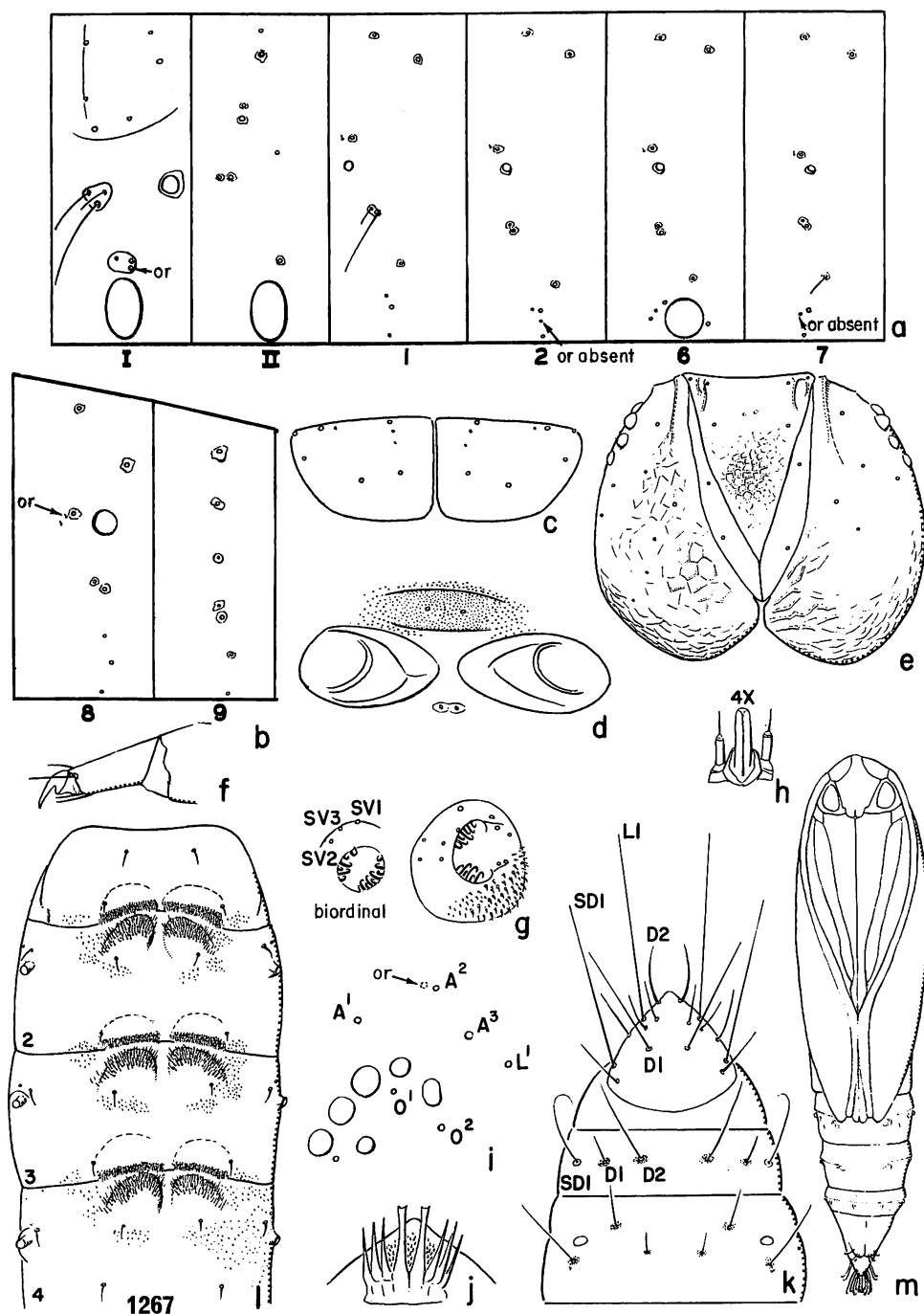


Figure 1267—Details of the larva and pupa of *Dichomeris acuminatus* (Staudinger), especially drawn for this text by Margaret MacKay. *a*, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7, lateral aspect; *b*, setal map of abdominal segments 8 and 9, lateral aspect; *c*, prothoracic shield; *d*, prosternum; *e*, frontal view of head; *f*, tarsus and claw of a left leg; *g*, crochets on a leg of the sixth abdominal segment and an anal proleg; *h*, spinneret and labial palpi, ventral aspect; *i*, ocelli and associated setal sockets; *j*, anal fork; *k*, dorsal aspect of abdominal segments 8, 9, and 10; *l*, dorsal aspect of abdominal segments 1 to 4 of the pupa; *m*, ventral aspect of the pupa.

larger they bind two or three, or more, leaves together, the leaves retaining their flat shape. The larval life is about fifteen days.

Pupation takes place either between two leaves fastened together or in a rolled leaf or in the larval shelter of top-leaves bound together, the interior of the shelter being lined with a thin layer of silken fibre. The pupa is about 5 mm. long, cylindrical, tapering to a point posteriorly, brown; the anal extremity prolonged into a process from the apex as well as from the base of which arise many stiff brown circinate hairs which are entangled in the fibres of the cocoon. The pupal period is about six days. The whole life-cycle is thus about 25 days.

These details were assembled in Pusa, India, and the account is accompanied by a useful colored plate of the egg, larva, pupa, adult, and damage caused by the larvae feeding on indigo.

The pupa of *Dichomeris acuminatus* is basically similar to that of *Trichotaphe aenigmatica*. Both species have the peculiar setose patches on the basal abdominal tergites as illustrated in figure 1267. However, in the pupa of our *Trichotaphe* the primary setae are long, pigmented, and very conspicuous, and the larger of the primary setae are apically bifid. The setae are short and inconspicuous on *Dichomeris*. The most distinctive detail is that on *Trichotaphe* there are large, conspicuous, transverse, median pits at the bases of tergites five, six, and seven (see figure 1271). These pits are sometimes concealed from view when the abdomen is tightly telescoped. *Dichomeris* has no trace of such peculiar pits. The abdominal spiracles are more protuberant on *Dichomeris* than they are on *Trichotaphe*.

I am indebted to my friend Klaus Sattler who has helped me with the study of this species and who made a detailed investigation to establish the new synonymy.

#### Genus **TRICHOTAPHE** Clemens

*Trichotaphe* Clemens, 1860:166. Type-species: *Trichotaphe setosella* Clemens.

Designated by Walsingham, 1911:89 (1909–1915).

*Begoe* Chambers, 1872:209. Type-species: *Begoe costolutella* Chambers.

*Malacotricha* Zeller, 1873:280, 282. Type-species: *Gelechia bilobella* Zeller, 1873:280, fig. 28.

Gaede, 1937:464, world list.

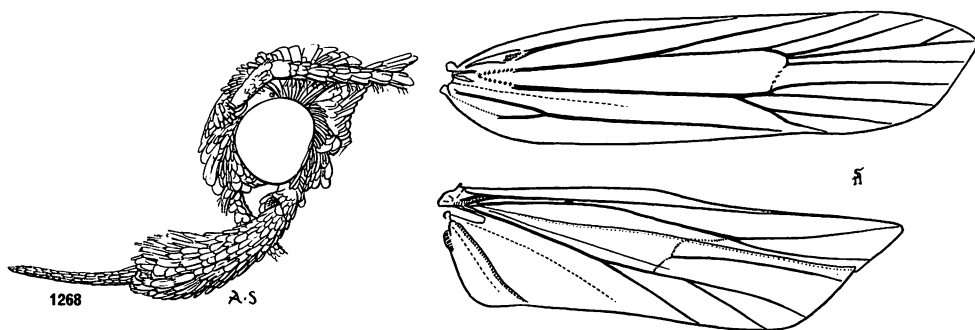


Figure 1268—Head and wing venation of *Trichotaphe aenigmatica* Clarke, male (BM slide 14316); frenulum broken off and hindwing partly folded; Honolulu.



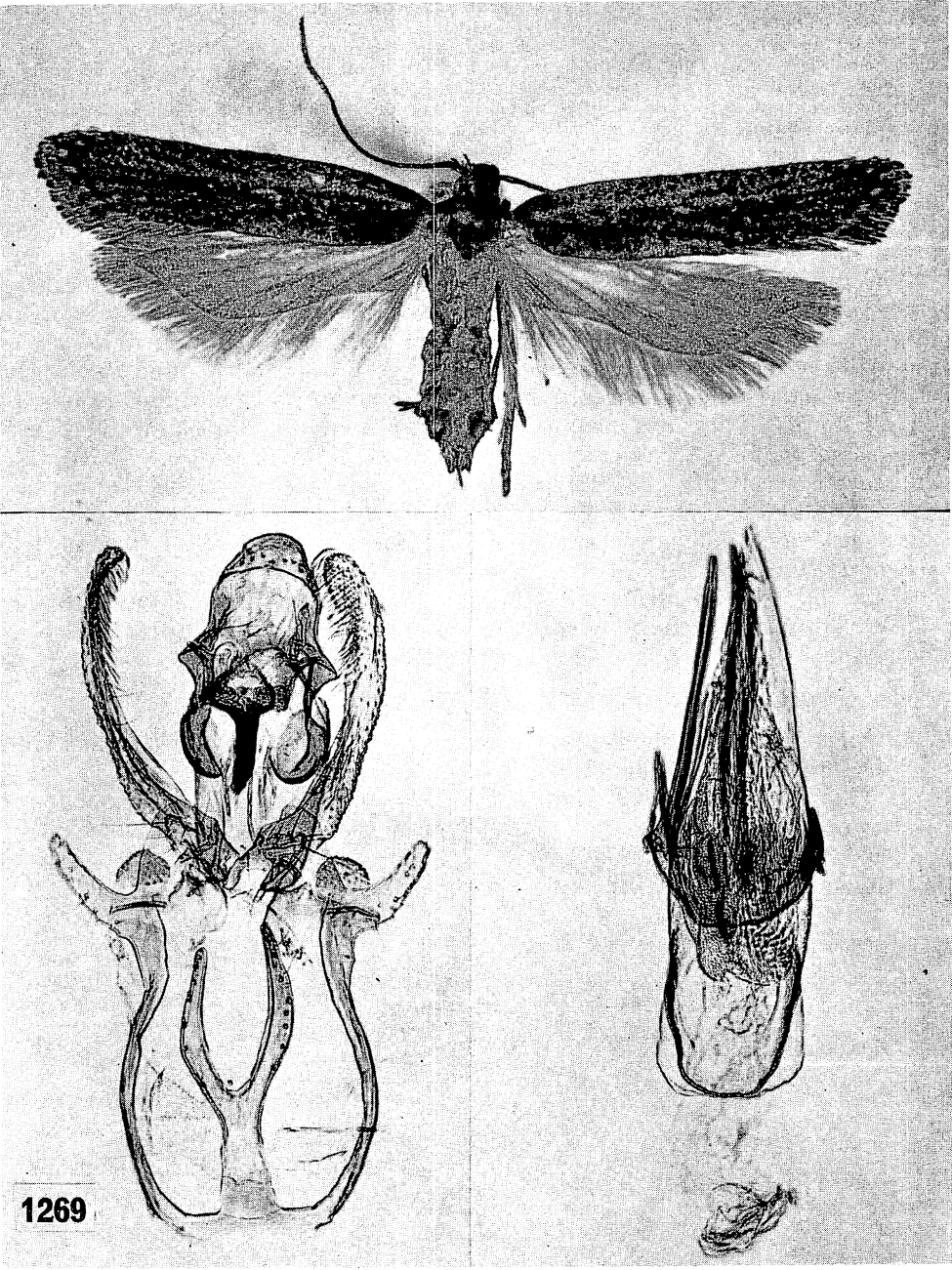


Figure 1269—*Trichotaphe aenigmatica* Clarke. Female at top; male genitalia at bottom, with the aedeagus at right (BM slide 14195); specimens bred from *Pluchea*; Honolulu.

*Trichotaphe*, as it is now constituted in literature, is a large genus containing species from Africa, Asia as well as many species from North and South America. It appears to be a very close associate of *Dichomeris*, if it is really worthy of full generic rank. One purposely introduced species represents the group in Hawaii.

**Trichotaphe aenigmatica** Clarke (figs. 1268, head and wing venation; 1269, moth, male genitalia; 1270, female genitalia; 1271, larva and pupa).  
*Trichotaphe aenigmatica* Clarke, 1962:123, fig. 1.

Oahu, Maui.

Purposely introduced from Mexico by the Hawaii State Department of Agriculture (type locality: Boca del Rio, Vera Cruz).

Hostplant: *Pluchea odorata* ("sour bush").

The moth has a wing expanse of about 11 mm. The forewings have a mostly pale fuscous or greyish background; the veins are marked by lines of black squamae. There are two small, variable, cream-colored maculae at the middle of the wing, and there may be a very small cream-colored macula on the fold.

In 1957, Noel Krauss sent this moth from Mexico to Hawaii to aid in the

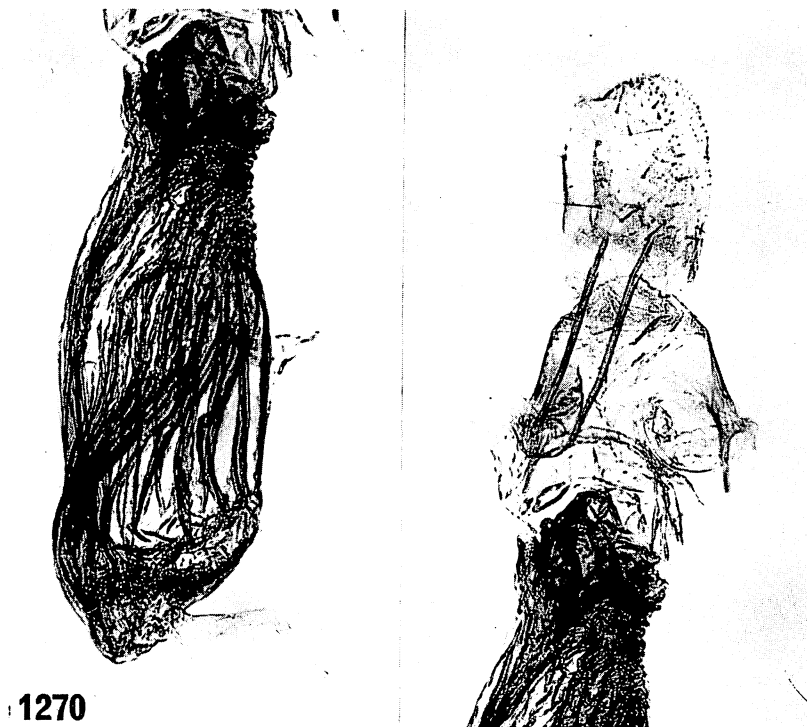


Figure 1270—*Trichotaphe aenigmatica* Clarke, female genitalia (BM slide 15806); reared from *Pluchea*; Honolulu.

control of "sour bush" which has become a widespread weed pest in the islands. After rearing and testing in the laboratory, the moth was released at Papakolea, Oahu, in 1957, and later at other localities. It was found established at Ewa, Oahu, in 1959. It was released at Kahului, Maui, in 1960. (Data taken from a letter from C. J. Davis.)

Although similar in essential characters to the pupa of *Dichomeris acuminatus*, the pupa of *Trichotaphe aenigmatica* can be recognized at once among the Lepidoptera now known in Hawaii. The *Trichotaphe* pupa has a peculiar, large, deep, transverse, median pit at the basal margins of abdominal tergites five, six, and seven. These pits are diagnostic of *Trichotaphe* in the Hawaiian Gelechioidea (figure 1271). The pits may be hidden beneath the caudal margins of the preceding segments when the abdomen is tightly telescoped, or only one or two of the pits may be visible. The only other pupa that I now know in Hawaii that has rather similar *single* dorsal abdominal pits is that of *Amorbia emigratella* Busck in the Tortricidae. That species has the pits on most of the abdominal tergites, and the pupae of the two genera are otherwise conspicuously different as my illustrations demonstrate. The endemic tortricid genus *Panaphelix* has *paired* pits on abdominal tergites two to seven.

The dorsal surface of abdominal segments one, two, and three and the base of four are conspicuously uneven. At the middle of the posterior edges of tergites one, two, and three, there is a band of dense, straight setae directed caudad. Opposite these setae on the cephalic edges of tergites two, three, and four there are corresponding clusters of heavier, curved setae on each side of the medial line. These are directed cephalad against the clusters of straight setae. The wings, antennae, and posterior legs end near the apex of the fifth abdominal segment, although their relative position of termination may vary according to the extent to which the abdominal segments are expanded or telescoped.

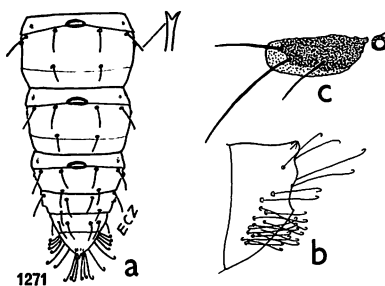


Figure 1271—Details of the pupa and larva of *Trichotaphe aenigmatica* Clarke, *a*, dorsal aspect of abdominal segments 5 to 10 of the pupa. Note the large medial foveae on segments 5, 6, and 7. These pits may be hidden beneath the posterior margins of the preceding segments when the segments are partially withdrawn. *b*, left lateral aspect of the cauda of the pupa of another example. *c*, the left prothoracic spiracle and the three prespiracular L setae; the setae are dark and conspicuous on both the larva and the pupa. The pupa, excluding the dorsal abdominal pits and its much more prominent setae, is generally similar to that of *Dichomeris* (see figure 1267). Specimens reared from *Pluchea odorata* from Waimanalo, Oahu.

Tribe **CHELARIINI** (Heslop), **new status***Chelariinae* Heslop, 1938:80. LeMarchand, 1947:153.Genus **CRASIMORPHA** Meyrick*Crasimorpha* Meyrick, 1923:33. Type-species: *Crasimorpha peragrata* Meyrick, 1923:33, by monotypy.

Only two species have been assigned to this genus: the type-species from French Guiana and the Hodges' species introduced into Hawaii from Brazil. Meyrick made a serious error when he stated that the ocelli were "posterior". There are no ocelli on *Crasimorpha*. The type-species was described from a unique female. The male is not yet positively known, although Hodges (1964a: 303, fig. 2) surmised that he had a male. Perhaps the placement of *infusata* Hodges in *Crasimorpha* should be considered tentative.

***Crasimorpha infusata*** Hodges (figs. 1272, wing venation; 1273, moth, palpi, pupa in gall; 1274, male and female genitalia; 1275, pupa).

*Crasimorpha infusata* Hodges, 1964a:303, figs. 1-4.

Hawaii.

Purposely introduced from Brazil by the Hawaii Department of Agriculture and first released at Kiolakaa, Kau, Hawaii, between December, 1960, and March, 1961. See Krauss, 1963:282.

Hostplant: *Schinus terebinthifolius* (Christmas berry).

This moth was introduced to assist in the control of its hostplant which is a pasture and range pest in Hawaii. The caterpillars bore into the terminal parts of the host and form galls. The larval attack thus reduces flowering and seed formation. I do not now know whether the species is established in Hawaii. To my knowledge no field captures had been reported by the end of 1970.

The male has a small yellow subcostal brush on the hindwing.

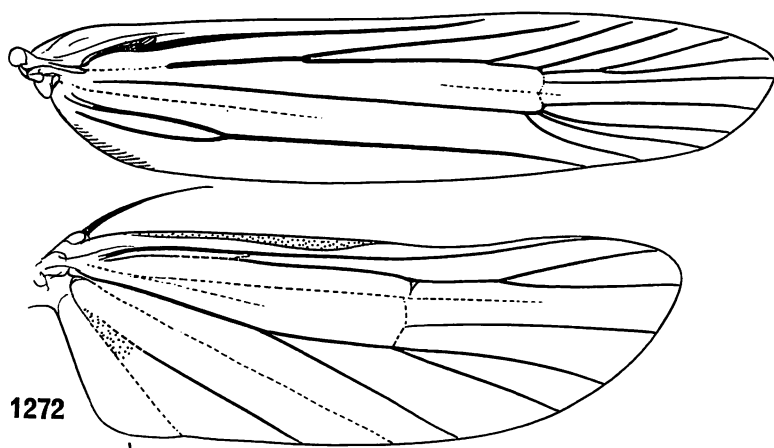


Figure 1272—*Crasimorpha infusata* Hodges, wing venation (slide Z-XII-17-65); Honolulu; laboratory bred.

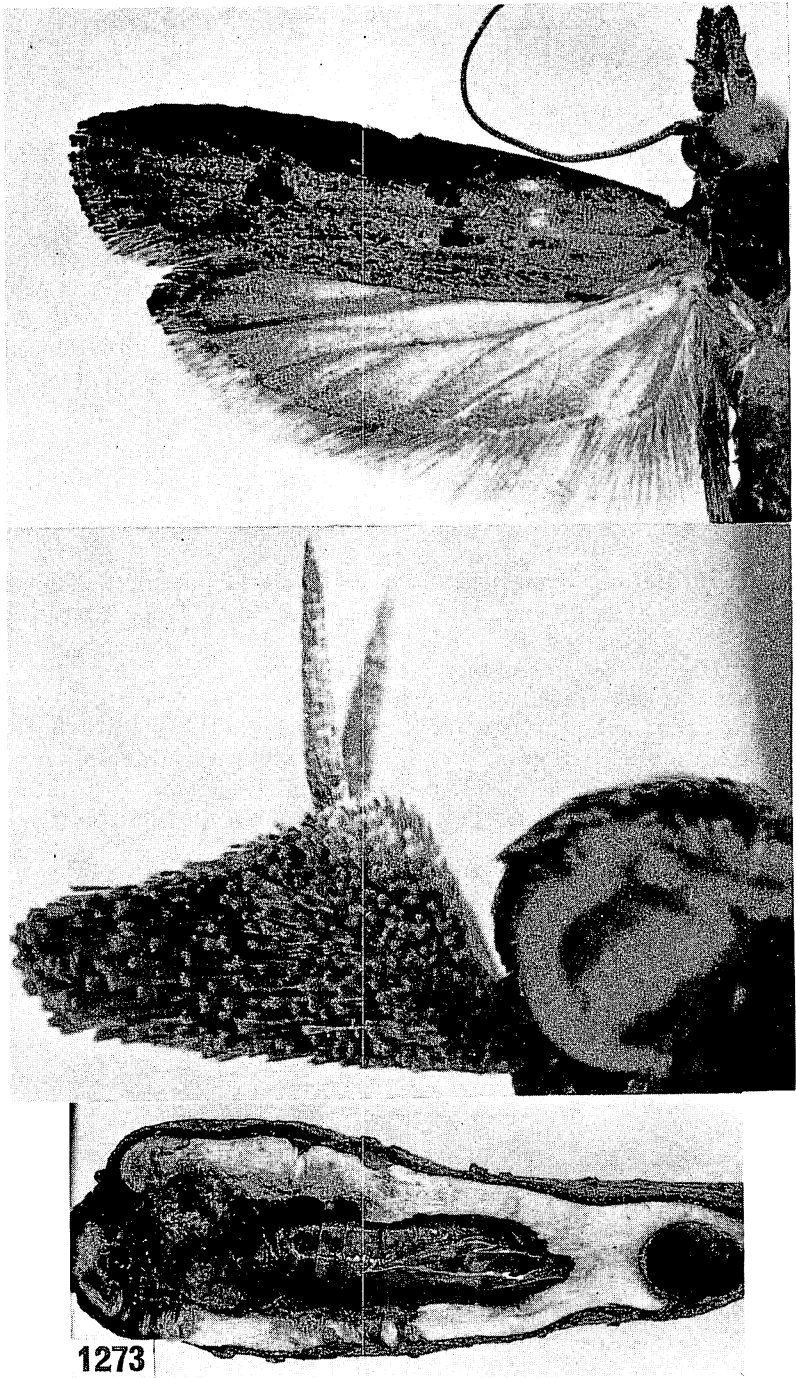


Figure 1273—*Crasimorpha infusata* Hodges. Top, a male (photograph supplied by Ron Hodges). Middle, head and palpi. Bottom, pupa in a gall on *Schinus* (kindly photographed by David Kissinger). Specimens laboratory bred from *Schinus* in Honolulu.

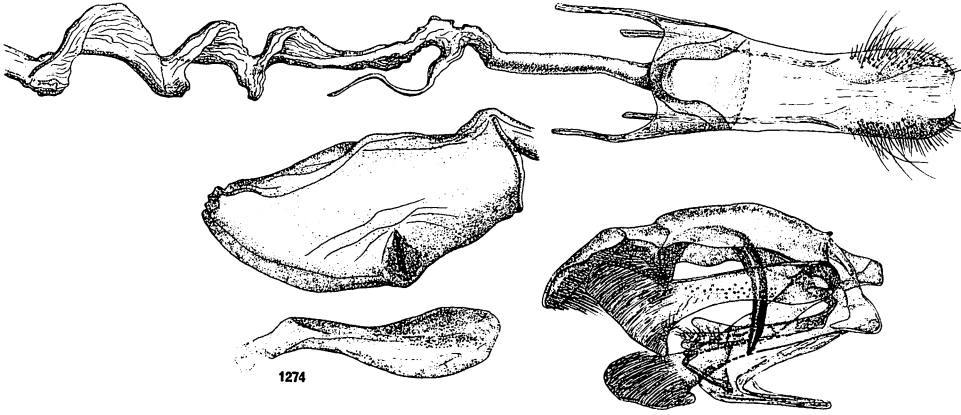


Figure 1274—*Crasimorpha infusata* Hodges. Male and female genitalia. (Drawings supplied by Ron Hodges.)

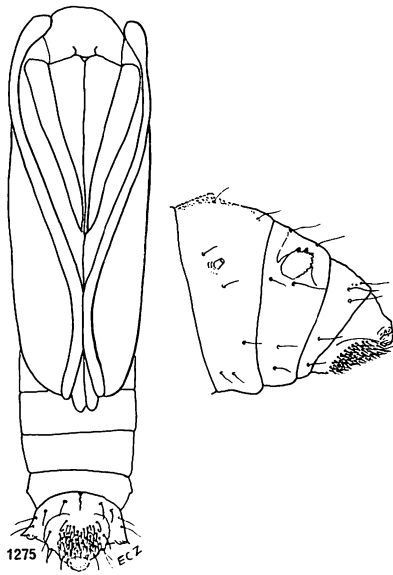


Figure 1275—*Crasimorpha infusata* Hodges. A cast pupal skin in ventral aspect with an enlargement of abdominal segments 7 to 10 in left lateral aspect. An Hawaiian-bred specimen. Length 11 mm. The pupa is formed in the stem-gall burrow, and at eclosion the anterior part of the top of the head is broken away to permit the moth to escape through the tunnel made by the larva.

Tribe **GNORIMOSCHEMINI** Povolný

*Gnorimoschemini* Povolný, 1964:332.

Two foreign species of economic importance represent this group in Hawaii. One belongs to *Phthorimaea* and the other to the closely allied *Keiferia*. The males of both have a subcostal brush of long hairs on each hindwing.

Genus **PHTHORIMAEA** Meyrick

*Phthorimaea* Meyrick, 1902:103. Type-species: *Gelechia operculella* Zeller.

Gaede, 1937:246, world list (most of the species listed by Gaede are now placed in other genera); see for bibliography and synonymy.

*Phthorimaea*, as now restricted, is a small genus of mostly South American species. A widespread, immigrant, pest species represents the genus in Hawaii.

**Phthorimaea operculella** (Zeller) (figs. 11, 12, 13, 23, 25, anatomy; 30, 35, male genitalia; 36, 38, female genitalia; 40, egg; 45, 46, 47, 50, 52, 55, larva; 1276, head, wing venation 1277, moth; 1278, 1279, 1284, male genitalia; 1280, 1281, larval damage; 1282, pupa; 1285, female genitalia and basal abdominal sternites; 1286–1291, larva).

*Gelechia terrella* Walker, 1864a:1024, *nomen oblitum*.

*Gelechia* (?*Bryotropha*) *operculella* Zeller, 1873:262, fig. 17.

*Phthorimaea operculella* (Zeller) Meyrick, 1902:104. Busck, 1903b:821; 1928:171, figs. 1–2. Walsingham, 1907b:483, pl. 13, fig. 27. Chittenden, 1912:162. Fletcher 1921 (1920):75, col. pl. 18. Povolný, 1964:338, figs. 1–9. Bartoloni, 1951:301–379, figs. 1–29, biology, morphology, egg, larva, pupa.

*Gnorimoschema operculella* (Zeller) Busck, 1931a:60, figs. 1–4. Keifer, 1936a:236, pl. 1, redescription, larva, pupa, adult.

*Gelechia sedata* Butler, 1880b:560; described from New Zealand.

*Parasia sedata* (Butler) Butler, 1881:399.

For extensive synonymy, see Walsingham, 1907b:483. Gaede, 1937:277, bibliography and synonymy. Bradley, 1966b:227, discussion and synonymy (but his conclusion regarding use of *terrella* is not acceptable under the International Code of Zoological Nomenclature). Hodges, 1967:52.

For details of biology, parasites, etc., in California, see Graf, 1917; in Italy, see Bartoloni, 1951, as noted above, and Silvestri, 1943:287–291, figs. 358–364. For a general, illustrated account, see Balachowsky, 1966:371–381, figs. 173–179.

The potato tuber moth, potato tuberworm.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Possibly a native of America, but now nearly cosmopolitan. First recorded from Hawaii by Butler, 1881:399, from examples collected by Blackburn “flying on the sea-shore at Kawaihae [Kawaihae], Hawaii.”

Hostplants: *Datura*, eggplant, *Nicandra*, *Physalis peruvianum*, potato, *Solanum* species, tobacco, tomato.

Parasites: *Apanteles scutellaris* Muesebeck, *Chelonus* (*Microchelonus*) *blackburni* (Cameron), *Chelonus* (*Microchelonus*) *phthorimaeae* Gahan (established?), *Horoglyphus blackburni* (Cameron), *Panhormius pallidipes* (Ashmead), *Pristomerus hawaiiensis* Perkins. A number of other parasites are known to attack the species in America and elsewhere; see Graf, 1917.

This species, *Keiferia lycopersicella* (Busck), *Dichomeris acuminatus* (Staudinger), and *Trichotaphe aenigmatica* Clarke are the only species of Gelechiinae in Hawaii that have ocelli.

*Phthorimaea operculella* is closely similar externally to *Keiferia lycopersicella*. The following summary of characters from those listed by Keifer (1936a:236–238) may assist in separating *operculella* from *lycopersicella* (compare similar details under *Keiferia lycopersicella* below). The adult of *Phthorimaea operculella* is 15 to 18 mm. in wing expanse. The forewings are brownish or dull pale tan with dark dots. Male genitalia are externally covered dorsally by a plate with yellow setae or setalike scales and with lateral recurved tufts. The tegumen is

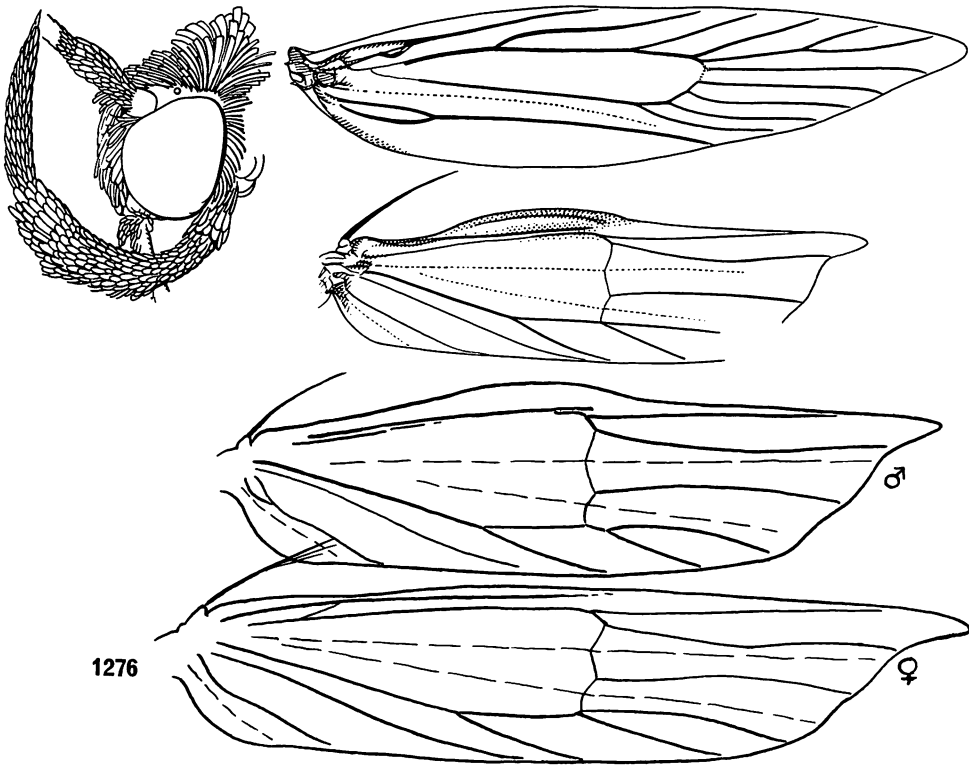


Figure 1276—*Phthorimaea operculella* (Zeller). Head from a specimen from Tahiti; top pair of wings from a specimen from southern France; bottom hindwings from California specimens. Note the sexual differences in the hindwings and the variation at the bases of veins 3 and 4. Upper figures drawn by Arthur Smith; bottom figures by H. H. Keifer.



narrow and elongate. The uncus is as broad as the tegumen and is tonguelike. The valvae have simple dorsal margins (not toothed).

The larva is 10 to 11 mm. long when full grown. Its head is black to brown. The first thoracic segment tends to be pinkish or pale brown with shield more or less blackened. The remainder of the body is dirty cream-white except when the larva is in the prepupal stage when pink coloring is unevenly overlaid throughout. Body tubercles are small and dark. The suranal plate is yellowish, and it often has darkened areas. There are 24 to 27 central proleg crochets, in complete biordinal circle, which are weakened outwardly. There are about 20 anal proleg crochets, in complete biordinal series. The head is not flattened. It is slightly retracted, with adfrontal setae nearer each other than the second is to the apex of the adfrontal sclerite. The frontal setae are nearer to frontal punctures than to frontal suture. A line from seta O2 to A3 runs through anterior side of the posterior ocellus. The mandible has six teeth—the first is small and drawn toward base, the second does not nearly reach the length of third,

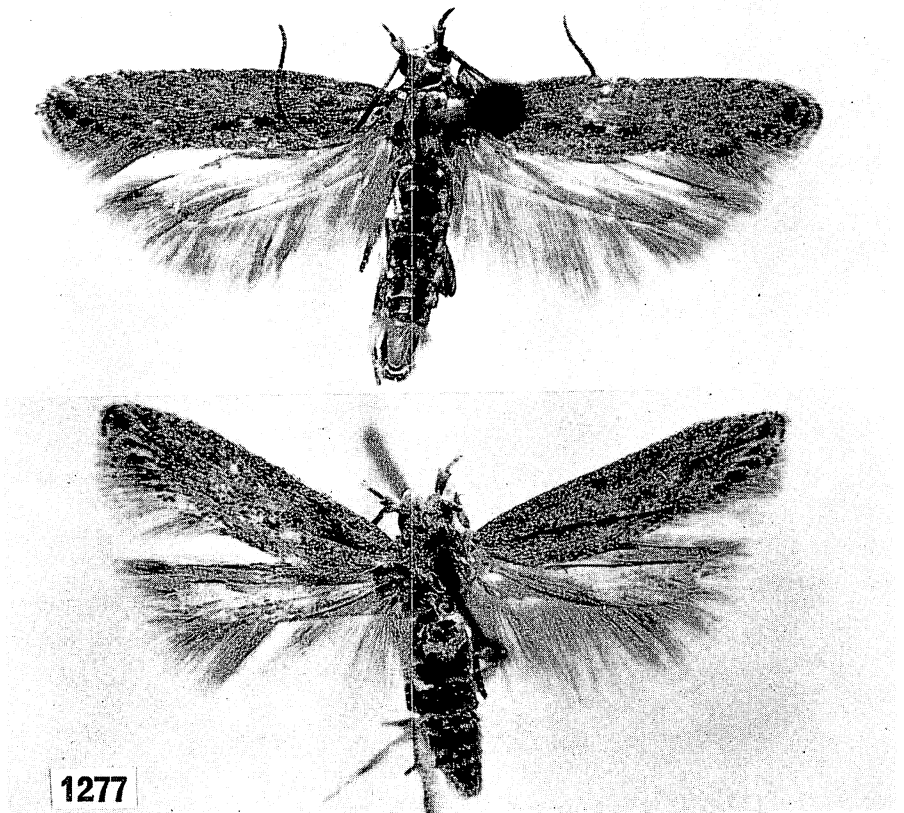


Figure 1277—Top, *Phthorimaea operculella* (Zeller), the potato tuber moth; forewing=7 mm.; Oahu; ex potato tuber. Bottom, *Keiferia lycopersicella* (Walsingham), the tomato pinworm; forewing=4.5 mm.; Waimanalo, Oahu; ex tomato leaf.

the sixth is pointed. Setae D1 and D2 of meso- and metathorax are separate. Setae SD2 and SD1 are narrowly separated. The tarsi are spinulate. On the second abdominal segment seta SV3 is separated from setae SV1 and SV2. Seta SD1 on abdominal segment 8 is dorso-anterior to spiracle. On abdominal segment 9 seta L3 is associated with or is near to L1 and L2. The pupa is 5.5 to 6 mm. long, and the wing cases extend to sixth abdominal segment. The cremaster is a small up-curved spine.

This is the worst insect pest of potatoes in Hawaii. It also damages tomatoes (sometimes severely), eggplant, and tobacco. When it attacks tobacco or tomato, it is sometimes called the tobacco or tomato splitworm. The larvae mine the leaves and tunnel stems, fruits, and tubers. The larvae often bore into green tomato fruits and destroy them before they mature. When potato tubers are left too long in the ground or in storage, great damage may be caused by the larvae. On occasion, entire shipments of Hawaiian-grown potatoes have been ruined by the larvae of this moth.

The oval, whitish eggs are deposited in the eye or in a scar or around the origin of a sprout on a potato tuber. Eggs may also be deposited on sacks used for potatoes, in potato debris in storage and packing places, or in piles of trash containing potato refuse. The larvae make extensive tunnels beneath the skin and into the deep tissue of the potato tubers.

The larva generally works downward in the stem, although in a very few cases where the stem is thick and succulent it may turn and work upward. Wherever a larva works within the stem for several days before becoming mature the terminal section of the stem usually dies. It is easy to see that wherever this occurs generally over a field while the potato plants are young considerable injury might result through reduction of leaf surface and weakening of the plants. (Graf, 1917:4.)

For additional details on the characters of the larvae and for a key to separate the larvae from those of *Keiferia*, see the information given under *Keiferia* below.

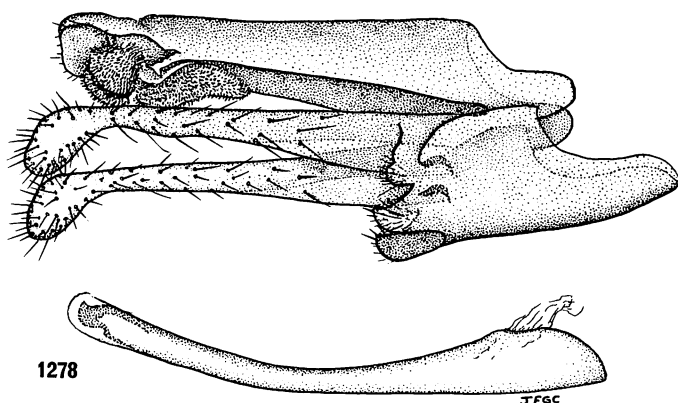


Figure 1278—Male genitalia of *Phthorimaea operculella* (Zeller).

Genus **KEIFERIA** Busck

*Keiferia* Busck, 1939:571. Type-species: *Eucatopus lycopersicella* Walsingham (= *Phthorimaea lycopersicella* Busck), by original designation.

*Keiferia* is a small cluster of American species which Busck separated from *Phthorimaea* principally because of features of the male genitalia. One may wonder if the division will stand the test of time. In *Keiferia*, the uncus is a long, slender organ instead of the broad, tonguelike organ of *Phthorimaea*. Busck did not describe any features by which the females of *Keiferia* can be separated generically from those of *Phthorimaea*.

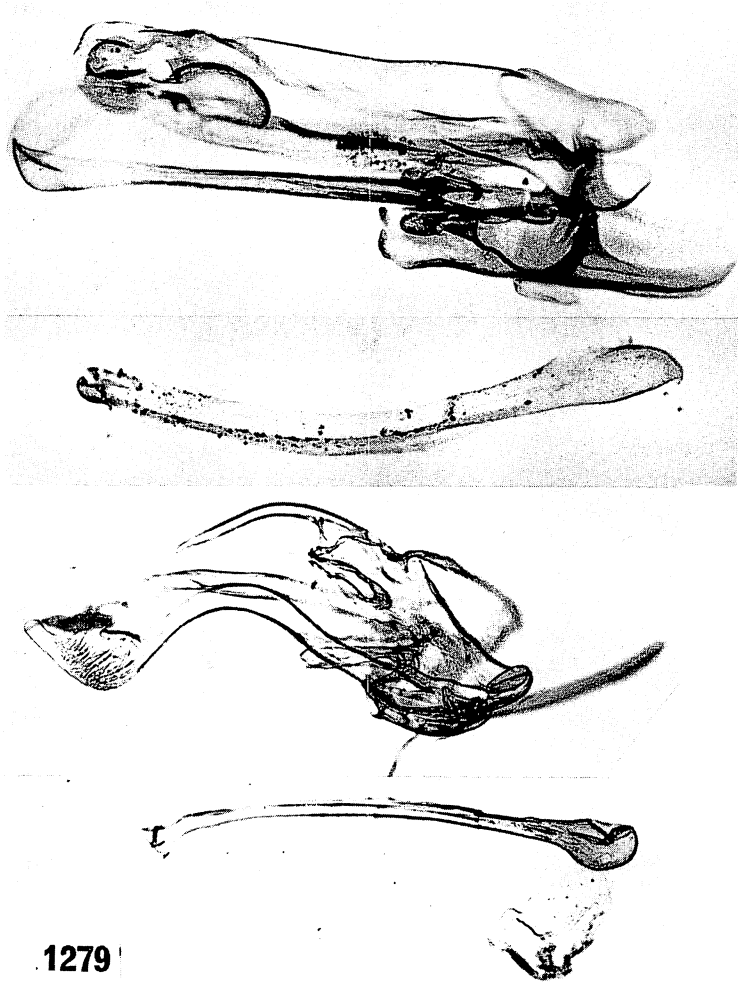


Figure 1279—Top, male genitalia of *Phthorimaea operculella* (Zeller); southern France (BM slide 5190). Bottom, *Keiferia lycopersicella* (Busck) (BM slide 5233).

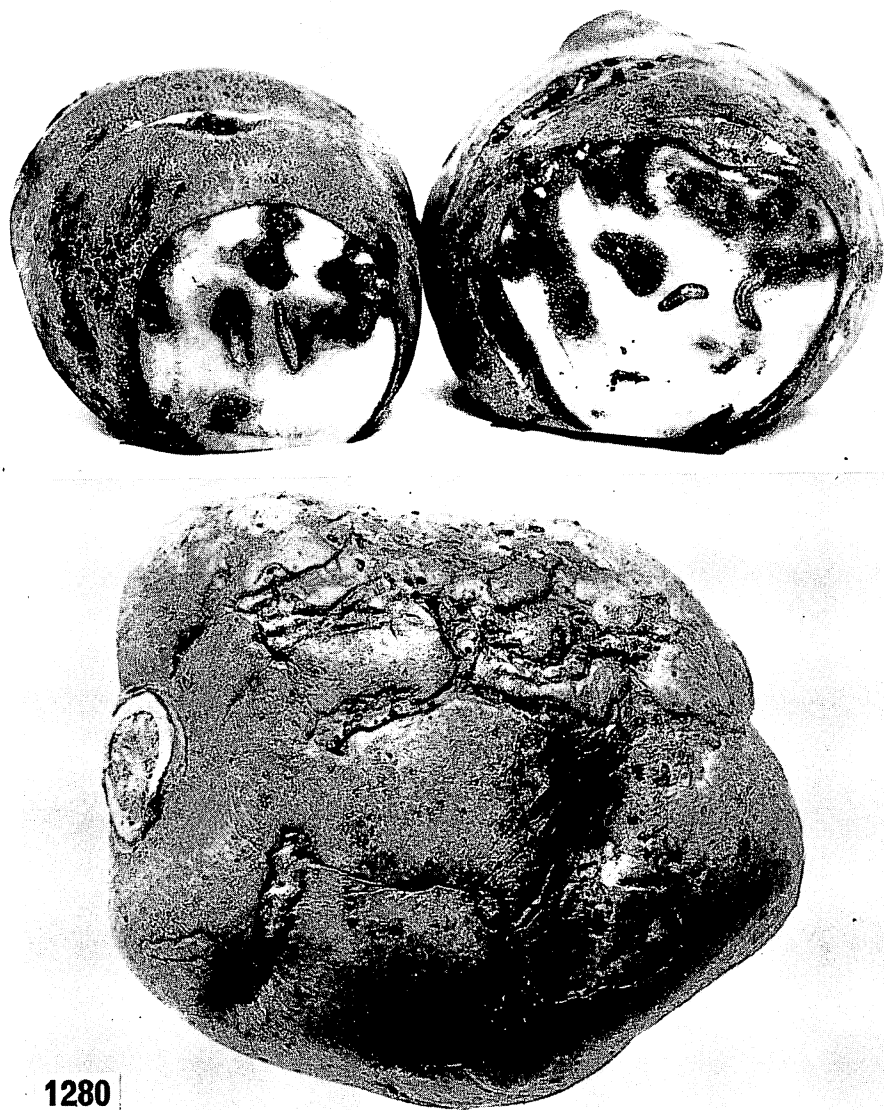


Figure 1280—Potatoes infested by larvae of *Phthorimaea operculella* (Zeller), the potato tuber moth.  
(University of Hawaii photograph.)

***Keiferia lycopersicella*** (Walsingham) (figs. 1277, moth; 1283, head, wing venation; 1284, male genitalia; 1285, female genitalia; 1286–1291, larva; 1292, pupa; 1293, larval damage).

*Eucatoptus lycopersicella* Walsingham, 1897:71.

*Phthorimaea lycopersicella* Busck, 1928:171, figs. 3, 6, 7, genitalia, wing venation.

*Gnorimoschema lycopersicella* (Busck) Busck, 1931a:60. Keifer, 1936a:237, pl. 2, details of larva, pupa, and adult; 1936b:351, pl. 2; 1937:177, chronology of discovery.

*Keiferia lycopersicella* (Busck) Busck, 1939:572.

See Swezey, 1928b:177, and especially Campbell and Elmore, 1935, and Elmore and Howland, 1943, for life history notes, control, illustrations, and other details. See Capps, 1946:563, for larva. See Povolný, 1967:100 for synonymy.

The tomato pinworm.

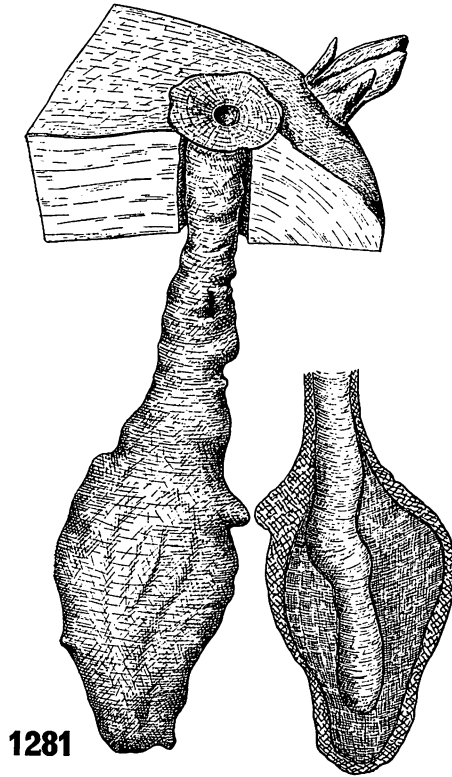


Figure 1281—Larval gallery of *Phthorimaea operculella* (Zeller) in a potato with a section of part of the same gallery at right. A corky mass of tissue is formed around the gallery. (After Bartoloni, 1951.)

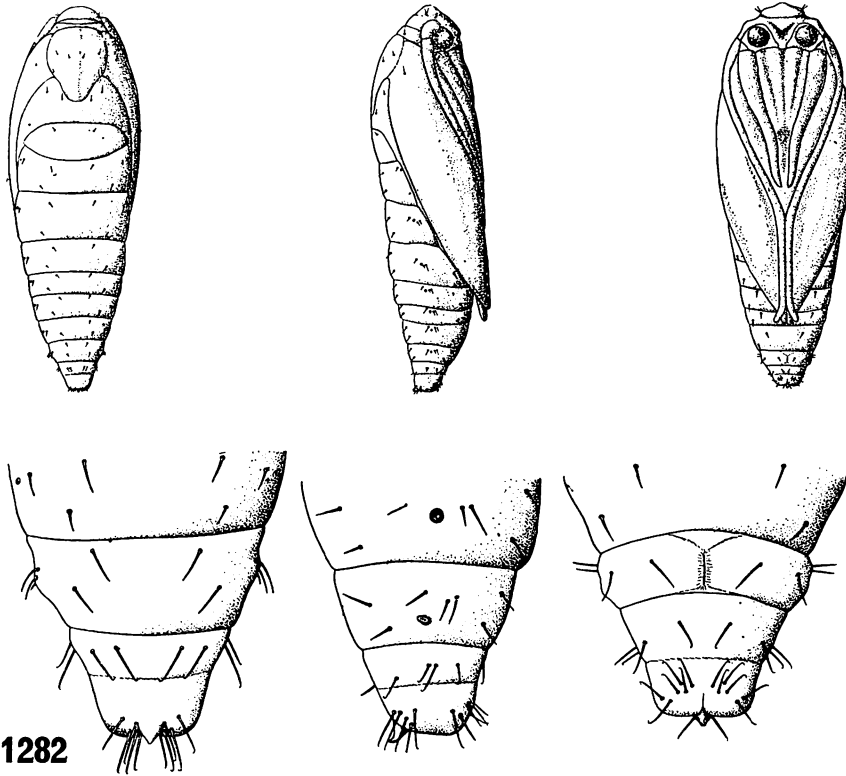


Figure 1282—*Phthorimaea operculella* (Zeller). Top, dorsal, lateral, and ventral aspects of the pupa. Bottom, the same of the caudal end of the abdomen, enlarged. (After Bartoloni, 1951.)



Figure 1283—*Keiferia lycopersicella* (Walsingham), head and wing venation. The costal margin of the hindwing is folded, and the apex of the forewing is broken off (BM slide 5233).

Kauai, Oahu, Molokai, Maui?, Hawaii.

Immigrant. It was first noticed in Hawaii by Swezey in 1925 when it was found on tomatoes on Molokai. It is known also from the southern United States, Mexico, the West Indies, and South America.

Hostplants: tomato and occasionally other solanaceous plants such as potato and eggplant.

Parasites: *Apanteles dignus* Muesebeck, *Horogenes blackburni* (Cameron), *Panhormius pallidipes* (Ashmead). A number of other parasites are known to attack the species in America.

The larva of this moth behaves somewhat differently from other related leafminers. It folds over the edge of the leaf, or fastens together the surfaces of a fold or wrinkle, or makes use of a lobe of a new leaf that has not entirely unfolded yet, for a hiding place, and feeds on the inner protected surface of the leaf. It does to some extent feed as a miner, the mine extending out from the retreat or hiding place, and it does not remain in the mine when not feeding. Several retreats may be made use of during the life of the larva. Pupation takes place within one of these retreats [or in the soil]. . . .

The full-grown larva is 5–6 mm., of a greenish color, with an interrupted mid-dorsal line of purplish fuscous shade, on each side of it a row of patches of the same color, and a spiracular line of smaller similar colored spots, another line of similar spots below the spiracles; spiracles circular, minute; head very pale greenish, eyes black, and black line on posterolateral margin, the portion behind the eyes much widened; cervical plate concolorous, with a wide black line at the posterior margin. The very young larva lacks the purplish markings, has the head entirely black and the cervical shield nearly entirely black. (Swezey, 1928b: 177–178.)

Although the larvae may cause extensive damage to the leaves of tomato, the most important damage is caused by those larvae which attack and penetrate the tomato fruits. On occasion, the larvae of both *Phthorimaea operculella* and *Keiferia lycopersicella* may be found in the same fruit at the same time. Larvae of *Phthorimaea* and *Keiferia*, according to Capps, 1956, share the following characters: Head with seta AF2 conspicuously below dorsal apex

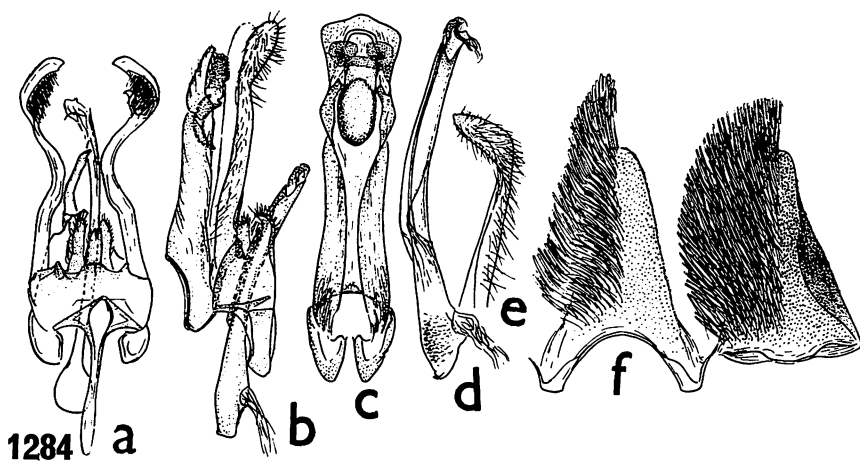


Figure 1284—Male genitalia of *Keiferia* and *Phthorimaea*. *a*, *Keiferia lycopersicella* (Walsingham). Other figures are of *Phthorimaea operculella* (Zeller). *b*, lateral view of the genitalia, with the aedeagus in situ; *c*, ventral view of the tegumen and its processes; *d*, lateral view of the aedeagus; and *e*, the apical part of a valva. At *f* the caudal (eighth) sternite and tergite are cut apart and spread open. (Drawings loaned by H. H. Keifer and rearranged from his 1936 paper.)

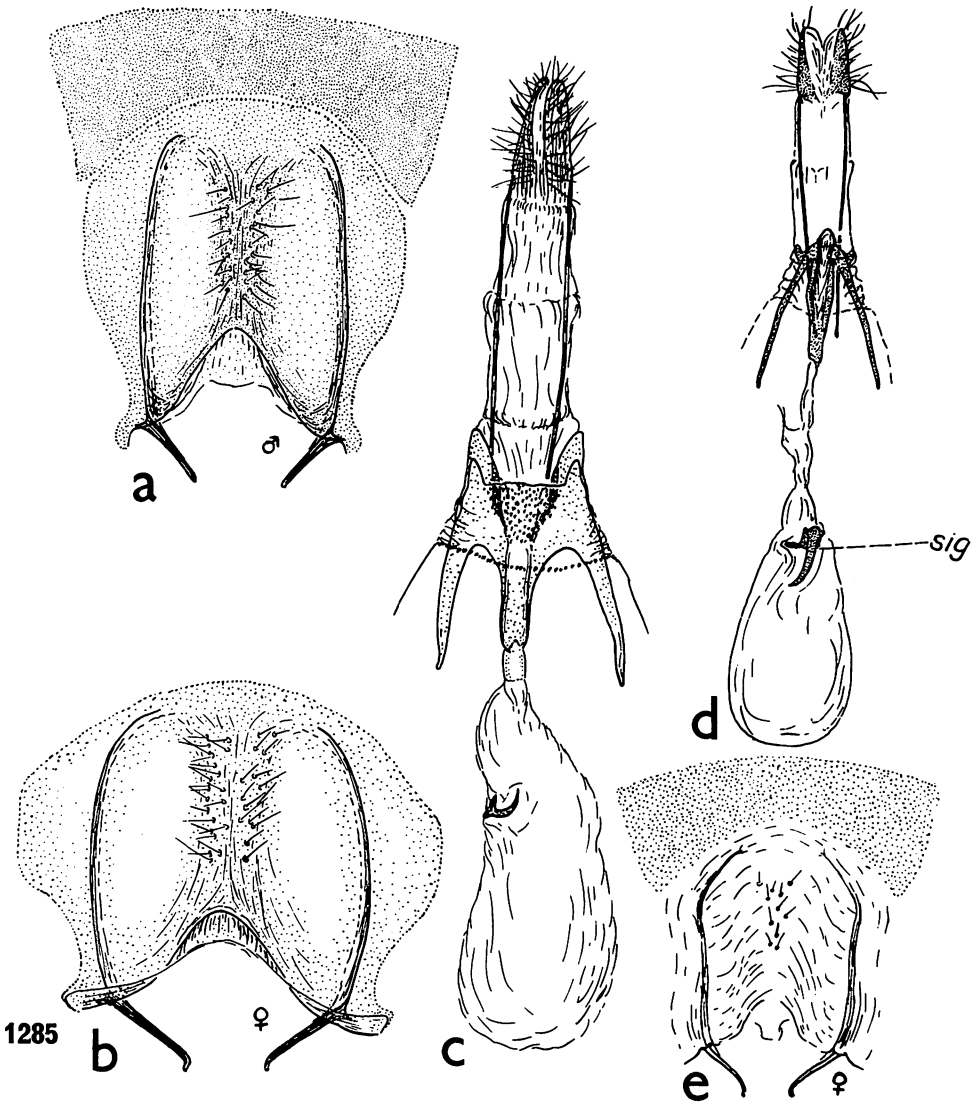


Figure 1285—Details of the female genitalia and bases of the abdomens of *Keiferia* and *Phthorimaea*. *a, b, c, Phthorimaea operculella* (Zeller): *a*, male, and *b*, female basal abdominal sternites; *c*, genitalia. *d*, genitalia and *e*, basal abdominal sternite of *Keiferia lycopersicella* (Walsingham). (Drawings loaned by H. H. Keifer and rearranged from his 1936 paper.)



of front, seta P2 laterad and only slightly above P1, and P1 slightly below the level of AF2. Submentum lacking a large oval pit. Prothorax with the prespiracular pinaculum not enclosing the spiracle and bearing three setae arranged in a triangle. Abdominal prolegs with many crochets. Proleg-bearing abdominal segments with setae L1 and L2 close together below spiracle. Eighth abdominal segment with seta SD1 not on a pinaculum. Ninth abdominal segment with seta D2 not on a pinaculum, seta D1 about as far from SD1 as from D2, and these setae not on a pinaculum.

#### KEY TO THE LARVAE OF PHTHORIMAEA AND KEIFERIA IN HAWAII

1. Mature larvae 10 to 11 mm. long; head mostly brown to blackish; prothorax pinkish to brownish with shield blackish; abdomen dirty creamy white; head not flattened and only slightly retracted into prothorax, in side view appearing nearly as high as long (excluding mandibles); the long seta below the posterior ocellus is below and *behind* the ocellus so that a line drawn from this seta to the similar seta above the ocellus passes *behind* the ocellus . . . . ***Phthorimaea operculella*** (Zeller).
2. Mature larvae not over about 7 mm. long; head yellowish to brownish with dark lateral lines; prothorax purplish with shield yellowish or whitish with fuscous posterior and lateral margins; abdomen greyish or greenish with rows of purplish spots; head noticeably flattened with about one-half retracted into prothorax, in side view much longer than high, much more prognathous; the long seta below the posterior ocellus is placed below it, not below and behind it, so that a line drawn between it and the similar seta above the ocellus passes very close to or through the ocellus . . . . .  
. . . . . ***Keiferia lycopersicella*** (Walsingham).

In California, development of all stages may continue, but at a retarded rate, during winters when tomato vines survive. Ordinarily, however, the tomato pinworm spends the winter in the pupal stage at or near the surface of the soil. During March and April the moths emerge to mate and lay eggs on the leaves of the young plants. Larvae hatching from the eggs mine the leaves during about half their larval existence, or during the first two instars. At the beginning of the third instar the larvae, having become too large to continue as true leaf miners, emerge from their mines and form leaf folds. Infestations are usually light on young plants early in the season, but as the season advances a gradual build-up is apparent. As the fruits set a few larvae enter them instead of folding the leaves. The number of larvae entering the fruits increases as the pinworm population multiplies, until a large proportion of the fruits may become infested. In cases of heavy infestations leaf injury may also become conspicuous.

When the larvae become mature in leaf folds or on the fruit they lower themselves by silken threads to the ground, where they form loosely woven pupal cells intermingled with particles of soil. . . . Seven to eight generations have been reared during a year, of which four or five occurred during the summer months. (Elmore and Howland, 1943:8-9; see for additional details on habits.)

As noted above, this species and *Phthorimaea operculella* are externally rather similar. To balance the data given under *Phthorimaea operculella* above, the following details have been assembled from the account of Keifer (1936a:237-

238): Moth 7.5 to 11 mm. in wing expanse. The forewings nondescript dull tan with slight blackish dots and often with some faint yellowish or ochraceous streaks. The apex of the abdomen of the male lacks the yellow vestiture or lateral tufts surrounding the genitalia that are present on *Phthorimaea operculella*. Male genitalia with tegumen short, triangular; uncus narrow, spinelike; gnathus oval with a blunt setiferous secondary projection at its apex; the valvae with a slender, toothlike, subapical process on the inner side that may make the apical part of the valva appear bifid from certain angles of view.

Larva 5.5 to 7.0 mm. long when full-grown. Head greenish-yellow, yellowish to brown, with black side lines not broadly reaching eyes; hypostomal sclerite

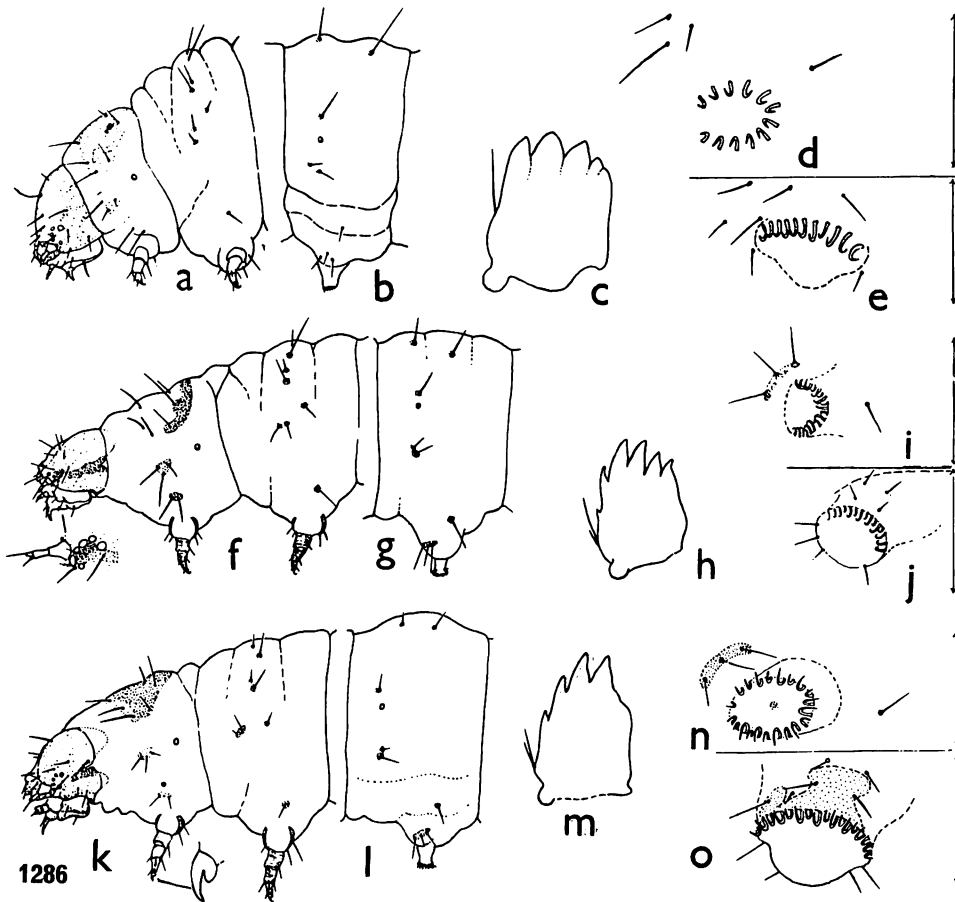


Figure 1286—Details of the larvae of three Gelechiidae of economic importance (rearranged from Peterson, 1962). *a* to *e*, *Pectinophora gossypiella* (Saunders); length 11 mm. *f* to *j*, *Keiferia lycopersicella* (Walsingham); length 8 mm. *k* to *o*, *Phthorimaea operculella* (Zeller); length 13 mm. Each series includes head, pro- and mesothorax and fourth abdominal segment in lateral aspect, mesal aspect of right mandible, proleg or crochets of a sixth abdominal segment, and an anal proleg, in that order.



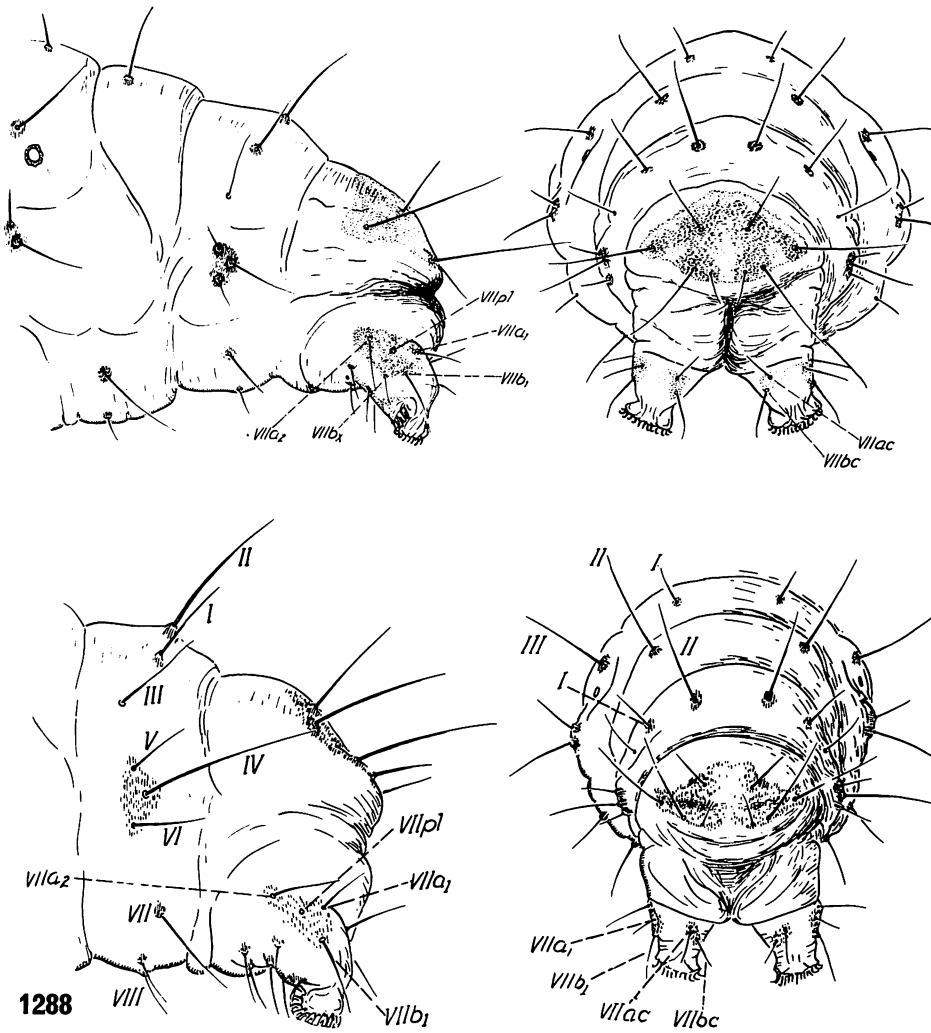


Figure 1288—Details of mature larvae of *Phthorimaea operculella* (Zeller), top figures, and *Keiferia lycopersicella* (Walsingham), bottom figures, showing left lateral aspects of the caudal end of the abdomen at left and direct caudal aspects at right. (Drawings loaned by H. H. Keifer and rearranged from his 1936 paper).

black anteriorly. Body pale grey or green, tapering rather abruptly at both ends and flattened; thoracic shield body colored, white centrally, black on posterior and lateral margins; meso- and metathorax mainly suffused with deep purple; abdomen with large, deep purple dorsal spots in two rows, one subdorsal, one spiracular; suranal plate infuscated; thoracic legs black. Head decidedly flattened and half retracted; frons, including adfrontal sclerites, broad, suddenly narrowed behind; mandibles rather similar to those of *Phthorimaea operculella*. Central proleg crochets in incomplete circle, broadly broken on outer side, 13 to 16 in biordinal series; anal proleg crochets 10 to 14 in complete biordinal series.

Chaetotaxy: adfrontal setae nearer each other than upper seta is to apex of adfrontal sclerites, adfrontal sutures abruptly converging in front of occipital foramen; frontal setae nearer frontal punctures than to frontal sutures; a line drawn from O2 to A3 usually passes between the two posterior ocelli; seta D1 and D2 on meso- and metathorax rather widely separated, setae SD2 and SD1 also rather widely separated but not quite so far; tarsi partly spinulate; second abdominal segment with seta SD1 dorsad and slightly cephalad to

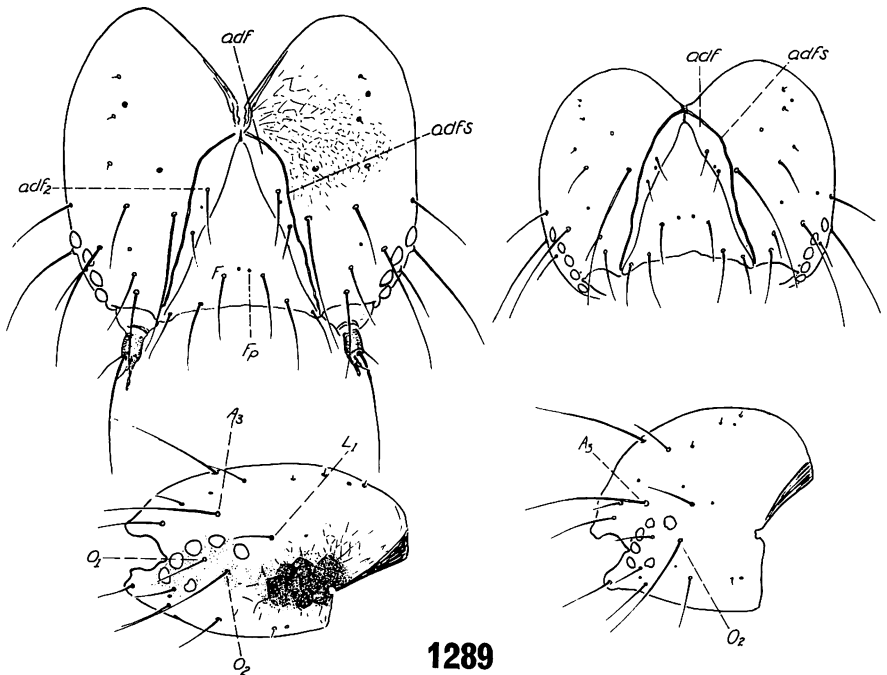


Figure 1289—Frontal and lateral views of larval head capsules of *Keiferia lycopersicella* (Walsingham), left, and *Phthorimaea operculella* (Zeller), right. Note the major differences in the shapes of the head capsules. (Drawings loaned by H. H. Keifer and rearranged from his 1936 paper.)

spiracle; abdominal segment nine with seta L3 united on same tubercle with L1 and L2 or near it. Pupa about 4.0 to 4.5 mm. long; cremaster a very small spine; wing sheaths extend to the sixth abdominal segment.

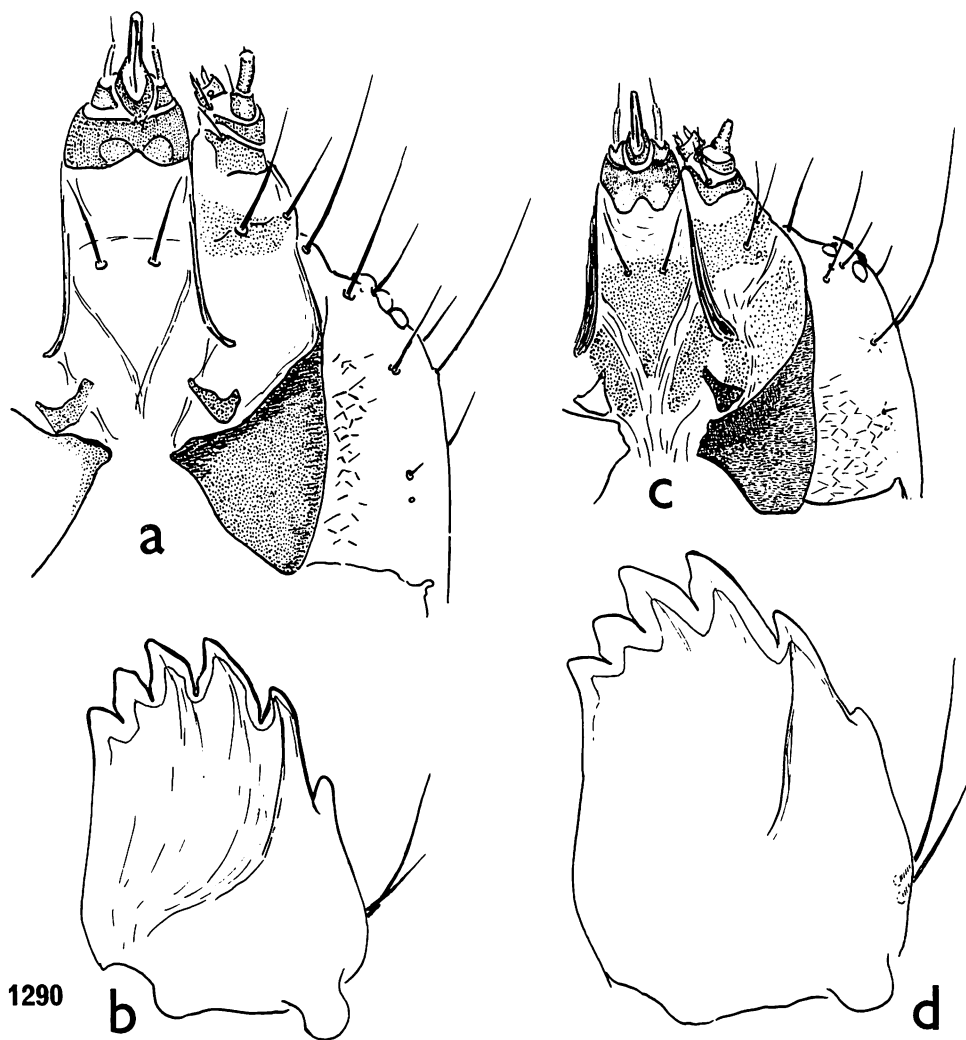


Figure 1290—Details of the mouthparts of mature larvae of *Keiferia lycopersicella* (Walsingham), *a* and *b*, and *Phthorimaea operculella* (Zeller), *c* and *d*. *a* and *c*, ventral aspects of mentum, spinneret, and left maxilla. *b* and *d*, mesal surfaces of left mandibles. (Drawings loaned by H. H. Keifer and rearranged from his 1936 paper.)

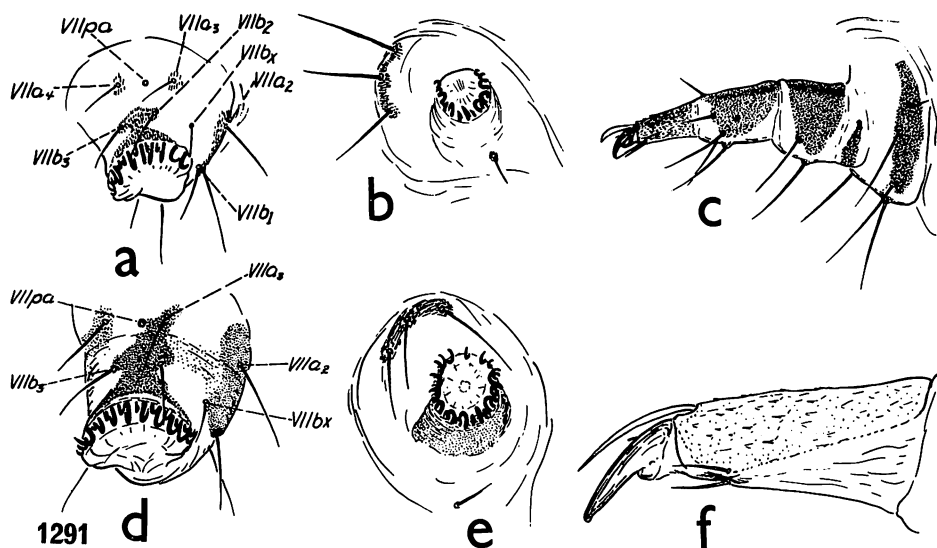


Figure 1291—Details of the legs of mature larvae of *Keiferia lycopersicella* (Walsingham), top figures, and *Phthorimaea operculella* (Zeller), bottom figures. *a* and *d*, left anal prolegs; *b* and *e*, prolegs of the third abdominal segments; *c*, left metathoracic leg; *d*, tarsus of left metathoracic leg. (Drawings loaned by H. H. Keifer and rearranged from his 1936 report.)

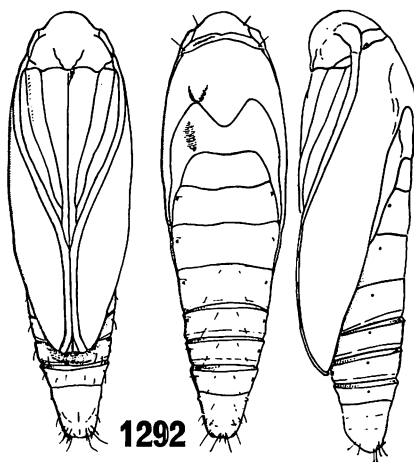


Figure 1292—Ventral, dorsal, and lateral aspects of the pupa of *Keiferia lycopersicella* (Walsingham). (Drawings loaned by H. H. Keifer and from his 1936 report.)

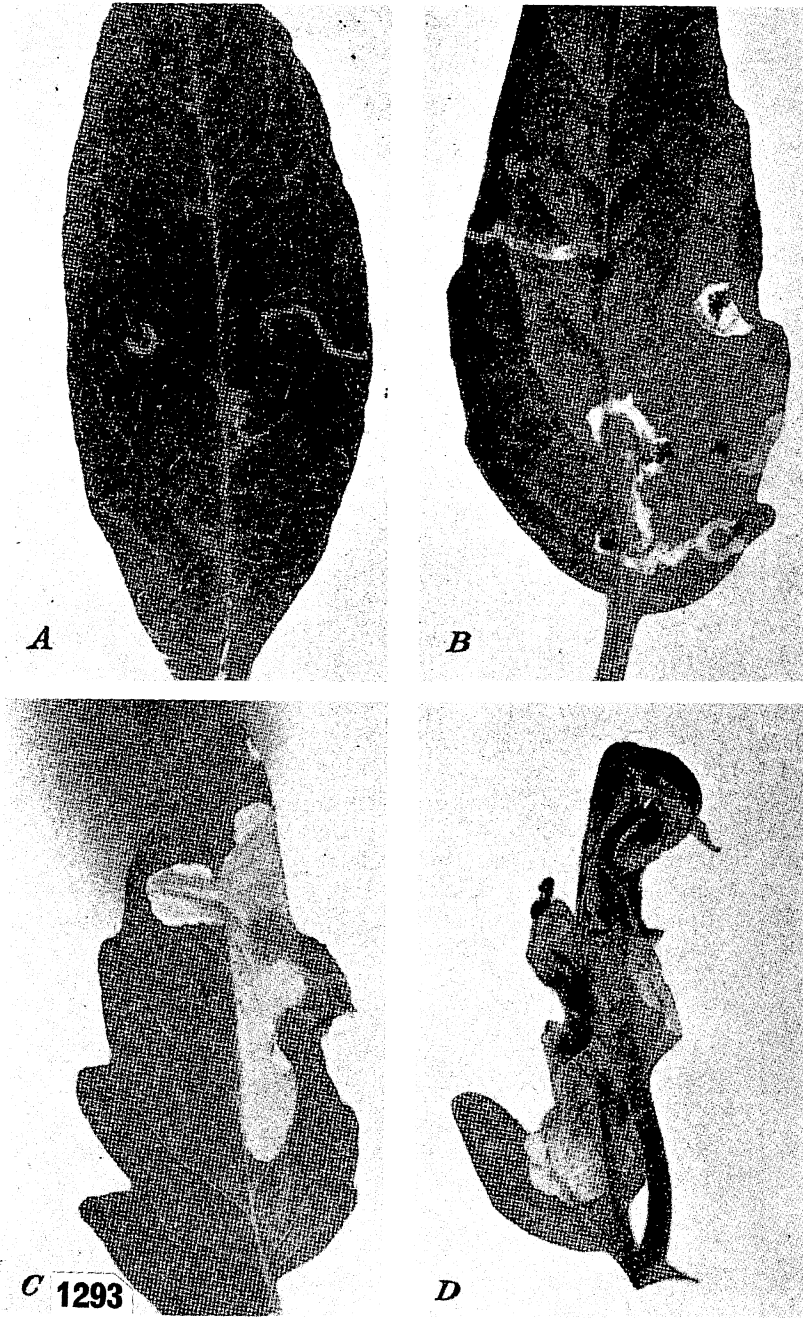


Figure 1293—Damage to tomato leaves by *Keiferia lycopersicella* (Walsingham), the tomato pinworm. A, mines made by young larvae; B, typical appearance of the mines of larvae a few days old; C, folded leaf edge and typical translucent blotch mine; D, damage in an advanced stage. (After Elmore and Howland, 1943.)



Tribe **GELECHIINI** (Stainton)*Gelechidae* Stainton, 1854:75, in part.Genus **SITOTROGA** Heinemann*Sitotroga* Heinemann, 1870:287. Type-species: *Alucita cerealella* Olivier.*Syngenomictis* Meyrick, 1927c:78. Type-species: *Syngenomictis aenictopa* Meyrick, described from Samoa. Fletcher, 1929: p. 2 of his "Further Addenda. . ."

As now constituted, *Sitotroga* contains two named species occurring naturally in Eurasia and Africa. It and *Pectinophora* are the only genera of gelechiines in Hawaii that bear well-developed antennal pectens, although *Merimnetria* (*Aristoteliodes*) species may have one or two bristles as rudiments of pectens.

***Sitotroga cerealella*** (Olivier) (figs. 1294, head, wing venation; 1295, male genitalia; 1296, larva; 1297, pupa; 1299, moth; 1344, male genitalia; 1355, damage to maize, larva, pupa, moth).

*Alucita cerealella* Olivier, 1789:121, pl. 93, fig. 8.*Gelechia cerealella* (Olivier) Clemens, 1860c:162 (and in the Stainton reprint on p. 112).*Sitotroga cerealella* (Olivier) Heinemann, 1870:287.*Tinea Hordei* Kirby, in Kirby and Spence, 1815:172 (this name was not included by Sherborn in his great *Index Animalium*).*Gelechia arctella* Walker 1864a:635.*Gelechia melanarthra* Lower, 1900:416.*Epithectis palearis* Meyrick, 1913c:65.*Syngenomictis aenictopa* Meyrick, 1927c:78.

Swezey, 1910g:102–106, figs. 1–5; 1910h:146–147, Hawaiian data.

Bach, 1920:1–20, figs. 1–16, account of the species in North America.

Silvestri, 1943:295–301, figs. 366–372, general account.

Sharplin, 1963, figs. 44, 61, wing base sclerites.

Balachowsky, 1966:351–359, figs. 166–168, general account.

It has been thought by some workers that *Gelechia* (*Sitotroga*) *coarctella* Zeller, 1877:353, is a synonym, but Klaus Sattler has informed me that it is a separate species.

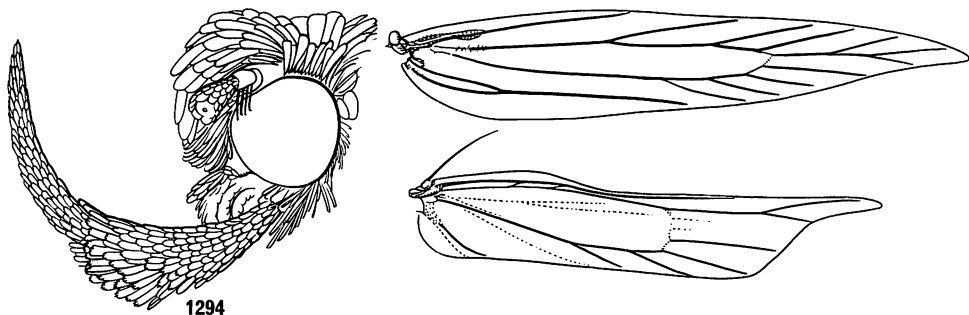


Figure 1294—Head and wing venation of *Sitotroga cerealella* (Olivier); Queensland, Australia (BM slide 2312).

The Angoumois grain moth.

Oahu, Maui, Hawaii.

Immigrant. This is perhaps a southern Eurasian species, although now it is nearly cosmopolitan. Although Perkins did not collect this species in the islands, it is possible that it was established in Hawaii prior to the turn of the century. The earliest published record I have seen regarding the moth in Hawaii is that by Van Dine, 1908:43. He noted that the moth "has been bred in large numbers from stored rice during the past year." In his report for the previous year, Van Dine did not include the species in his list of rice pests. Swezey overlooked the Van Dine report when he stated in 1910 (1910*g*:102) that it was first found in the Hawaiian Islands on Maui in December, 1909. Later in 1910 (1910*h*:146), Swezey reported that the pest had been known to farmers on Maui as early as about 1903.

Hostplants: maize, rice and wheat in Hawaii (elsewhere: peas, beans, sorghum, barley, Sudan grass seed, etc.).

This is a bad pest of grains. The ovate eggs are laid on the kernels. The yellow-headed, stout, short-legged, white larvae bore within the kernels. Grain may be attacked in the field or in storage, and infestations may be severe. In Hawaii, rice standing in the fields, or paddy rice in storage is subject to attack. Evidently as a result of the reduction in rice growing and reduction in the growing of maize grain for livestock feeding, the insect is not now often mentioned in Hawaii.

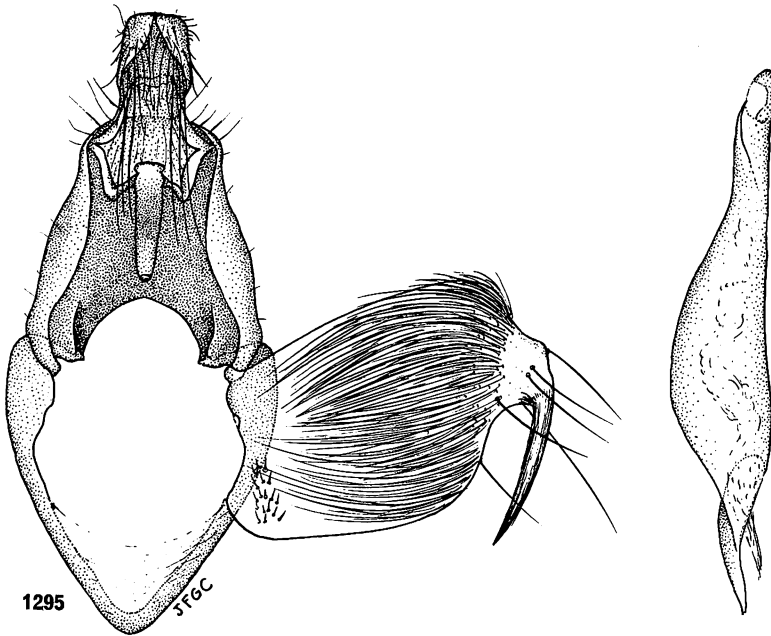


Figure 1295—Male genitalia of *Sitotroga cerealella* (Olivier); also see figure 1344.

Essig (1929:715) stated that this species was the first insect to be discussed in a scientific publication in America. Back (1920:3) said that the first report in America was in 1728 in North Carolina.

The name Angoumois is taken from that of a province in France.

For a detailed, illustrated, general account of the species, with bibliography, see Balachowsky, 1966:351–359. For an account of the species in India, see T. B. Fletcher, 1921 (1920):69–71, fig. 1.

The newly-hatched larva is less than 1 mm. long, cylindrical, pinkish-yellow; head brown; five pairs of equally developed prolegs. It seldom bores into the grain on which the egg was deposited but wanders about and selects a grain into which it begins to bore by making a hole in the cavity left by the breaking away of the stalk. After boring a little way into one grain it may leave it and wander about again in search of another. When once it has really entered into a grain, however, it does not leave it again but passes the rest of its larval life in that grain. There is never more than one larva in one grain, at least in the case of rice. Before it has finally settled down, the larva is very quick in its movements, but when grown larger it can hardly walk and seems to be helpless if removed from the grain, nor can it bore into another grain. The larva makes its way directly into the starchy part of the grain and the germ is left untouched. By the time that the larva is full-grown the whole of the starchy portion (of a rice grain) has been consumed.

The full-grown larva is about 6 mm. long and about 1 mm. broad, body very soft with the segments fairly distinct, pure white, with scattered minute white hairs; head smaller than prothorax, into which it is at times retracted, pale yellow, mouthparts brown; prothoracic shield large, pale yellow; spiracles round, rimmed with yellow, five pairs of reduced prolegs.

Pupation takes place inside the grain in which the larva has fed. The pellets of frass are pushed to one side and there is formed a white silken cocoon lining almost the whole length of the cavity formed by the larva. The end of the cocoon next the capital extremity of the pupa is left open and the hard covering of the grain at this part is eaten just so much as to leave a thin membranous cover for the open mouth of the cocoon. This cover is broken through by the moth on its emergence [T. B. Fletcher, 1921 (1920):70.]

Dr. Swezey (1910g:103–104) made the following observations on the larvae feeding on maize and wheat in Hawaii:

The eggs are somewhat elongate oval, slightly pinkish-iridescent, and are deposited on the outside of grains or kernels of corn. On ears of corn, the eggs are placed in the crevices between the kernels, and are thrust so far down as to easily escape observation. On hatching, the tiny larva burrows into the kernel and feeds on the substance, making a burrow scarcely larger than it can conveniently occupy. In wheat there is just about enough material in one grain for the nourishment of one larva, but a kernel of corn may

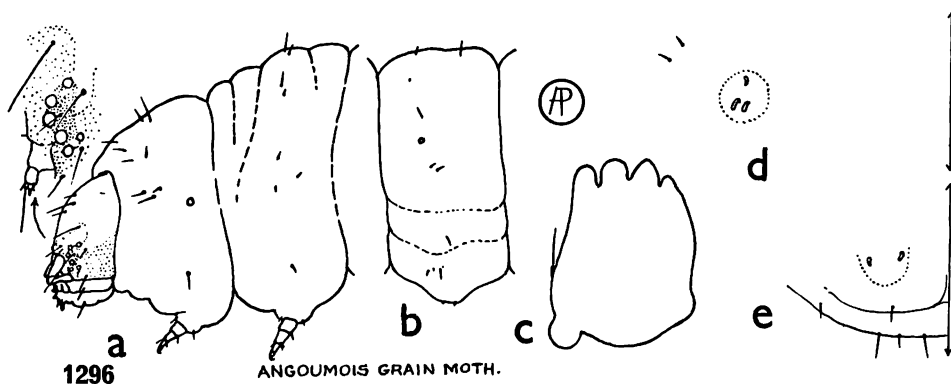


Figure 1296—Details of the larva of *Sitotroga cerealella* (Olivier) (after Peterson, 1962). Mature larva is about 6 mm. long. *a*, left lateral aspect of head, pro- and mesothorax; *b*, left lateral aspect of fourth abdominal segment; *c*, mesal aspect of right mandible; *d*, ventral aspect of right proleg of the sixth abdominal segment; *e*, ventral aspect of an anal proleg. Note the greatly reduced prolegs and the few crochets.

furnish food for three or four. When full-grown the larva is plump and white, and occupies nearly all the space it has eaten in the grain. It may be distinguished from weevil larvae, as it is straight while the latter are shorter and more or less curved or curled up.

Before spinning its slight white cocoon inside the kernel, the larva eats to the skin or epidermis of the grain and cuts an accurate circular piece, which is not removed but held tightly in position by a little silk from its cocoon, and can be readily pushed away by the moth when ready to emerge.

The larvae of *Sitotroga* have the following additional characters (Capps, 1956): Abdominal prolegs with not more than three or four crochets. Proleg-bearing abdominal segments with setae L1 and L2 close together below spiracle. Prothorax with three setae in the prespiracular group. Eighth abdominal segment with seta SD1 above the level of the spiracle. Ninth abdominal segment with the D2 setae not on pinacula and seta D1 as close to D2 as to SD1 and not on a pinaculum. Hinton (1943:294) said that the larva "is an extremely specialised form adapted to feeding inside grain kernels where all instars except the first are found. The mature larva is 4–7 mm. long, . . . with thorax much stouter than abdomen, which is gradually narrowed behind, and white with head pale brown and mandibles moderately dark reddish brown. From all other moth larvae associated with stored products it may be distinguished by its short, narrow, and often very indistinct prolegs, each of which has only two widely separated crochets."

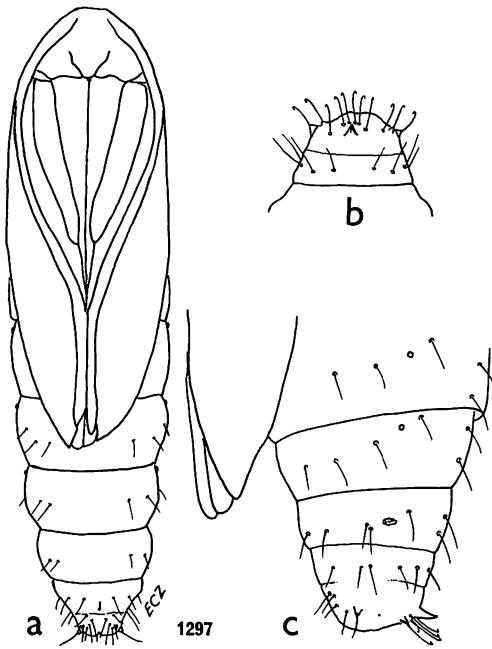


Figure 1297—Details of the pupa of *Sitotroga cerealella* (Olivier). *a*, ventral aspect, abdominal segments expanded; *b*, dorsal aspect of cauda; *c*, left lateral aspect of part of the abdomen of a different specimen from *a*, and this shows the abdominal segments more retracted. Pupal length about 6 mm.

Genus **PECTINOPHORA** Busck

*Pectinophora* Busck, 1917:346. Type-species: *Depressaria gossypiella* Saunders, by original designation.

*Pectinophora* and *Sitotroga* are the only genera of Gelechiinae now in Hawaii that have conspicuous, strongly developed pectens on the basal antennal segments. Some other genera, such as *Merimnetria* (*Aristoteliodes*), may have species which have one or two obscure bristles on the basal antennal segments that appear to be remnants of pectens, but none has well-developed pectens. *Sitotroga* is easily separated from *Pectinophora* because the apices of the hindwings are drawn out into long slender points in *Sitotroga*. This is a character that can readily be observed in the whole moths under low magnification, as my photographs of the moths in figure 1299 clearly demonstrate, and as do also the drawings on figures 1294 and 1298. Each hindwing bears a conspicuous tuft of hair on the vannus.

Busck's original descriptions of the generic characters of both the larva and adult of *Pectinophora* are extensive, and the reader is referred to his 1917 paper for detailed information. Common, in his *A Revision of the Pink Bollworms of Cotton . . . and Related Genera in Australia*, 1958a, has given a most helpful summary of information, including a key to the associated genera in Australia. He clearly sets forth characters for separating genera and species. He also gives an interesting historical account of the knowledge of *Pectinophora* in Australia.

*Pectinophora* includes a small group of species distributed from Africa, southern Eurasia to Australia. Some of the species have been dispersed by man so that now the genus is represented on all the continents and on many

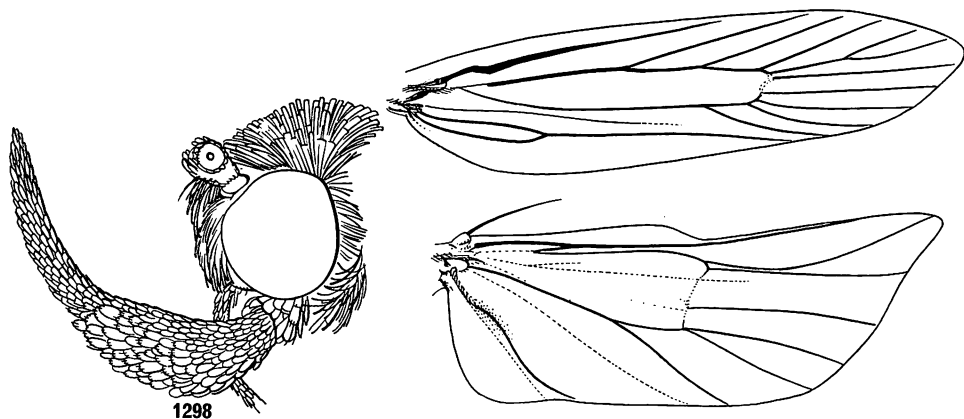


Figure 1298—Head and wing venation of *Pectinophora gossypiella* (Saunders) (BM slide 1921). Honolulu specimens collected by Perkins. In other specimens, veins 3 and 4 in the hindwings may be connate or stalked.

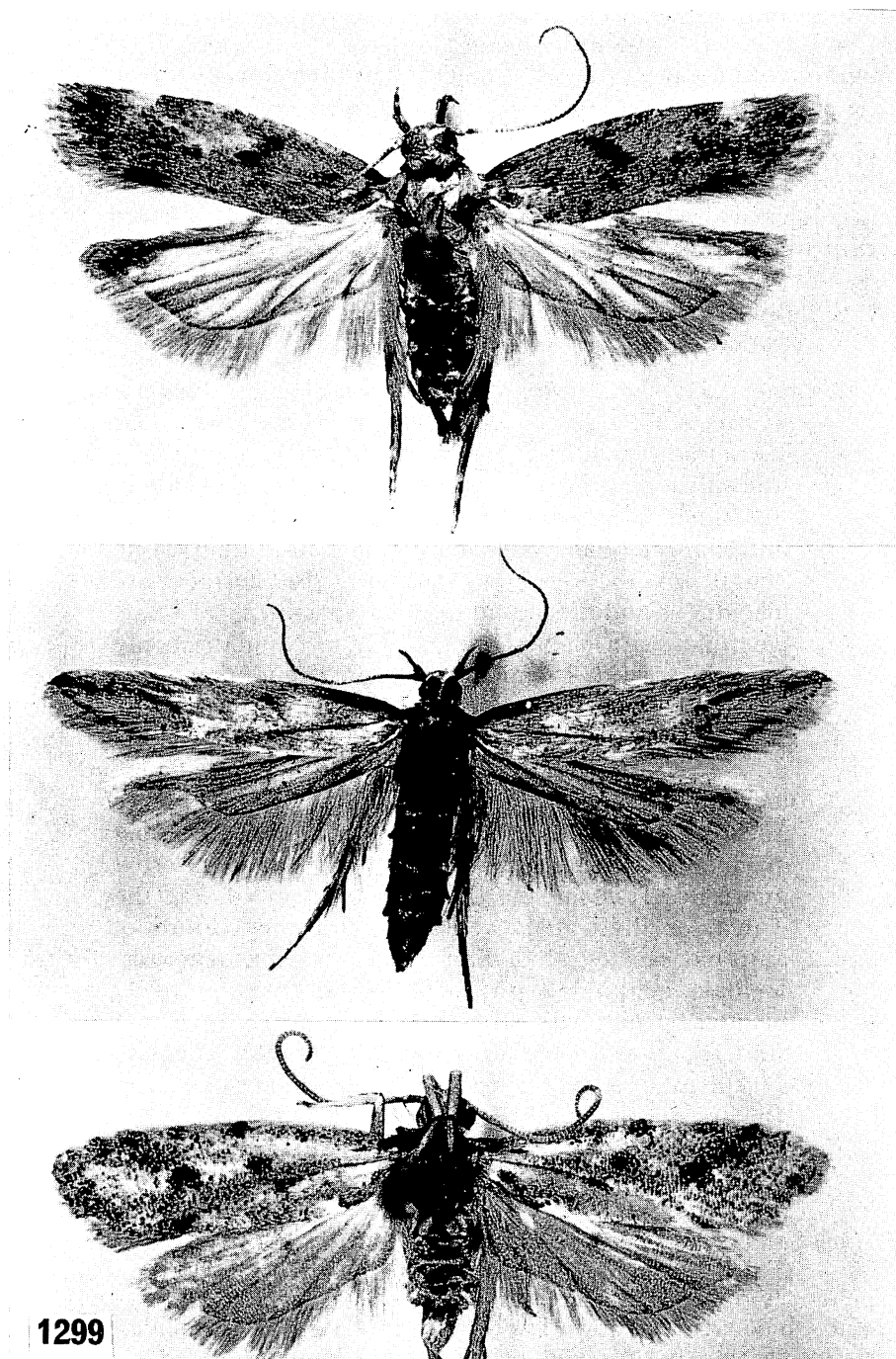


Figure 1299—Some Gelechiinae. Top, *Pectinophora scutigera* (Holdaway), forewing=8 mm.; Kokokahi, Oahu, ex *Thespesia populnea* ("milo"). Middle, *Sitotroga cerealella* (Olivier), forewing=8 mm.; Paia, Maui. Bottom, *Stoerberhinus testaceus* Butler; forewing=7 mm.; Manoa Valley, Oahu; note the long male palpi curved up over the thorax.

islands. Several of the species are closely similar externally, and the genitalia must be used for their identification. The larvae feed upon Malvaceae. Two immigrant cotton-eating pest species represent the genus in Hawaii.

#### KEY TO THE SPECIES OF PECTINOPHORA IN HAWAII

The two species of *Pectinophora* in Hawaii are outwardly so closely similar in the adult stage that no satisfactory way of identifying them by the use of external characters alone has yet been discovered. The species may be determined by differences in both the male and female genitalia, and the larvae and pupae are conspicuously different. It is surprising that the larvae are so different whereas the adults are so similar.

##### A. ADULTS

1. Inner face of male genital valva with a large, diagonal cluster of long, heavy setae whose bases are covered by a common membrane which extends diagonally across the valva, and the setal insertions extend mesally along the inner face of the valva, as illustrated; cornuti of internal sac of aedeagus more than half as long as the length of the aedeagus (*caution*: the cornuti are deciduous and are absent on some specimens). Female genitalia with each signum of bursa copulatrix only slightly curved, broad and flattened, and the broad surfaces not denticulate (denticles are confined to the inner edge and extend all the way to apex); figure 1302 ..... **gossypiella** (Saunders).
2. Inner face of male genital valva with the cluster of large setae mentioned above with their bases not arising from beneath such a membrane and the setae inserted more nearly along the thickened ventral edge of the valva, as illustrated; aedeagus with the cornuti of internal sac less than half as long as the aedeagus. Female genitalia with each signum comparatively slender beyond base, strongly curved, nearly C-shaped and the lateral surfaces denticulate (also denticulate on the inner edge, but these denticles do not extend to the apex of the inner margin); figure 1302 ..... **scutigera** (Holdaway).

##### B. LARVAE

*Pectinophora* larvae share the following characters (see Capps, 1956): Head with seta AF2 near to or dorsad of the level of the top of the front, seta P2 conspicuously dorsad of P1 with a sensory puncture (AFa) between AF1 and AF2 and Pb between P1 and P2. Prothorax with the prespiracular pinaculum not enclosing the spiracle and bearing three setae arranged in a triangle.

Setae L1 and L2 of the proleg-bearing segments of the abdomen close together below the spiracle. Eighth abdominal segment with seta SD1 above the level of the spiracle. See my illustrations for more complete details.

1. Setae of meso- and metathorax and abdominal segments mostly not borne from conspicuous pinacula (sclerotized plates in the cuticle), but if pinacula are distinguishable, such as on the prothorax or dorsum of the ninth abdominal segments, they are weak and inconspicuous (figure 1305); prolegs of abdominal segments 3 to 6 with the crochets arranged in an entire horseshoe shape with only one opening breaking the row and that directed laterad; crochets of the anal prolegs arranged in a single group in a continuous line; head with the AF2 setae slightly below the dorsal angle of the frons . . . . . **gossypiella** (Saunders).
2. Setae of all thoracic and abdominal segments borne from well-sclerotized, conspicuous pinacula that are much broader than the setal sockets (figure 1305); prolegs of abdominal segments 3 to 6 each with the crochets arranged in separated anterior and posterior crescents, the two rows being separated by one inner and one outer opening; crochets of the anal prolegs arranged in a broken line into an ectal and ental group along the anterior edge of each proleg; head with the AF2 setae slightly dorsad of the dorsal apical angle of the frons . . . . . **scutigera** (Holdaway).

#### C. PUPAE

The pupae of *Pectinophora* are densely and conspicuously pilose (the short pilosity may be easily overlooked on specimens viewed in fluid). Their gross details are as illustrated in figure 1304.

1. Apex of abdomen in lateral view as in figure 1308; longitudinal dorsal contour cephalad of cremaster without any nodules or tuberclelike protuberances . . . . . **gossypiella** (Saunders).
2. Apex of abdomen in lateral view as in figure 1308; dorsal outline appearing nodose or tuberculate just cephalad of base of cremaster . . . . . **scutigera** (Holdaway).



***Pectinophora gossypiella*** (Saunders) (figs. 34, female genitalia; 1286, larva; 1298, head, wing venation; 1300, head, leg, moth; 1301, 1302, 1303, male and female genitalia; 1304, larva, pupa; 1305, 1306, 1307, larva; 1308, pupa).

*Depressaria Gossypiella* Saunders, 1844:285.

*Gelechia gossypiella* (Saunders) Meyrick, 1905:592. Walsingham, 1907*b*:731. Durrant, 1912:203, fig. 1.

*Platyedra gossypiella* (Saunders) Meyrick, 1918:136. Fletcher, 1921 (1920):79, pl. 19.

*Pectinophora gossypiella* (Saunders) Busck, 1917:343, many figs., detailed account of larva, pupa, adult and biology in Hawaii. Holdaway, 1929*a*:179–185, figs. 1–8. Common, 1958*a*:275, figs. 1A, 2A, 2B, redescription.

*Gelechia umbripennis* Walsingham, 1885:884.

Gaede, 1937:231, world bibliography. See Fletcher, 1921(1920):79, col. pl. 19, for biology in India. Silvestri, 1943:279–285, figs. 347–355, Capps, 1958:631. For a detailed account of the species in tropical Africa, see Pearson and Darling, 1958:164, col. pls. 7–8. For a general, illustrated review, see LeGall in Balachowsky, 1966:399–441, figs. 185–197.

The pink bollworm.

Kauai, Oahu, Molokai, Maui, Lanai?, Hawaii.

Immigrant. The first record that I have seen for this species in Hawaii is that by Perkins (Walsingham, 1907*b*:732) who noted that it was highly injurious to cotton in Hawaii in 1901. It was, therefore, accidentally introduced to the islands before 1900. The insect was first described from Broach, India,

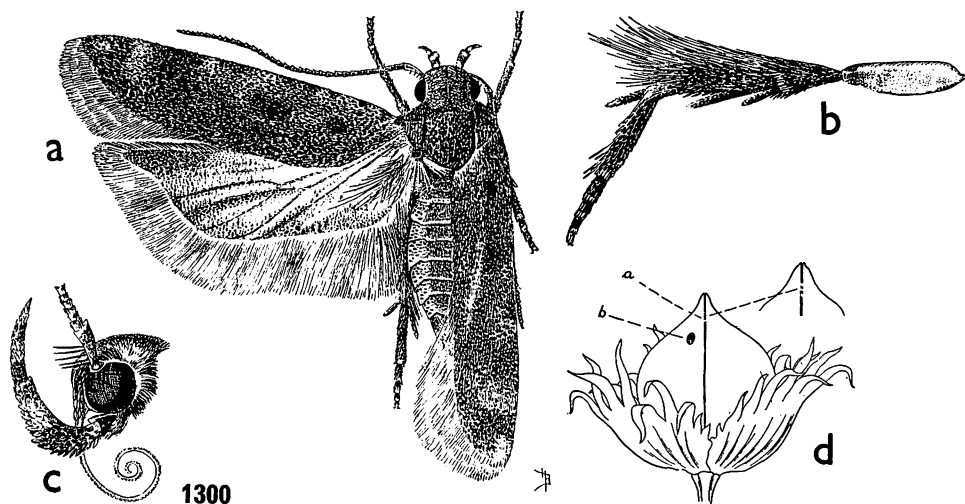


Figure 1300—*Pectinophora gossypiella* (Saunders). *b*, a right hindleg; *d*, a cotton boll showing eggs at *a* and an exit hole of a moth at *b*. (Rearranged from Busck, 1917.)

where it was known as a pest of cotton about 1840. It has since become established in most parts of the world where cotton is grown. It is now known from Africa, India, Ceylon, Burma, Malaya, Philippines, Australia, various Pacific islands, and North and South America.

Hostplants: cotton (infests bolls, feeds on seeds and spoils cotton fibers in unripe bolls), *Gossypium tomentosum* (native Hawaiian cotton), *Hibiscadelphus hualalaiensis*, *Hibiscus brackenridgei*, *Hibiscus rosa-sinensis*, *Hibiscus youngianus* (attacks seed capsules; a large proportion of the flower buds may be damaged as well).

Parasites: *Agathis hawaiiicola* (Ashmead), *Bracon mellitor* Say (= *Microbracon pambertoni* Bridwell), *Brachymeria obscurata* (Walker), *Chelonus* (*Microchelonus*) *blackburni* (Cameron), *Ephialtes hawaiiensis* (Cameron), *Perisierola emigrata* Rohwer, *Pristomerus hawaiiensis* Perkins, *Stomatoceras pertorvum* Girault, *Trichogramma minutum* Riley. See Willard, 1927:1-15, figs. 1-6, for parasitism in Hawaii. However, Willard confused *Pectinophora scutigera* with *gossypiella* in some of his work.

This pest does enormous damage to cotton crops. The literature concerning it is voluminous. Since cotton is no longer grown commercially in Hawaii, Hawaiian studies on the insect have not been extensive. General accounts have been given by Busck (1917), Fullaway (1909:18; 1913:23), Van Dine (1908:30), and Willard (1927:1). Illingworth, 1929:249, said that the species was "by far the most serious" pest of cotton at Kona, Hawaii, in 1928. The ravages of this moth were responsible for the discontinuance of cotton production in Hawaii. Fullaway (1913:23) said, "Some attention has been given to the pink bollworm . . . , which is now recognized as an important factor in the successful production of cotton in Hawaii. A great deal was expected of the cultural methods of control, but after the second year's trial the results seem only partially assuring. . . . One field of Sea Island cotton cut back in December was again in full flower in February and became so badly infested by bollworms that it was necessary to plow up and burn it to save adjacent fields." In 1917:344, Busck said, "In the Hawaiian Islands the cultivation of cotton has practically been abandoned on account of this pest, which during 1915 infested from 50 to 99 per cent of the bolls in the few fields yet remaining and destroyed from one-half to nine-tenths of the lint."

Busck (1917:343-370) made the most detailed study of the pink bollworm in Hawaii. Little has been written about it in Hawaii since his report. Busck (1917:346) gave the following summary of characters, which can be seen with a hand lens, for use in preliminary field identification of *gossypiella*:

If a small dark-brown moth is caught in the cotton field or in a cotton mill or warehouse and is found to have the forewings pointed and the hindwings broad and sinuated below the tip and to possess long curved palpi and long stiff hairs on the first antennal joint, it is reasonably certain that the moth is *P. gossypiella*, the adult of the pink bollworm . . .

If, within the cotton boll or associated with stored cottonseed, a small white or pinkish caterpillar with brown head is found and under a hand lens the mandibles are seen to have four teeth . . . and the crotches [crochets] on the abdominal prolegs form a partial circle or horseshoe, opening outwards . . . , the caterpillar will most probably prove to be the pink bollworm.

Again, if, within a cotton boll or otherwise associated with cotton in the field or in the mill, a small lepidopterous pupa is found, which under the lens is found to be entirely covered with a short velvety pubescence and to possess a short, curved, upturned hook at the posterior end . . . it may with considerable certainty be determined as a pupa of the pink bollworm.

The following summary of details has been assembled mostly from Busck's report: The eggs are about  $1.0 \times 0.5$  mm. The shell is pearly white, finely wrinkled. It is slightly greenish when newly laid and turns reddish at maturity. The mature larva is about 11 to 13 mm. long, white with dorsum strongly suffused with pink. The larval head is reddish brown. The dark brown thoracic shield is divided in middle. The pupa is about 8 to 10 mm. long. The adult is a generally brownish moth intermixed with black.

The eggs are laid singly or in small groups on any part of the green cotton boll or on its calyx or flower. A female may deposit more than 100 eggs which hatch in 4 to 12 days. The first-stage larva tunnels into the boll beneath the eggshell or near it. The larva usually, but not always, enters near the apex of the boll and tunnels downward to attack one of the lowest seeds. After that seed has been partly eaten, it proceeds to feed on the seed next above and usually reaches maturity on one of the uppermost seeds. The larva feeds

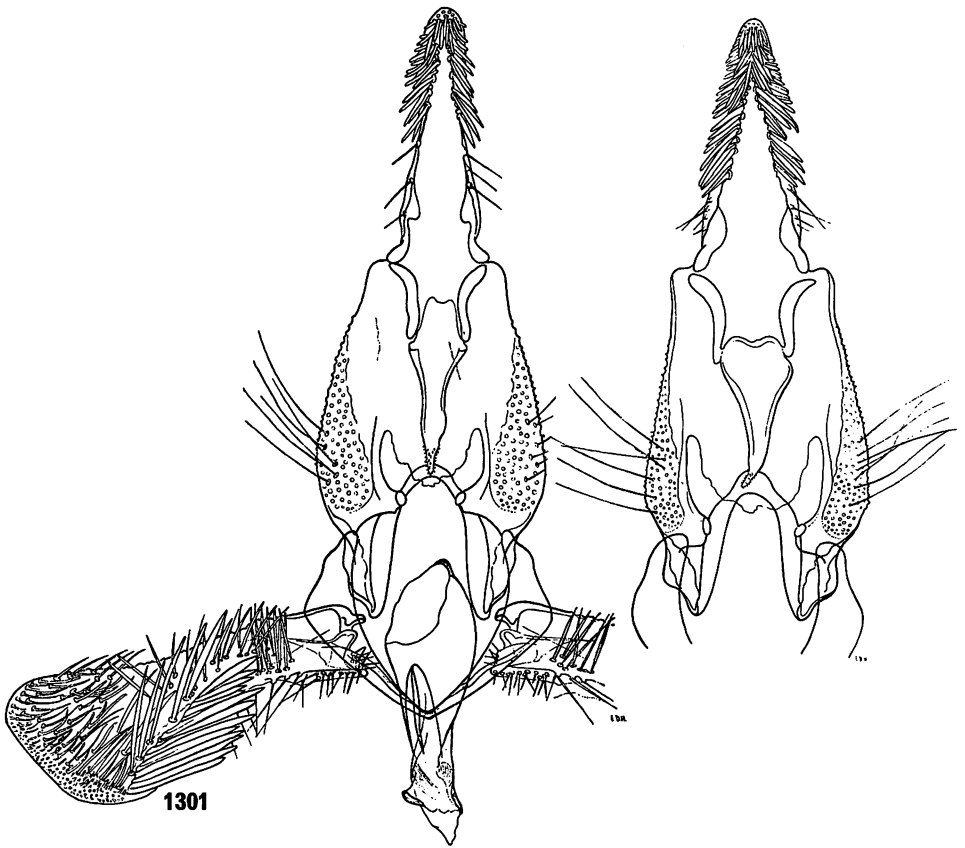


Figure 1301—Male genitalia of *Pectinophora*. Left, *scutigera* (Holdaway), aedeagus in situ. Right, tegumen, uncus, and gnathus of *gossypiella* (Saunders). (Rearranged from Holdaway, 1929.)

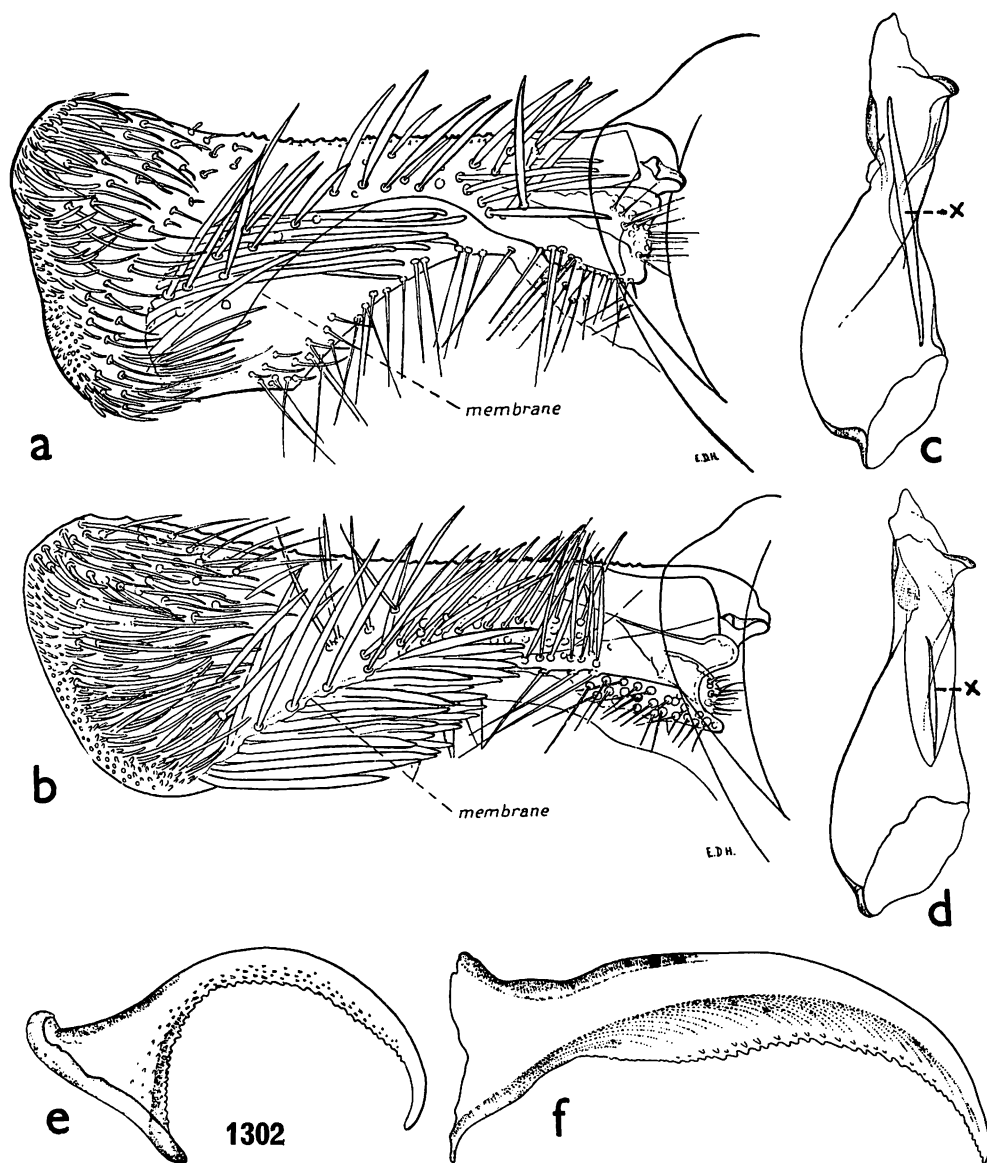


Figure 1302—Details of male and female genitalia of *Pectinophora*. Left male genital valvae of *gossypiella* (Saunders), *a*, and *scutigera* (Holdaway), *b*. Aedeagi of *gossypiella*, *c*, and *scutigera*, *d*, with cornuti marked by "x" (the cornuti are deciduous and may be absent, and the shape of the apex of the aedeagus may vary in appearance in different dissections). Signa of the bursa copulatrix of *scutigera*, *e*, and *gossypiella*, *f*. (Re-arranged from Holdaway, 1929.)

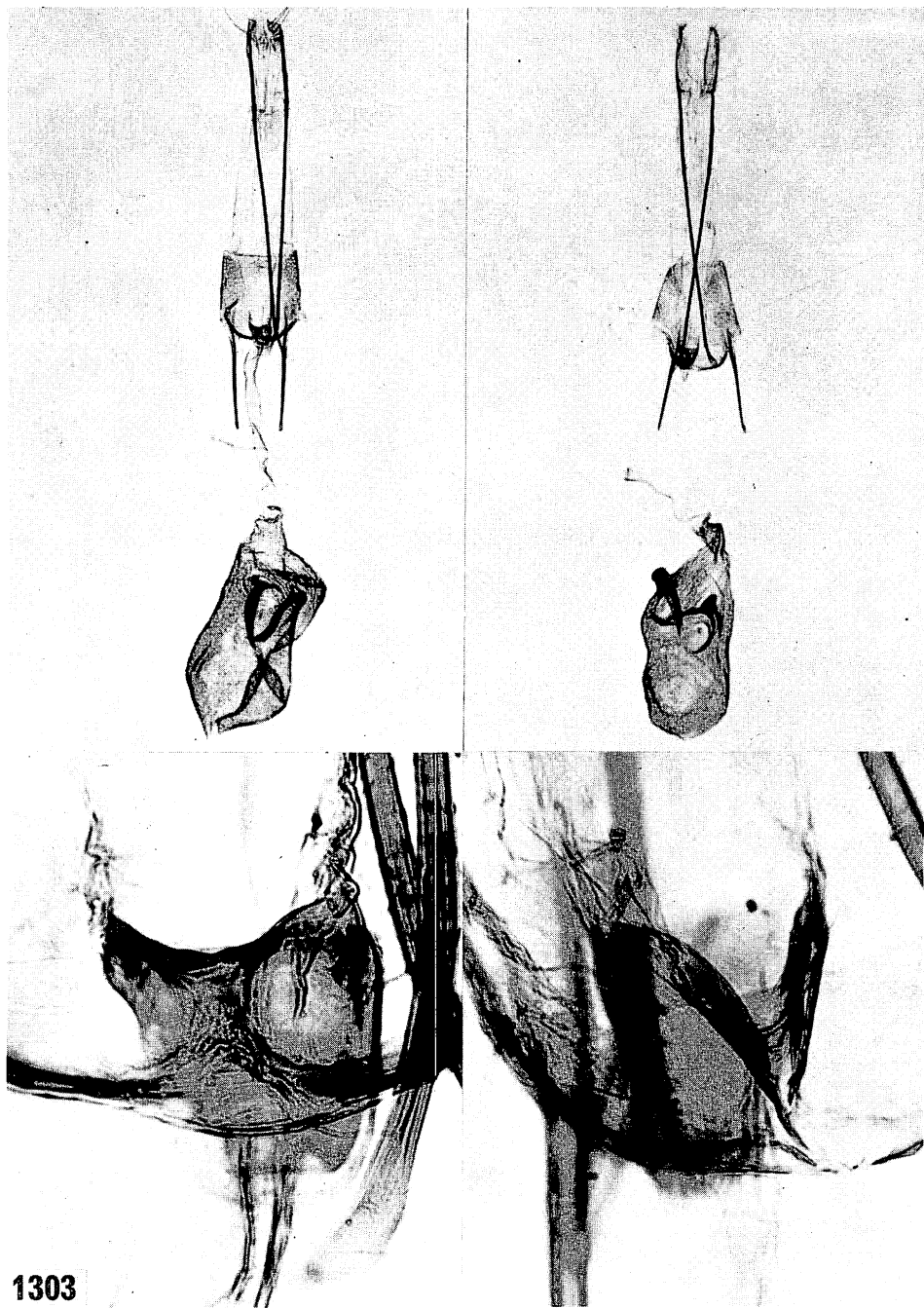


Figure 1303—Female genitalia of *Pectinophora*; ostia enlarged at bottom. Left, top and bottom, *gossypiella* (Saunders); Honolulu, ex *Gossypium* (BM slide 15821). Right, top and bottom, *scutigera* (Holdaway); Bundaberg, Queensland, ex cotton (BM slide 15816).

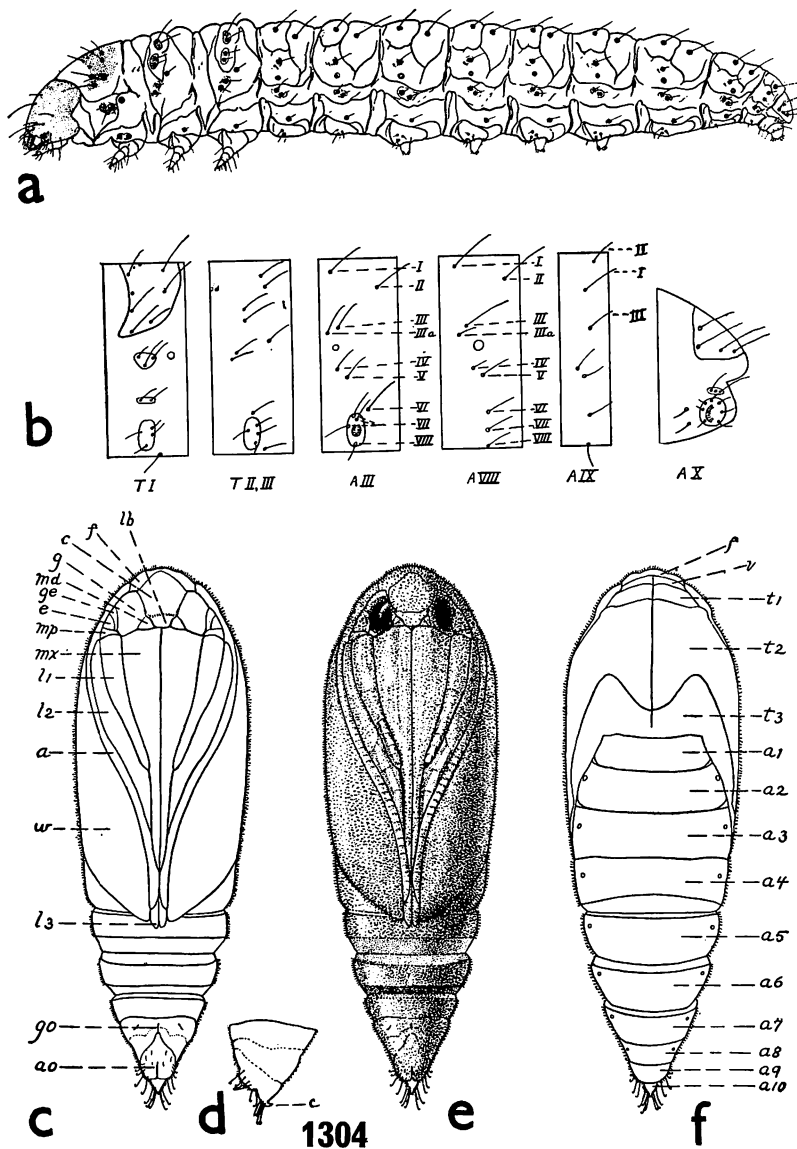


Figure 1304—Details of the larva and pupa of *Pectinophora gossypiella* (Saunders) (rearranged from Busck, 1917). *a*, mature larva; *b*, setal map of same (Heinrich, 1921:809, notes that setal labels IV and V should be reversed); *c*, ventral aspect of pupa (*a*, antenna; *ao*, anal opening; *c*, clypeus; *e*, post gena; *f*, frons; *g*, *ge*, covering of eye; *go*, genital opening; *lb*, labrum; *L1*, *L2*, *L3*, legs; *md*, mandible; *mp*, maxillary palpus; *mx*, maxillae or proboscis; *w*, wing); *d*, lateral aspect of apex of abdomen of pupa with cremaster at *c*; *e*, ventral aspect of pupa showing the vestiture of short hairs; *f*, dorsal aspect of pupa (*f*, frons; *v*, vertex; *T1*, *T2*, *T3*, pro-, meso- and metathorax; *a1* to *a10*, abdominal segments). In figure *b*, microseta MD1 was erroneously shown in the original to be two long setae, but I have altered the drawing. Most microsetae were not shown by Busck. The following is a conversion of the setal nomenclature into the modern system: I = D1; II = D2; III = SD1; IIIa = SD2; IV and V (reversed on this figure according to Heinrich) = L1 and L2; VI = L3; VII = the SV group; VIII = V1.

entirely within the boll. The attack is usually confined to one section of the boll, but other sections may be invaded. A larva may leave one boll and enter another. The seeds are destroyed. Tunnels are made through the lint so that it is cut, stained, and subjected to subsequent rot. Several larvae may infest one boll. There are four larval instars.

Very young larvae are almost all white with brown head, thoracic shield and tubercles. The fourth stage larva becomes suffused with pink, whence the name "pink bollworm". Hatching of the egg to formation of the cocoon occupies about 20 to 30 days in summer and much longer in colder weather. The larva hibernates during the winter within the cotton seeds, in debris, or

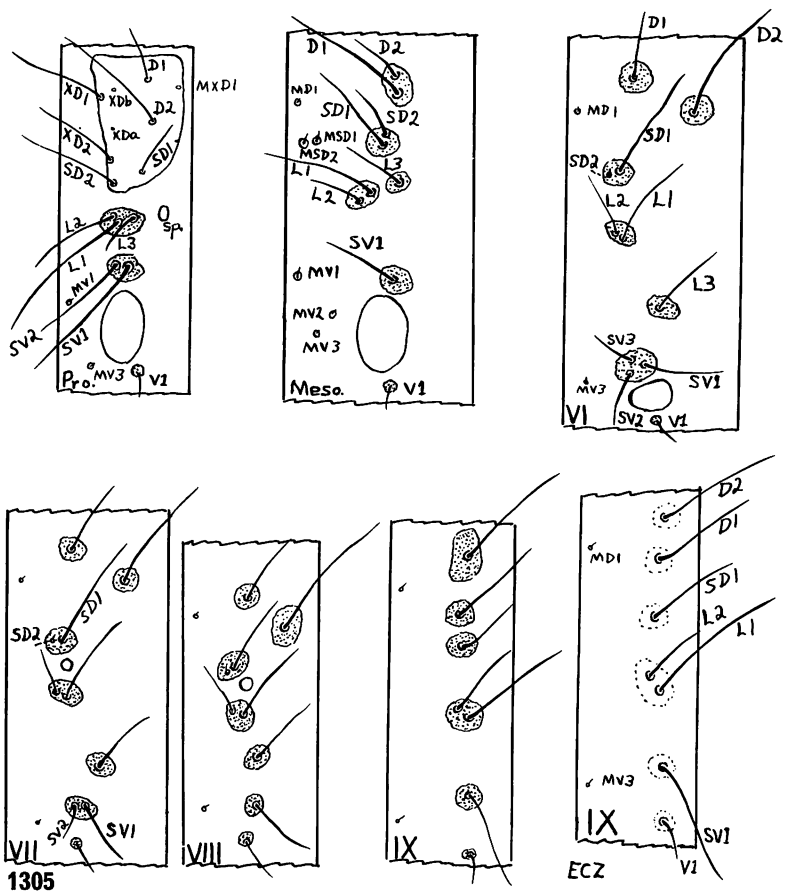


Figure 1305—Setal maps of *Pectinophora* larvae. Top three figures and three figures in lower left are of prothorax, mesothorax, and abdominal segments VI, VII, VIII, and IX of *Pectinophora scutigera* (Holdaway). Lower right figure, abdominal segment IX of *Pectinophora gossypiella* (Saunders), for comparison. Note the different developments of the pinacula and different distances between setae D1 and SD1 on segments IX. Not all to the same scale.

in the soil. The thin brownish silken cocoon is normally spun within the cotton boll. The pupal period is from 10 to 20 days. The pupal skin remains within the cocoon after the moth emerges. The life cycle may be about 35 to 50 days.

The moths have secretive habits and are rarely seen in nature even in heavily infested fields. They rest during the day on or near the ground, among debris, under objects on the ground, and may even crawl beneath the surface of the soil. Their most active flight time is at dusk. They are rarely attracted to

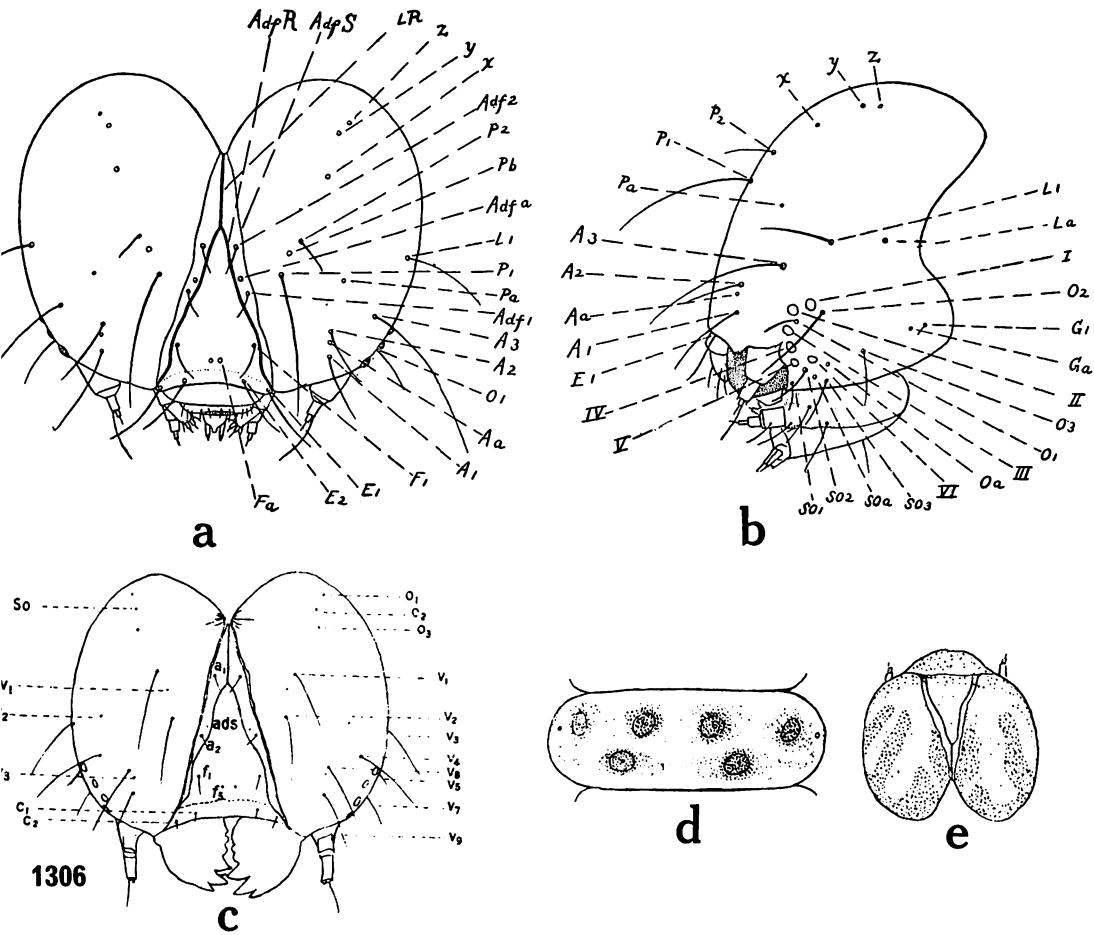


Figure 1306—Larval details of *Pectinophora*. a and b, frontal and lateral aspects of head of *Pectinophora gossypiella* (Saunders), mandibles omitted (after Busck, 1917, and with the Heinrich system of nomenclature; I have corrected the position of *La* on figure b to agree with Heinrich, 1921:809); c, d, e, *Pectinophora scutigera* (Holdaway): c, frontal view of the head with the Ripley modification of setal nomenclature; d, an abdominal tergite of a mature larva to show the areas of pink coloration in the living larva; e, head capsule showing color pattern (rearranged from Holdaway, 1926). See figure 64 for revised setal nomenclature.



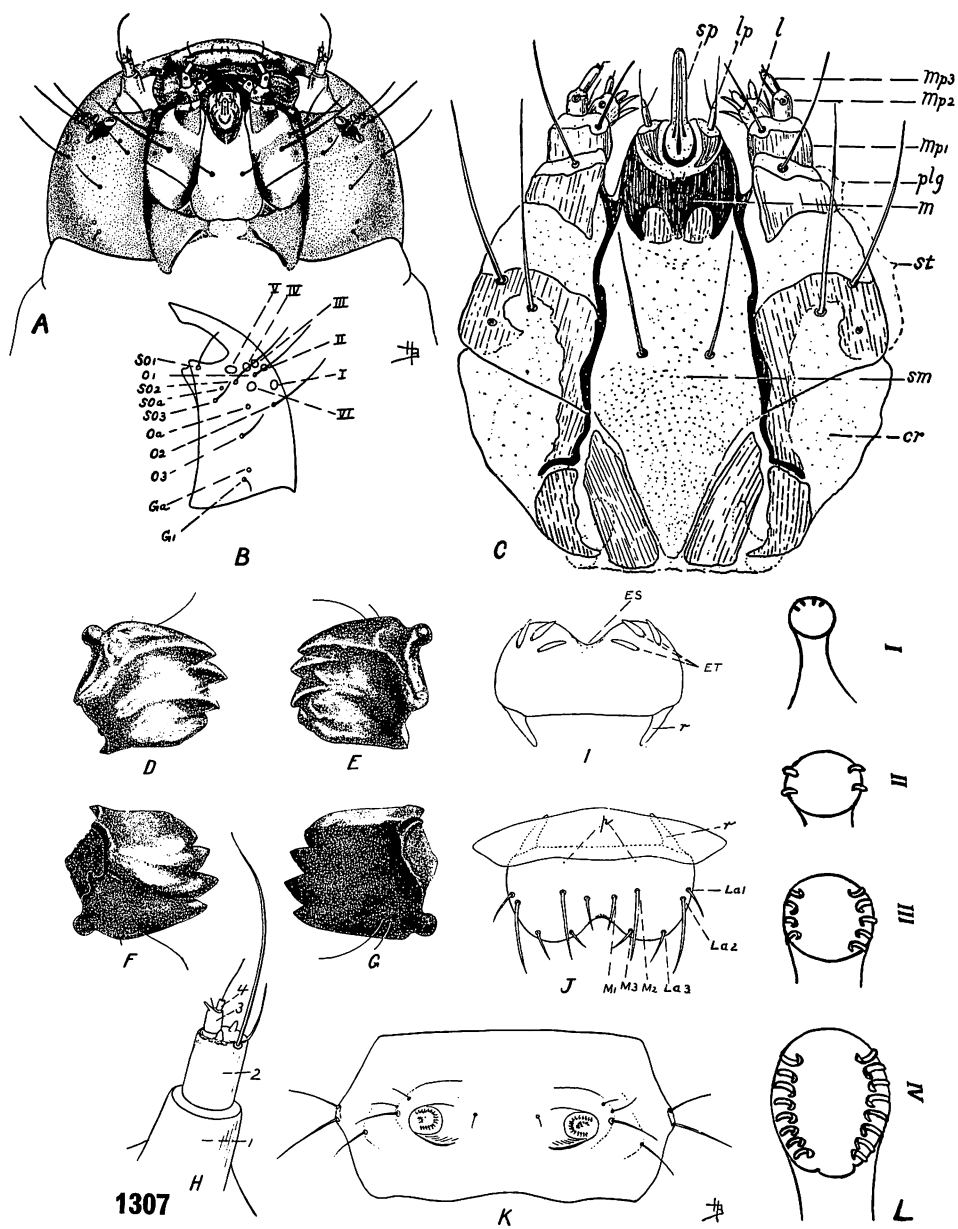


Figure 1307—See legend on page 1755.

ordinary light—strong kerosene and acetylene lamps, with white sheets as backgrounds, placed within 20 feet of heavily infested cotton fields failed to attract a single individual during many nights of trial.

Busck made extensive studies of hundreds of fruits of *Thespesia populnea* (“milo”), *Hibiscus tiliaceus* (“hau”), endemic Hawaiian *Hibiscus*, and some other possible hostplants in the Malvaceae. He claimed that he was not able to find any infestation of any plant in Hawaii except cotton, including the endemic *Gossypium tomentosum*. This contrasts with the reports of Fullaway, Willard, Swezey, and others who reported the rearing of this moth from *Thespesia*, various species of *Hibiscus*, and from the endemic *Hibiscadelphus*. Common (1958a:276) lists the native Australian *Hibiscus ficulneus* as a host. T. B. Fletcher (1921(1920):80) lists *Hibiscus abelmoschus* and *Abutilon indicum* as hosts in India and *Hibiscus esculentus*, *Hibiscus cannabinus*, and hollyhock (*Althaea*) in Egypt, but some incorrect identifications may be involved in his records. Willard studied the species in Hawaii in 1918, and, in 1927:1–2, he reported as follows:

Although Busck's observations in Hawaii . . . [in 1915] indicated that the pink bollworm was there confined to the genus *Gossypium*, and that Fullaway's record [1909:17] that he had reared it from milo, *Thespesia populnea*, was doubtful, it has since been shown that not only is *T. populnea* its food plant [this may be an error; see below] but that two other plants, *Hibiscadelphus hualalaiensis* [this is correct] and *Hibiscus youngianus* [I have not examined specimens from this host] are also its hosts in Hawaii. Bridwell . . . reported breeding *P. gossypiella* from *T. populnea* on a small island on the windward side of Oahu. Giffard . . . reared adult *P. gossypiella* in September 1917, from fruits of the native tree *Hibiscadelphus hualalaiensis* [this is correct] collected at Puuwaawaa, island of Hawaii. One adult was reared by Swezey . . . from a seed capsule of *Hibiscus youngianus*, collected at Waimalu, Oahu, in April, 1921, and three adults from fruits of the same plant, collected near Hilo, Hawaii, July, 1921.

During September, 1918, the writer made a study of *T. populnea* to determine its susceptibility to attack by *P. gossypiella*. From 34 pink bollworm eggs deposited by moths in confinement on pods of this tree, 4 adults were reared. The high mortality was probably due to starvation caused by the inability of the newly hatched larvae to tunnel through the shell of the pods, which became very hard and dry shortly after removal from the tree. An examination of 155 milo pods . . . gave the following results: Ten empty pupal shells, 2 living pupae, 4 mature larvae, and one half-grown larva of *P. gossypiella*. One pupa was killed during removal from the seed pod, but from the other pupa and the 4 mature larvae, 5 adults of the pink bollworm were reared. From 442 milo seed pods, collected in various localities on Oahu, 68 adult *P. gossypiella* were reared, together with various parasites. These records indicate that *T. populnea* is frequently used as a food plant by this moth. [Willard confused *scutigera* with *gossypiella*—it was *scutigera* that he reared from *Thespesia*. See discussion below.]

In Hawaii, as in many other parts of the world where cotton is grown, *P. gossypiella* is the most destructive cotton insect. Records were made of the average number of pink bollworms per boll in the various lots of cotton collected. Although these records were made both from green bolls and from those which had begun to open, the average infestation figures from large numbers is a good indication of the extent of attack. Occasionally a collection of bolls would be entirely free from infestation. Such collections, however, were

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Figure 1307—Details of *Pectinophora* larvae. *A* to *K*, *Pectinophora gossypiella* (Saunders) (rearranged from Busck, 1917). *A*, ventral aspect of head. *B*, lateral aspect of left side of head; ocelli labelled 1 to 6; *O*1 to *O*3, ocellar setae; *O*a, ocellar puncture; *SO*1, *SO*2, and *SO*3, subocellar setae; *SO*a, subocellar puncture; *G*1, genal seta; *G*a, genal puncture. *C*, ventral aspect of labium and maxillae; *Sp*, spinneret; *lp*, labial palpus; *l*, lacinia and galea; *m*, prementum; *sm*, postmentum; *cr*, cardo; *st*, stipes; *plg*, palpiger; *mp*1, *mp*2, *mp*3, first, second, and third segments of maxillary palpus. *D*, *E*, ventral aspect of right and left mandibles. *F*, *G*, dorsal aspect of right and left mandibles. *H*, ventral aspect of left antenna; segments numbered 1 to 4. *I*, epipharynx; *ES*, epipharyngeal shield; *ET*, epipharyngeal setae; *r*, epipharyngeal rod. *J*, labrum; *La*1, *La*2, *La*3, lateral labral setae; *M*1, *M*2, *M*3, medial labral setae; *p*, labral punctures; *r*, epipharyngeal rod. *K*, ventral aspect of third abdominal segment. *L*, *Pectinophora scutigera* (Holdaway), arrangements of the crochets on the mid-abdominal prolegs of each of the four larval instars (after Holdaway, 1929). Note the “double crescent” arrangement and compare figure *K* of *gossypiella* which has the crochets arranged in “horseshoe” patterns.

always made from a single plant, or a very small group of plants, which were in every case isolated from other cotton. The heaviest infestation was obtained from one lot of 22 bolls, collected at the experiment station in September, 1918. This lot contained 113 pink bollworm larvae, or an average of 5.1 larvae per boll. The total of 8,744 bolls, which were collected during 1918 and 1919, contained 12,985 caterpillars of *P. gossypiella*, an average of 1.5 per boll. While the average number of larvae per boll may seem small, it was difficult to find a well-developed boll not infested in most of the cotton patches visited. Parasitism did not reduce the infestation to a noticeable extent.

As noted in more detail under the discussion of *scutigera*, Willard did not realize that he had confused two species in his records. He reared both *gossypiella* and *scutigera*, but he understandably considered all of his specimens to be *gossypiella*. I have studied several of the specimens he reared from *Thespesia*, and they are *scutigera*. I have also examined a male specimen from the Giffard material cited by Willard as having been reared from *Hibiscadelphus hualalaiensis* and can confirm that it is *gossypiella*. I have not seen the specimens reared from *Thespesia* by Fullaway and recorded by him in 1909:17 so that I do not know which species of *Pectinophora* was involved.

Sometime between about 1850 and 1870, Hillebrand found the only two trees that he saw of the then very rare and now extinct *Kokia drynarioides lanceolata* (*Gossypium drynarioides* variety *B* of Hillebrand), the remarkable endemic red cotton tree. He reported (1888:51) that "the ripe seeds are mostly spoiled by worms, for in consequence of the imperfect dehiscence of the capsule they are retained an undue length of time." Could this have been our earliest record of *Pectinophora* in Hawaii? It is now probably impossible to tell, and the reference may apply to *Crociosema* tortricids. The record is, at least, one of the earliest of all references to damage by moth larvae in Hawaii. One could determine which moth was involved if the remains of larvae or pupae could be found in Hillebrand's herbarium specimens.

T. B. Fletcher (1921:80) said, "In the case of larvae feeding in stored cotton-seed, the larva usually attaches a second seed to the seed in which it is feeding and the presence of these double seeds is a sure sign of infection by this insect."

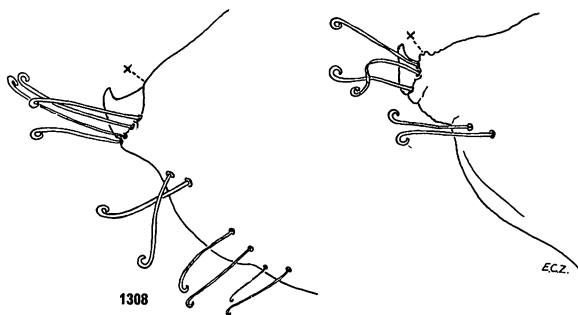


Figure 1308—Left, lateral aspect of the apices of the abdomens of the pupae of *Pectinophora gossypiella* (Saunders); Puuwaawaa, Hawaii; reared from *Hibiscadelphus* by Giffard. Right, *Pectinophora scutigera* (Holdaway); Honolulu; reared from *Thespesia populnea* by Willard. Compare the outlines marked "x" in the two figures. Only the hooked setae of the right side are shown. All short and long hairs and sharp-pointed setae are omitted. There is much variation in the numbers of setae; I have seen specimens of *gossypiella* with only three lateral setae where six are shown here.

Wellso and Adkisson (1962:233) described the female reproductive system and stated that more than 500 eggs may be contained in eight ovarioles.

For details regarding the early history of *Pectinophora* in Australia, see Tryon, 1924:353–361.

***Pectinophora scutigera*** (Holdaway) (figs. 1299, moth; 1301, 1302, 1303, male and female genitalia; 1305, 1306, 1307, larva; 1308, pupa).

*Platyedra scutigera* Holdaway, 1926:67, figs. 1–9, pl. 6, larva.

*Pectinophora scutigera* (Holdaway) Holdaway, 1929b:74; 1929a:179, figs. 1–8; 1929b (1928):74. Common, 1958a:276, figs. 2C, 2D, 3B, redescription.

The Queensland pink bollworm.

Oahu (and other islands?).

Immigrant. It was described from Australia. Prior to its recorded presence in Hawaii, it was known only from Australia, New Guinea, and, according to Common (1958:277), Micronesia. It is not known how long this species has been in Hawaii. It has at least been here for most of this century, although it has been confused with *gossypiella*. The first published record of its occurrence in Hawaii (Chilson, *Proc. Hawaiian Ent. Soc.* 16:185, 1957) originated from larvae that were found by plant quarantine inspectors in June, 1952, and August, 1955, in baggage and in cotton bolls originating in Hawaii. These larvae were determined as *scutigera* by H. W. Capps at the U.S. National Museum.

Hostplants: cotton (*Gossypium* species), *Hibiscus tiliaceus* (“hau”) *Thespesia populnea* (“milo”).

Parasites: not yet recorded in Hawaii but probably most of those listed above under *gossypiella*. Part of Willard's 1927 records of parasitism were based upon rearings from *scutigera* which he had confused with *gossypiella*.

The moth is externally so closely similar to *Pectinophora gossypiella* that it can be separated with certainty only by an examination of the genitalia. It has long been confused with *gossypiella* in Hawaii, just as it was in Australia until Holdaway proved it to be different. In 1909:17, Fullaway reported rearing *gossypiella* from *Thespesia populnea*, but his record was discredited by Busck (1917:358–359) who was unable to rear any *Pectinophora* from *Thespesia* or *Hibiscus* during his studies in Hawaii in 1915. It is probable, however, that Fullaway reared *scutigera* and not *gossypiella* from *Thespesia*. Willard (1927:1) reported that in 1918 he had reared numerous specimens of *gossypiella* from *Thespesia* (see my quotation from his report under *gossypiella* on p. 1755 above). Willard's records are, however, based upon misidentified specimens—he actually reared specimens of *scutigera*. Through the kindness of J. F. G. Clarke of the U.S. National Museum, I have been able to study Willard's 1918 Hawaiian material. I have determined that the specimens, without doubt, are *scutigera*.

In the early nineteen twenties, when efforts were being renewed to revive the cotton industry in Australia, pink bollworms were found attacking cotton in Queensland. Moths were sent to various world authorities, including Meyrick, Busck, and Turner. All agreed that the moths were the notorious cotton bollworm, *Pectinophora gossypiella*. Tryon (1924) reported that bollworm

larvae found in native *Hibiscus* in Queensland appeared to be different from larvae of "*Platyedra*" *gossypiella*. F. G. Holdaway, who later became professor of entomology at the University of Hawaii, studied larvae of the bollworms from cotton in Queensland. He found them to differ from descriptions of the larvae of *gossypiella* and to agree with larvae collected from the seed capsules of *Hibiscus tiliaceus* in Queensland. Holdaway was unable to find *Pectinophora gossypiella*, the true cotton bollworm, in Queensland, although it was present in Western and Northern Australia. He correctly concluded that the Queensland bollworm was a native insect which infested the common wild *Hibiscus* and *Thespesia* plants and had added cotton to its diet when cotton was planted in the area. Holdaway then described the Queensland species as "*Platyedra*" *scutigera* from larvae. Although he had reared and studied adults, he peculiarly did not designate any types. Later (1929a:184), Holdaway defended his having described the species from larvae by saying:

"The rules of zoological nomenclature contain no restrictions on the making of a new species from immature stages. It is nevertheless a procedure which is inadvisable as a general practice. However, cases do arise in which there is no doubt that different species are represented, even though the adults apparently defy distinction. The pink bollworm constituted such a case. It was therefore felt that the importance of the economic problems centring round this nice taxonomic point were such as to warrant the procedure of designating a new species from larval material. The types thus consist of larval skins, of which the holotype is lodged in the British Museum (Natural History), and paratypes in the Australian Commonwealth collection at Canberra, . . . and the U.S. National Museum. . . . Plesiotypes in the form of male genitalia mounts are also lodged in the collections of the above-mentioned institutions."

Common (1958a:276) reports that no such specimens have been found in the institutions mentioned by Holdaway. It thus appears that a neotype should be selected for *Pectinophora scutigera*.

Holdaway reacted to criticism of his description of *scutigera* from larvae. In 1929a he published his paper giving "Confirmatory Evidence of the Validity of the Species *Pectinophora scutigera*. . . . From a Study of the Genitalia" in which he demonstrated the genital differences between the species. He did the latter work while a research student at Cornell University where he studied with W. T. M. Forbes, who no doubt gave him much help with the problem. Holdaway reported on the bionomics of the species. He found that the moths can be bred easily in captivity and that up to 135 eggs were observed to be laid.

Practically all parts of the plant are liable to attack; squares, flowers, bolls in all stages, terminal shoots, boll pedicels, and even fairly woody stems [the first and second stage]. Larvae often seem to browse on the green tissues [of the outside of the bolls] before entering the bolls, and sometimes make several holes in a group without gaining entrance to the boll through any of them. On such occasions, small yellowish borings and frass are left near the point of attack. . . . The habits of larvae after entering bolls are varied. They may work round in the tissue of a carpel just below the outer surface, or in the central column, but they seem to turn their attention eventually to the seeds. When attacking the seeds they may work upwards from the first to the second seed, or they may cut through the partition and enter the adjoining lock to attack the seeds there.

Larvae of different ages, together with pupae, may occur in the same boll. . . .

In the latter part of February at Gladstone infestation of large bolls of annual cotton, three months old, was over 70 per cent., and at about the same time in stand-over cotton at Sand Hills it was 90 per cent., while at the end of season 1924-25, at Callide, it was only 1 per cent. These few figures are quoted to show the high percentage of infestation on the coast where cotton was infested directly from the primary host.

Pupae are often found in cotton bolls and in the seed capsules of *H. tiliaceus*, but whether these are the usual situations selected for pupation is not known. Pupation was commonly observed in ripening bolls in March and April 1924. However, there is definite evidence that large larvae sometimes leave the scene of their attack, and also that pupation sometimes takes place between the involucre and the boll. When

it takes place in the boll, a light cocoon is spun and the larva may pupate at the base of a lock, in the cracks which develop between the drying carpels, in damaged seeds, or in the lint. (Holdaway, 1926:75-77.)

Holdaway also said (p. 77), "The larva can live some time in the seeds and have been found in seed which has passed through the gins. Of a batch of larvae collected in the field on 2nd March, one was still alive in a seed on 20th October following—233 days later. Mr. Ballard has observed what appear to be a 'double-seed' formation similar to that produced by the larvae of *P. gossypiella*." This statement, however, contrasts with the studies by Sloan (Queensland Jour. Agr. Sci. 3:80-85, 1946) as reported by Common (1958a:275) who said:

The larvae . . . of *gossypiella*, . . . often enter a larval diapause within the cotton seed. This habit has been largely responsible for its accidental introduction in seed to new cotton-growing areas. In areas where *P. gossypiella* occurs, treatment of cotton seed by heat or by fumigation has therefore been uniform practice to prevent dispersal and establishment of this pest. In contrast to this, *P. scutigera* does not normally enter diapause within the seed for Sloan (1946) examined many thousands of cotton seeds at a ginnery in central Queensland, where it occurs as a minor pest of cotton, without finding any living larvae or pupae. The heat treatment of plant seed before distribution to growers in this area was therefore unnecessary. As there have been no authentic records of *P. gossypiella* from Queensland, it is essential that quarantine measures be maintained to prevent its entry from north-western Australia or from abroad.

### Tribe **ARISTOTELIINI** (Heslop), **new status**

*Aristoteliinae* Heslop, 1938:78.

#### Genus **MERIMNETRIA** Walsingham, **revised concept**

*Merimnetria* Walsingham, 1907b:482. Type-species: *Merimnetria flaviterminella* Walsingham, by original designation and monotypy.

*Merimnetria* has rested in obscurity since it was described from a single specimen and has remained unrecognized in Hawaii since it was first made known in 1907. I have, however, discovered that Dr. Swezey described a second species of typical *Merimnetria* as *Aristotelia straussiella*. There can be little doubt that other species of *Merimnetria sensu stricto* remain undiscovered in the Hawaiian forests.

*Merimnetria sensu stricto*, is an endemic Hawaiian derivative of what formerly has been wrongly called *Aristotelia* in Hawaiian literature. The Hawaiian species assigned to *Aristotelia* do not belong to that genus—they are basically like *Merimnetria* but less specialized. I had at first considered the two groups to represent different genera, but the similarity of their genitalia gave reason for indecision. Klaus Sattler, an expert with long experience with the Gelechiinae, believes that I would err if I separated the groups as genera. I have chosen to compromise and to divide the assemblage into two subgenera, *Merimnetria* and *Aristoteliodes*, new subgenus, as follows:

1. Forewings with 12 veins; hindwings with 8 veins; figure  
1309.....**Aristoteliodes.**
2. Forewings with 10 veins; hindwings with 7 veins; figure  
1338.....**Merimnetria.**

See color plate 8, figures 5-8.

The fact that the wing venation differs so distinctly would appear to justify separation of the groups as genera. However, the basic similarity of the genitalia and other features demonstrates their obvious close affinity. *Merimnetria* is only

an endemic group of *Aristoteliodes* with degenerate wing venation. We must await further collecting and study of more species to reveal whether or not there are forms intermediate between *Merimnetria* and *Aristoteliodes*. If such forms are found, then *Aristoteliodes* may be found redundant. Meanwhile, it is convenient to keep the groups separated by different names. The differences in habit, pupae and wing shapes may indicate that additional subdivision will be made by future workers.

Subgenus **ARISTOTELIODES**, new subgenus

*Aristotelia* in the sense of Walsingham, 1907b: 478, not of Hübner. Type-species: "*Aristotelia*" *nigriciliella* Walsingham.

This group, the progenitor of *Merimnetria sensu stricto*, has all veins present in both fore- and hindwings and has veins 7 and 8 stalked in the forewing, but *Merimnetria* has only ten veins in the forewings, seven veins in the hindwings, and neither the fore- nor the hindwings have any stalked veins. The genitalia are similar.

Resembling in general facies *Aristotelia sensu stricto*, but the male genitalia lack the uncus and gnathus. Compare figures 1318 and 1319 of the male genitalia of *Aristotelia decurtella* Hübner, the type-species of *Aristotelia*, with the figures of the Hawaiian species. In addition, the wings are not so sharply

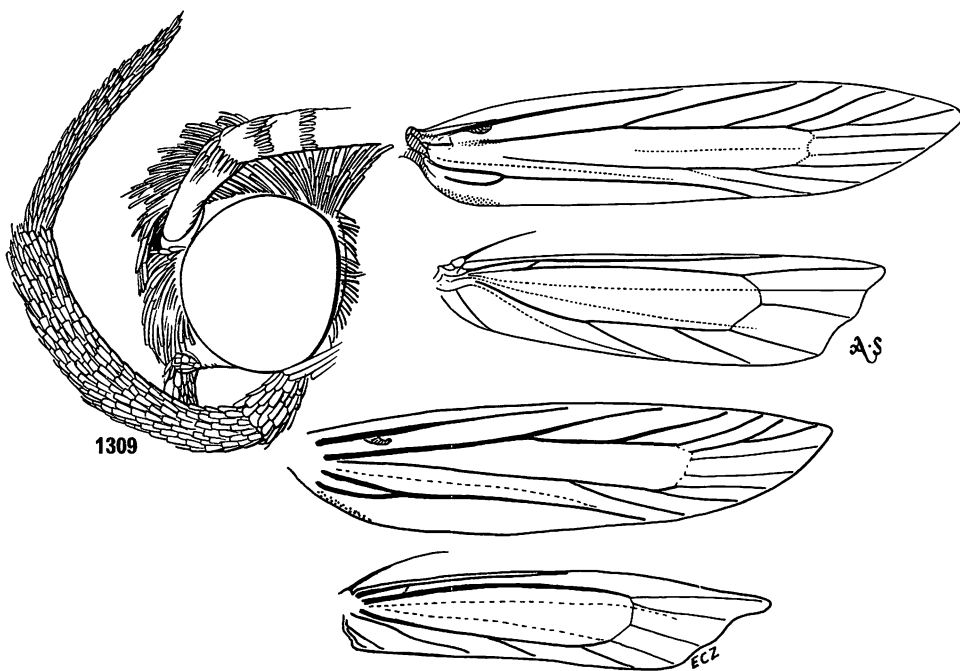


Figure 1309—Top, head and wing venation of *Merimnetria* (*Aristoteliodes*) *nigriciliella* (Walsingham), holotype (BM slide 4200), the type-species of *Aristoteliodes*; Kilauea, Hawaii. Bottom, wing venation of *Merimnetria* (*Aristoteliodes*) *thurifica* (Meyrick); Mt. Tantalus, Oahu (BM slide 15868). Note the crossvein between vein 8 and the cell in the hindwing in this group.

pointed as they are in *Aristotelia*. Head, palpi, genitalia, and wing venation are as illustrated. There may be a single bristle (rarely two) on the first antennal segment that represents a rudimentary pecten. However, it is usually obscure and is often absent. The condition is similar in *Aristotelia*.

The anal veins of the hindwings are not hairy (thus there are no vannal "pectens"). The ental side of the metascutum is clothed with broad squamae more or less similar to those on the metascutellum. However, at the ectal edge of the metascutum is a tuft (when not abraded) of long fine hairs, and these are often obliquely placed so that their apices extend across and caudad of the apex of the metascutellum.

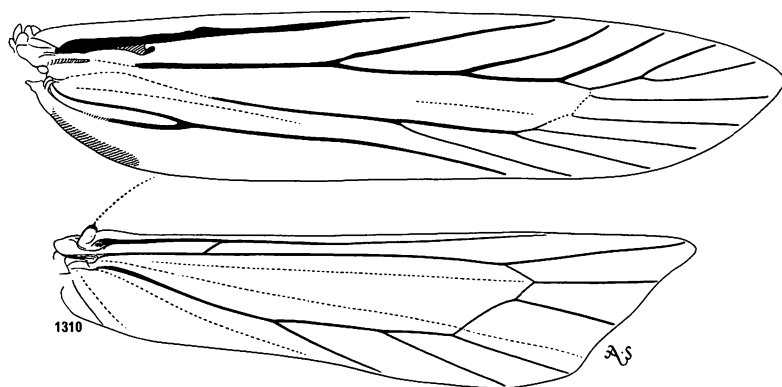


Figure 1310—Wing venation of *Merimnetria (Aristoteliodes) homoxyla* (Meyrick), paratype (Busck slide 157); Koolau Mts., Oahu.

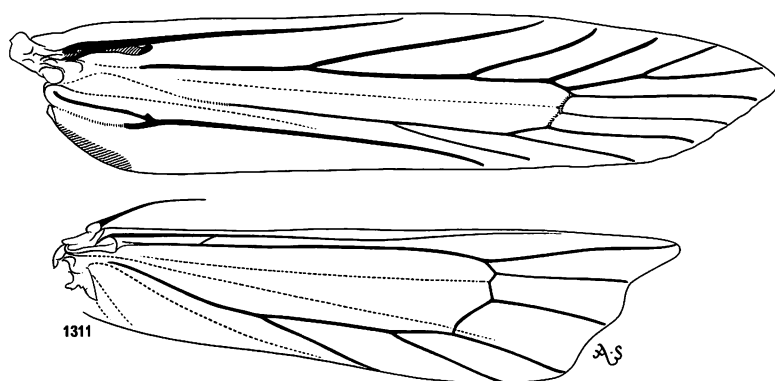


Figure 1311—*Merimnetria (Aristoteliodes) xylospila* (Meyrick), wing venation of a paratype (Busck slide 206); Mt. Kaala, Oahu.



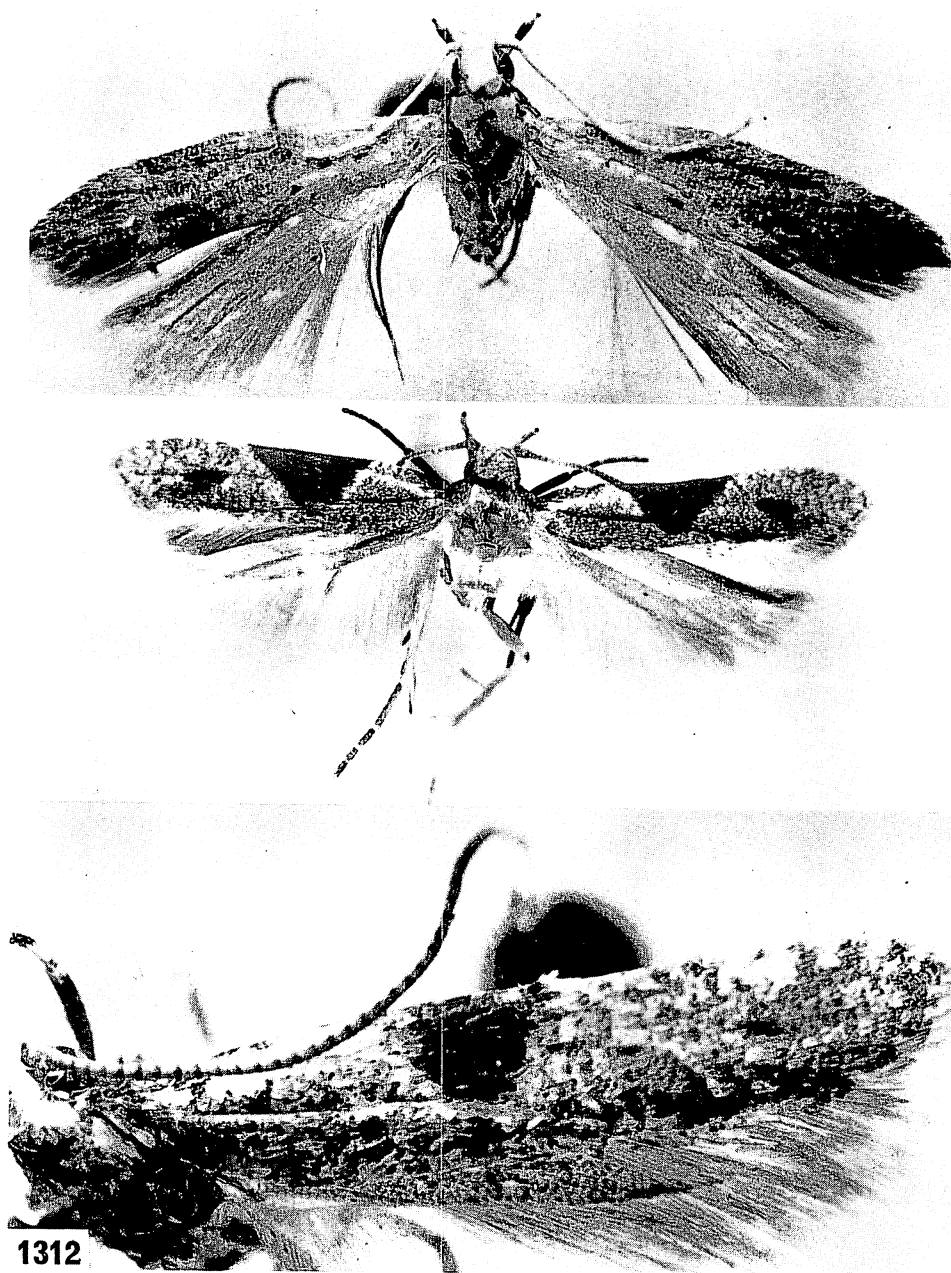


Figure 1312—*Merimnetria* (*Aristoteliodes*). Top, *arcuata* (Walsingham), male holotype (BM slide 4195); Waianae Mts., 3,000 feet, Oahu; expanse 11 mm. Middle, male holotype of *compsodelta* Meyrick; Mt. Tantalus, Oahu; ex *Hedyotis* fruit; expanse 11 mm (Busck slide 126). Bottom, *elegantior* (Walsingham), male holotype (BM slide 4201); near head of Kawailoa Gulch, Oahu; forewing=5.5 mm.

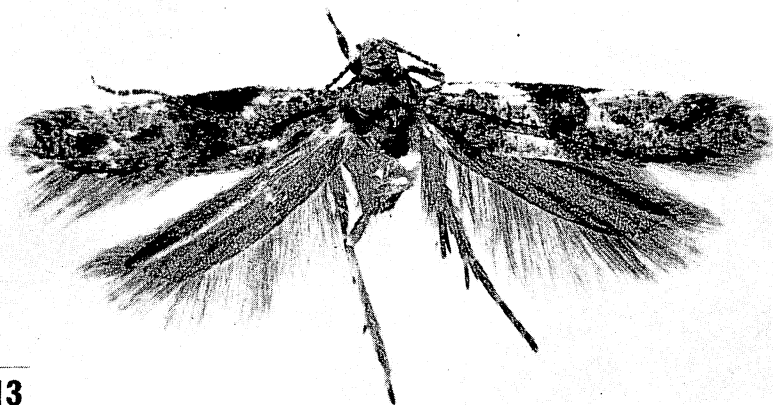
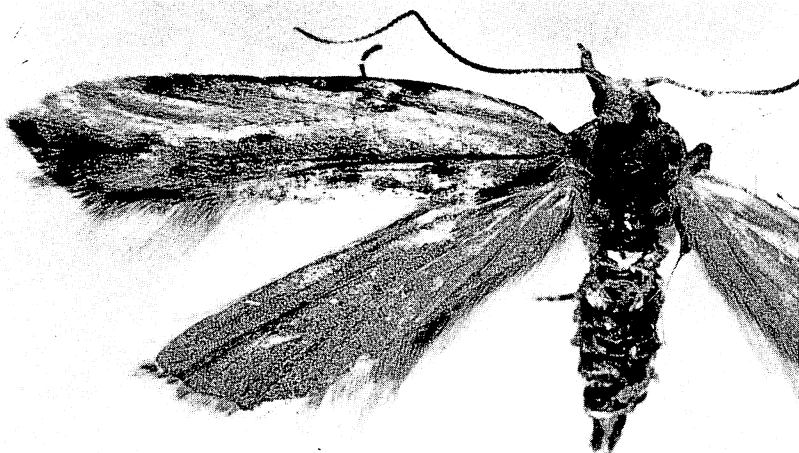
**1313**

Figure 1313—*Merimnetria* (*Aristoteliodes*). Top, female holotype of *epermeniella* (Walsingham); Kaholua-mano, 4,000 feet, Kauai; expanse 16.5 mm.; abdomen lost. Middle, *gigantea* (Swezey), holotype female; Kilauea, Hawaii; forewing=12.5 mm. Bottom, *gratula* (Meyrick), holotype female; Mt. Olympus, Oahu; ex *Psychotria* (= *Straussia*); expanse 11 mm.; abdomen lost.

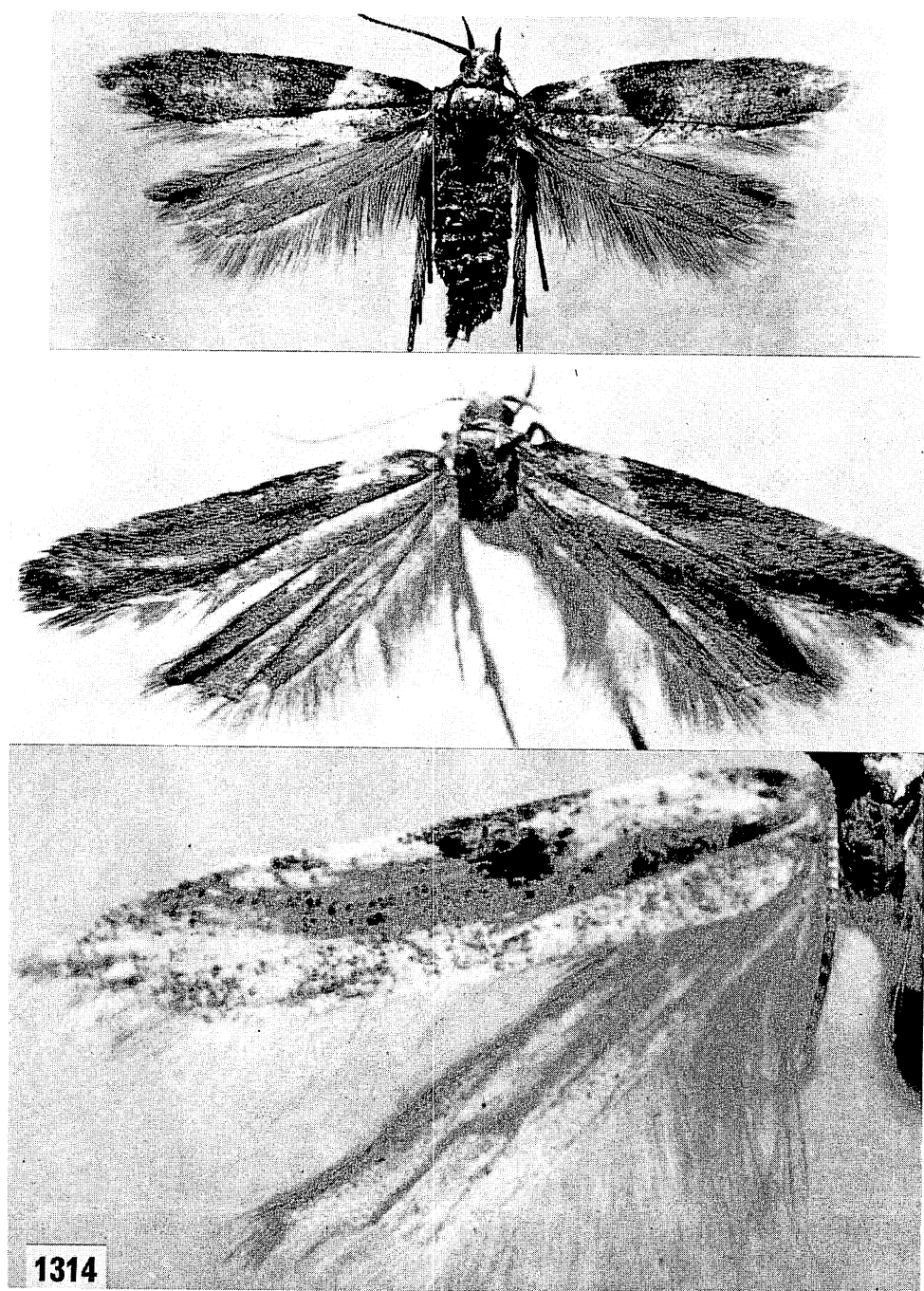


Figure 1314—*Merimnetria* (*Aristoteliodes*). Top, *homoxyla* (Meyrick), female paratype; Pacific Heights, Oahu; forewing=8 mm. Middle, *ichthyochroa* (Walsingham), holotype male (BM slide 4196); woods above Pelekunu, Molokai; expanse 16 mm. Bottom, *lanaiensis* (Walsingham), holotype male (BM slide 4198); Lanai, 2,000 feet; forewing =5 mm.

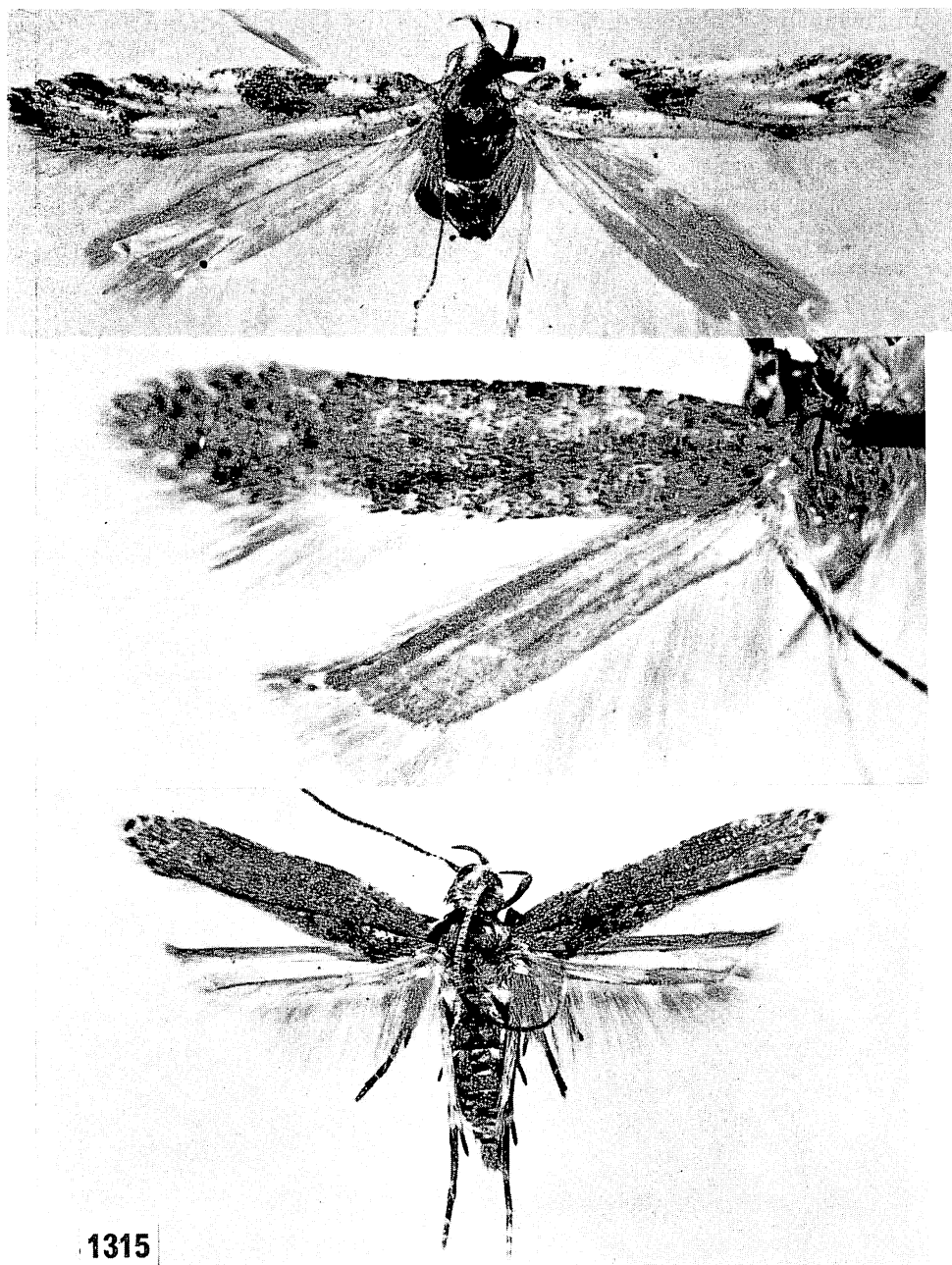


Figure 1315—*Merimnetria* (*Aristoteliodes*). Top, *maculaticornis* (Walsingham), holotype female (BM slide 4217); Kilauea, Hawaii; expanse 20 mm. Middle, *mendax* (Walsingham), holotype male (BM slide 4197); Kaholuamano, 4,000 feet, Kauai; forewing=5.5 mm. Bottom, *multiformis* (Meyrick), paratype; Pacific Heights, Oahu; forewing=6 mm.

In reviewing Walsingham's monograph of the Microlepidoptera in *Fauna Hawaiiensis*, Busck (1908a:136) had the following to say regarding Walsingham's treatment of what he called the Hawaiian *Aristotelia*:

One striking example of this need of structural figures is the genus *Aristotelia*, of which one is surprised to find that Lord Walsingham has retained the same abstract idea as in his West Indian paper of 10 years ago . . . , not withstanding subsequent revisional work in that group. With this originally monotypic genus, which has been limited by Meyrick and the writer to the species agreeing in venation with the type, *decurtella*, Hubner, Lord Walsingham continues to associate quite different forms. . . . In this genus, *Aristotelia* (Walsingham), figures of the venation, or at least a statement of it under each species, would have greatly facilitated a revision, which must in time take place, as even the coloured figures plainly show that the included species can not be congeneric.

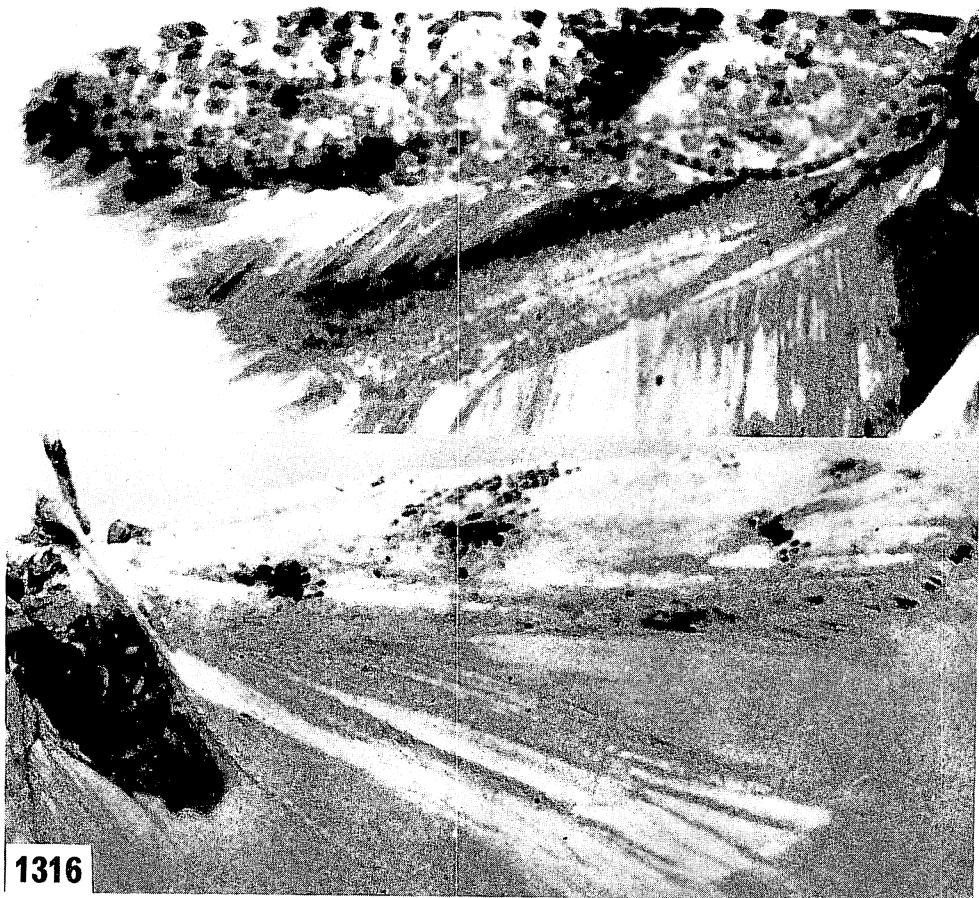
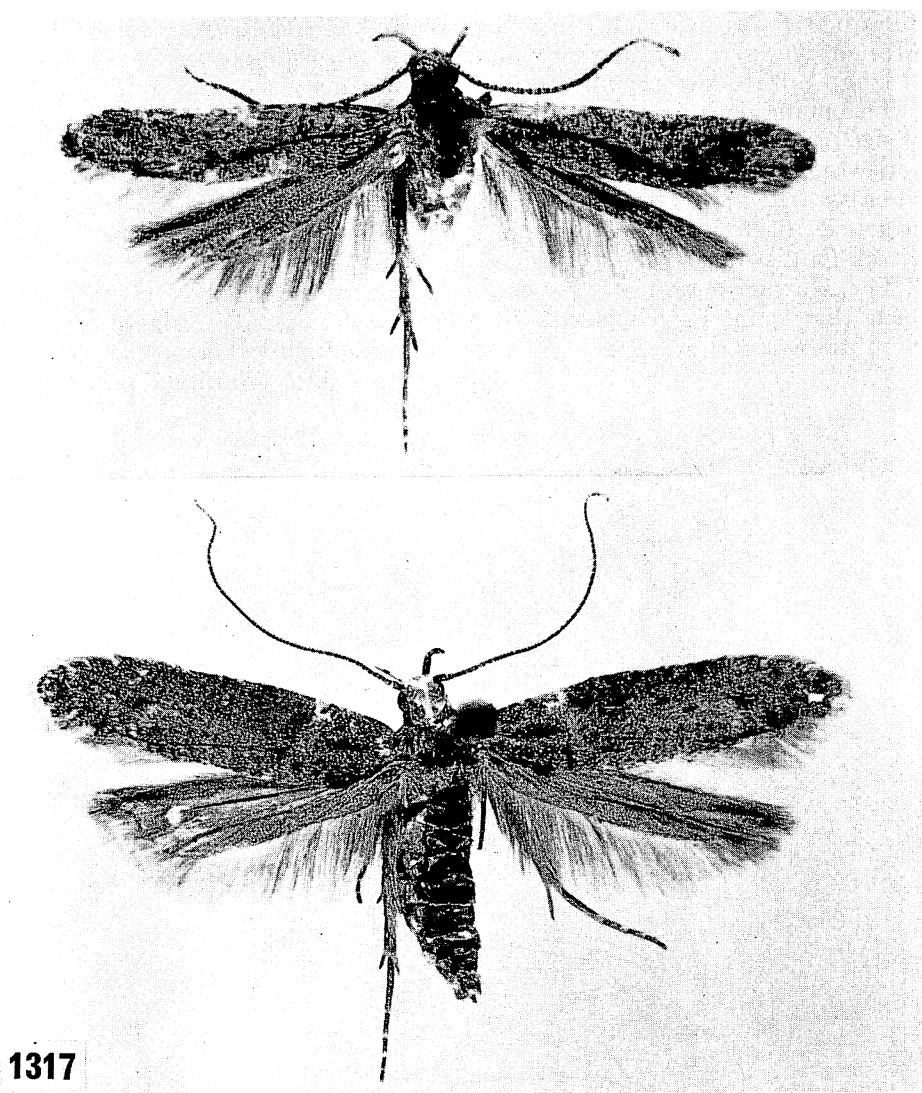


Figure 1316—*Merimnetria* (*Aristoteliodes*). Top, *nigriciliella* (Walsingham), holotype male (BM slide 4200); Kilauea, Hawaii; forewing=8.5 mm. Bottom, *notata* (Walsingham), holotype female (BM slide 4218); Molokai, over 3,000 feet; forewing=6 mm.

There are many closely allied species of *Aristoteliodes* in Hawaii. Numerous species no doubt remain to be discovered and described. Our knowledge of this taxonomically difficult group is poor, and the taxonomy continues to be confused. Few specimens of the described species have been collected, many of them are imperfect, the extent of variability is unknown, and working with



1317

Figure 1317—*Merimnetria* (*Aristoteliodes*). Top, *thurifica* (Meyrick), holotype; Palolo, Oahu, ex *Hedyotis* (= *Kadua*); expanse 9 mm; abdomen lost. Bottom, *xylospila* (Meyrick), holotype female; Mt. Kaala, Oahu, ex *Gouldia*; forewing=8.75 mm.



them under present conditions is difficult and discouraging. Clarification of some of the problems may be expected when the new collections made by Klaus and Edith Sattler are studied.

In 1937, in *Lepidopterorum Catalogus*, Gaede listed approximately 300 species in "*Aristotelia*". However, it is obvious that this assemblage is generically compound and in great need of revision. The Hawaiian group must be separated generically from the type-species of *Aristotelia*, and I am not aware of any described genus to which it may be assigned. *Aristoteliodes* is traceable to the African *Idiopteryx* Walsingham in Meyrick's world key in *Genera Insectorum* (1925*b*), but the two are obviously different genera.

The male genitalia of *Aristoteliodes* and *Merimnetria* closely resemble those of *Metzneria* Zeller, an Old World genus of considerable size, but the palpi and wing venation differ. In *Metzneria* vein 6 in the forewing arises from 7, whereas *Aristoteliodes* has vein 6 arising free from the cell. *Metzneria* are mostly attached to Compositae, but the species of *Aristoteliodes* (and *Merimnetria*) attack Rubiaceae.

The Hawaiian group is probably an endemic derivative of some Boreal form that gained early access to an ancient Hawaiian island and whose members lost certain of their genital structures during their insular evolution.

Text continued on page 1779.

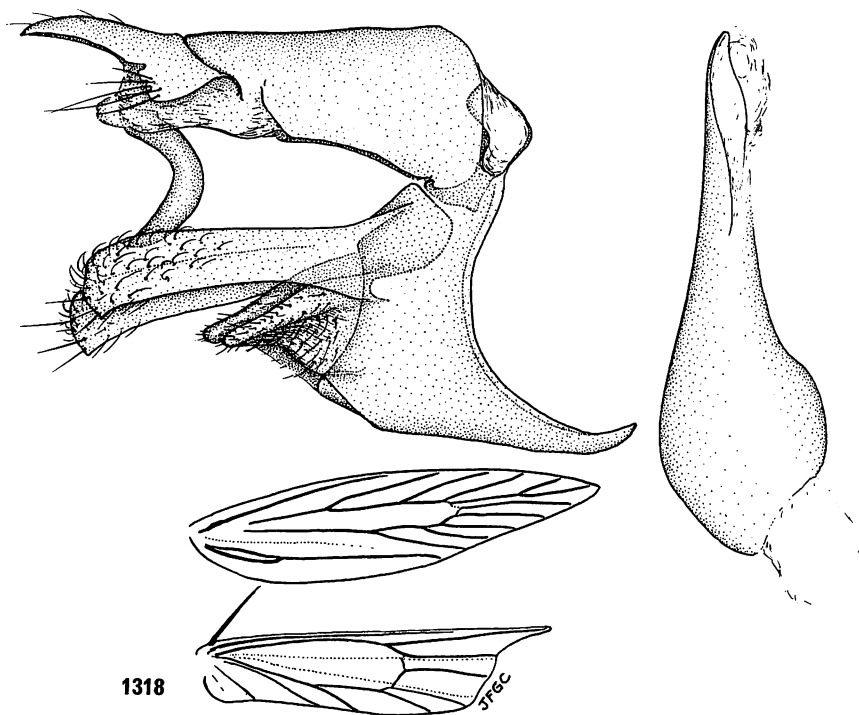
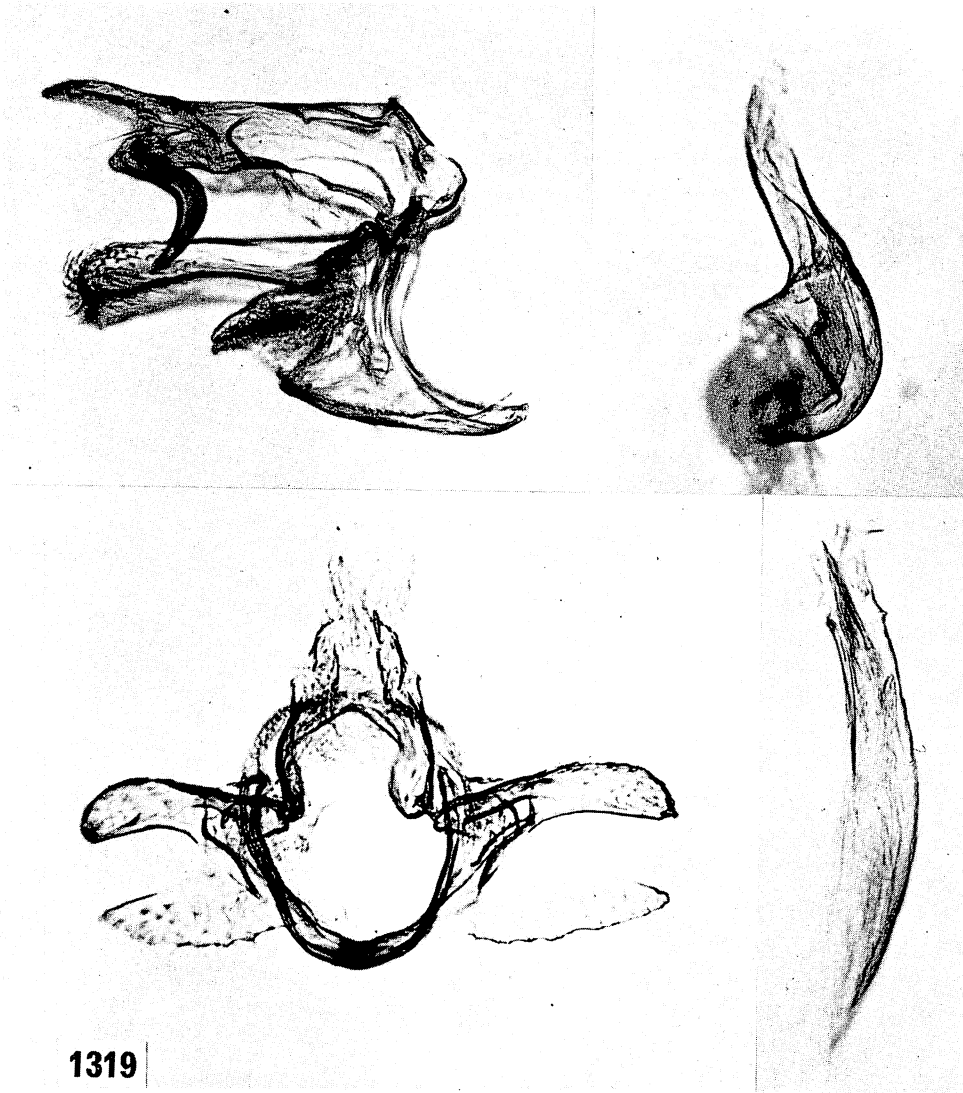


Figure 1318—Male genitalia and wing venation of *Aristotelia decurtella* Hübner, the type-species of *Aristotelia*; Europe. See also figure 1319.



1319

Figure 1319—Male genitalia of *Aristotelia* and *Merimnetria* (*Aristoteliodes*). Top, *Aristotelia decurtella* Hübner, the type-species of *Aristotelia*, in lateral view to show the well-developed uncus and gnathus; Europe (BM slide 1739); see also figure 1318. Bottom, *Merimnetria* (*Aristoteliodes*) *arcuata* (Walsingham), holotype (BM slide 4195); Waianae Mts., 3,000 feet, Oahu.



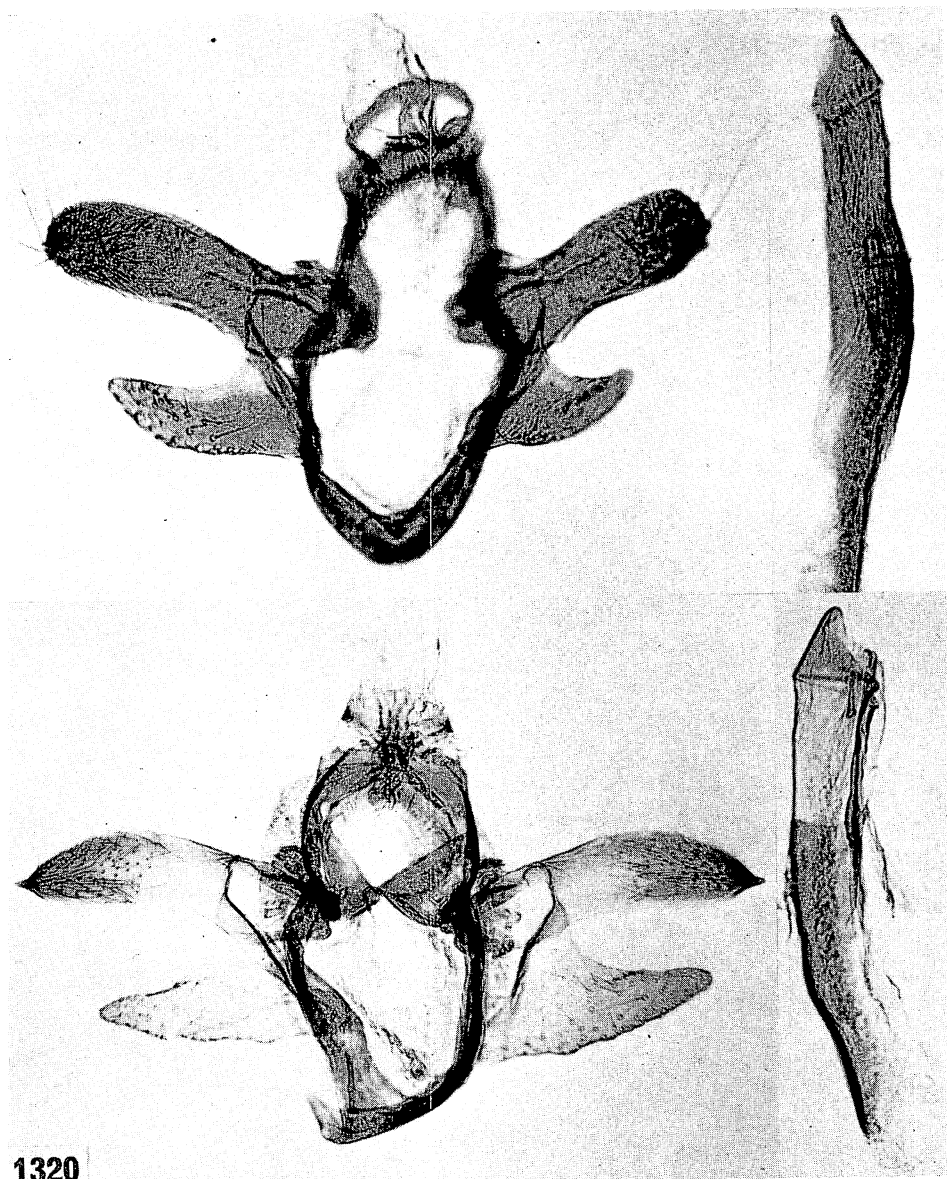
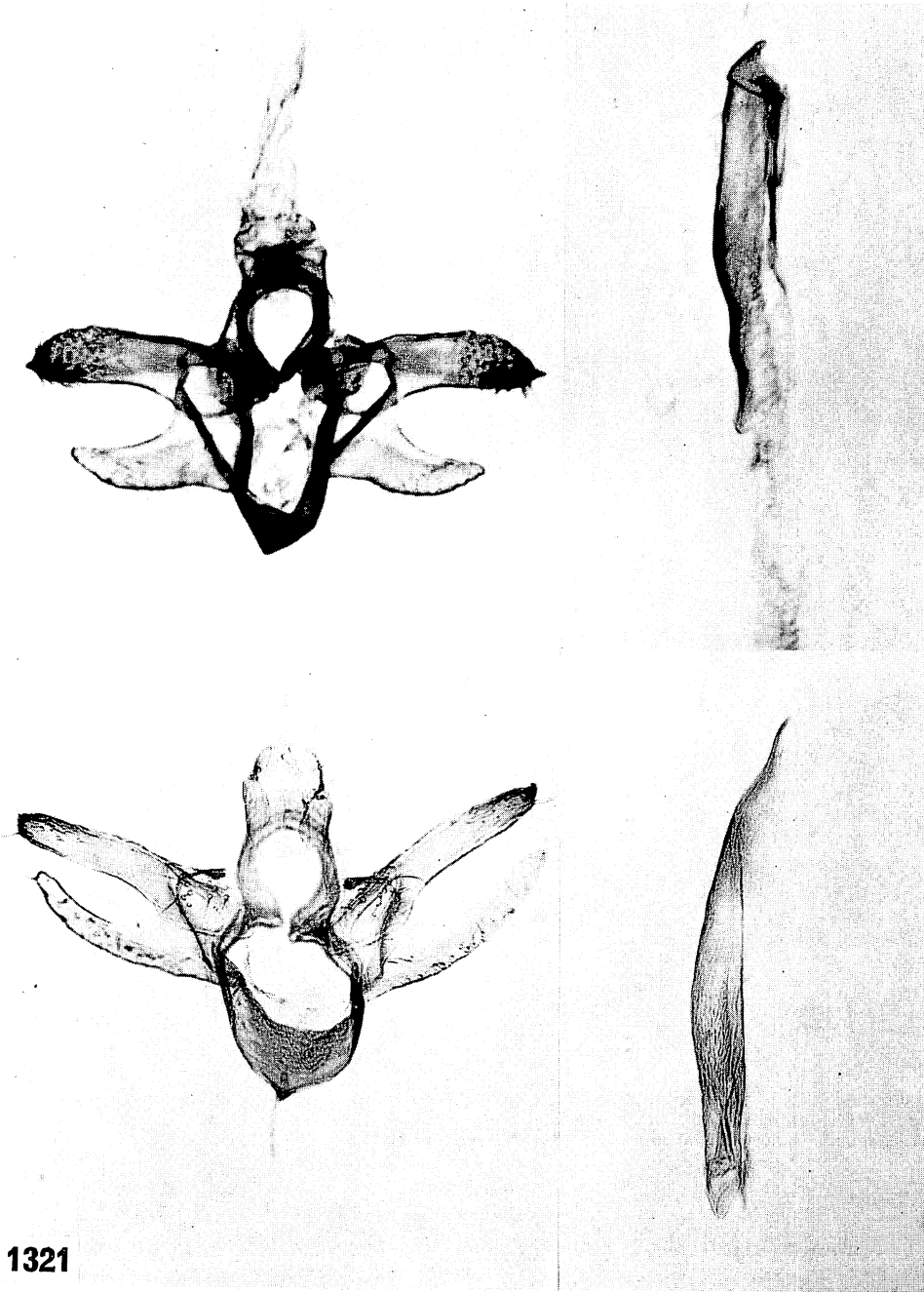
**1320**

Figure 1320—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, *compsodella* (Meyrick); Mt. Tantalus, Oahu (BM slide 5548). The valvae are in a "V" position on the slide and are somewhat foreshortened in the photograph. Bottom, *homoxyla* (Meyrick); Pauoa, Oahu (BM slide 15857).



1321

Figure 1321—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, *compsodella* (Meyrick); Mt. Tantalus, Oahu (BM slide 15858). Bottom, *mendax* (Walsingham); Kauai, 3,000 to 4,000 feet; paratype (BM slide 15892); aedeagus mounted in opposite direction to that of upper figure; compare figure 1323.

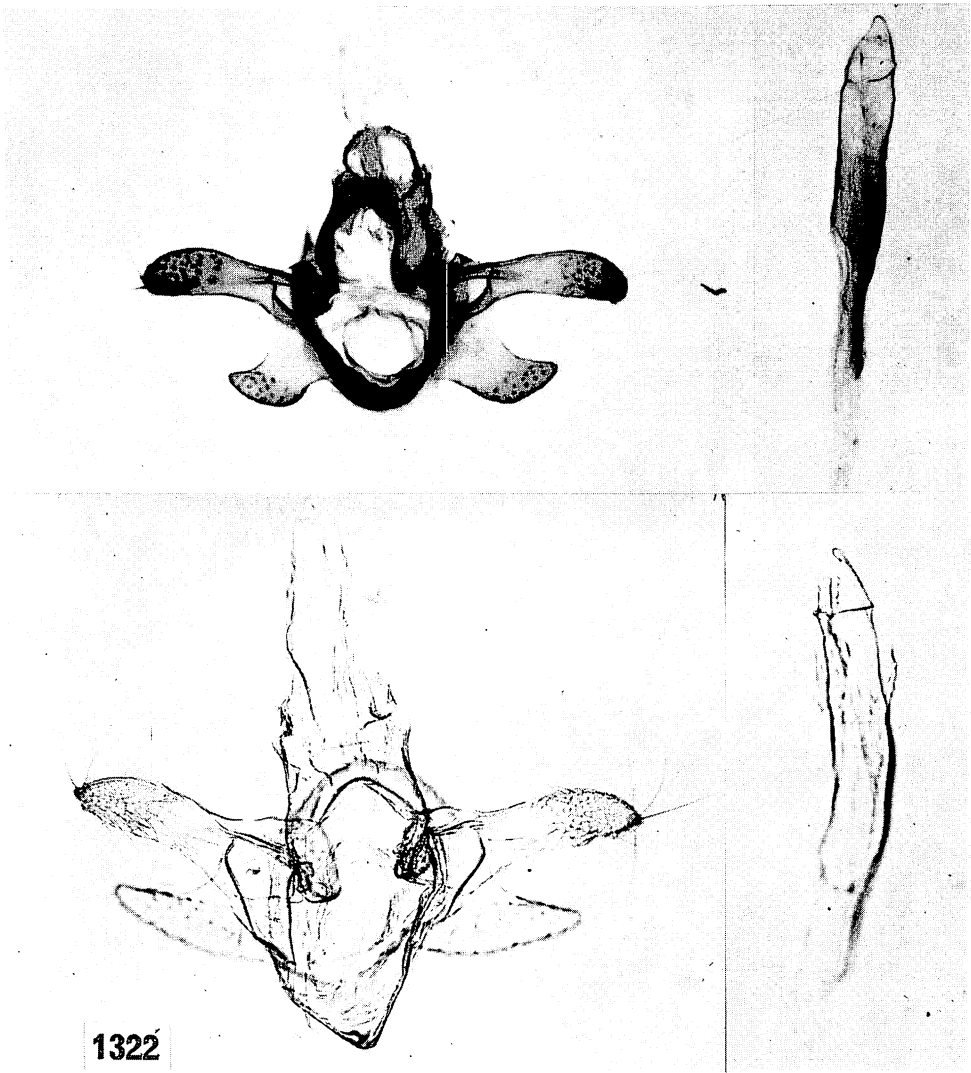


Figure 1322—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, *elegantior* (Walsingham), holotype (BM slide 4201); near head of Kawailoa Gulch, Oahu; see figure 1333 for lateral view. Bottom, *ichthyochroa* (Walsingham), holotype (BM slide 4196); above Pelekunu, Molokai.

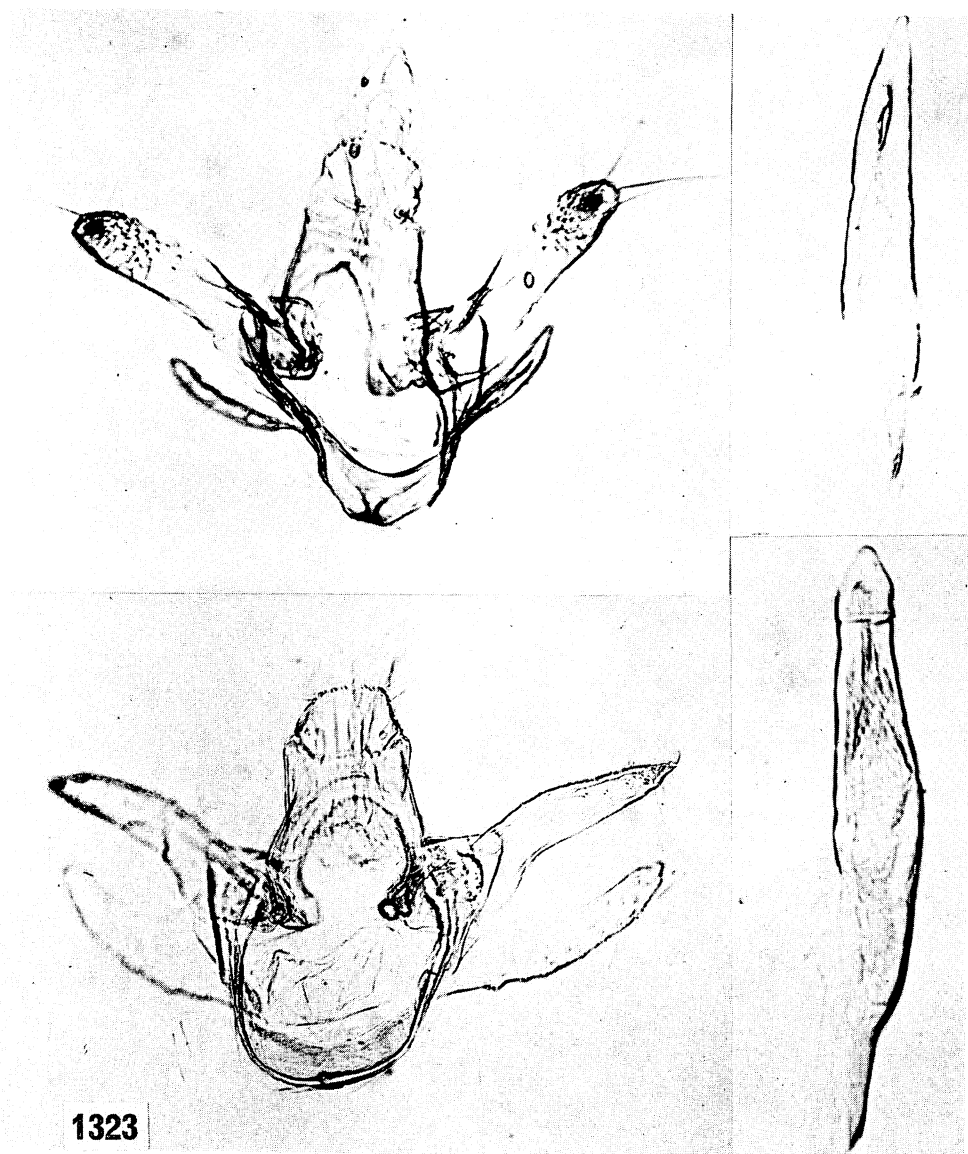


Figure 1323—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, *lanaiensis* (Walsingham), holotype (BM slide 4198); Lanai, 2,000 feet. Bottom, *mendax* (Walsingham), holotype (BM slide 4197); Kaholuamano, 4,000 feet, Kauai; compare figure 1321.

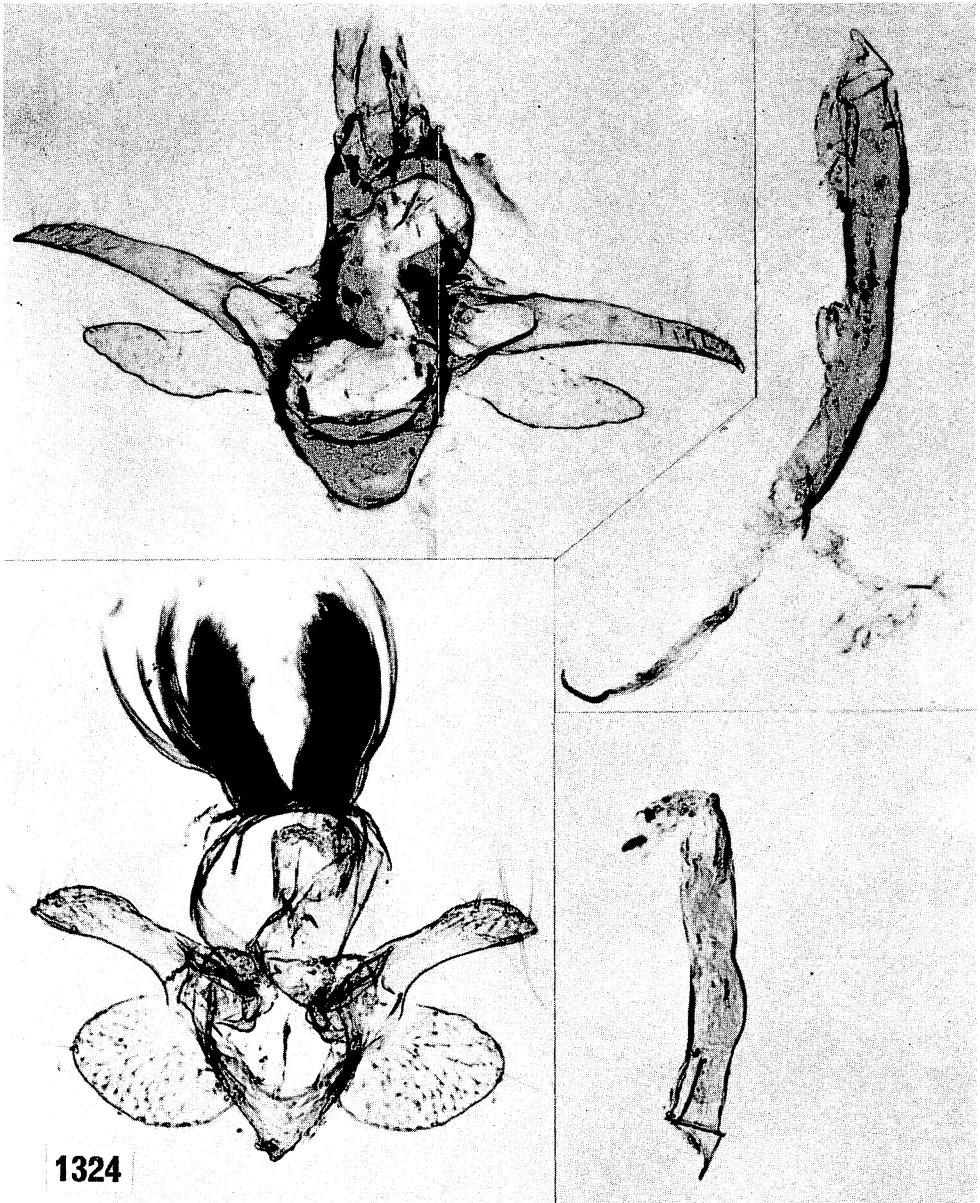


Figure 1324—Male genitalia of *Aristoteliodes* and *Merimnetria*. Top, *Merimnetria* (*Aristoteliodes*) *multiformis* (Meyrick), paratype (slide Z-XII-19-62-6); Pacific Heights, Oahu, ex *Gouldia*. Bottom, *Merimnetria* (*Merimnetria*) *strausiella* (Swezey), holotype (slide Z-XII-19-62-8); Mt. Tantalus, Oahu, ex *Psychotria kaduana*; aedeagus pictured upside down; compare figure 1325.

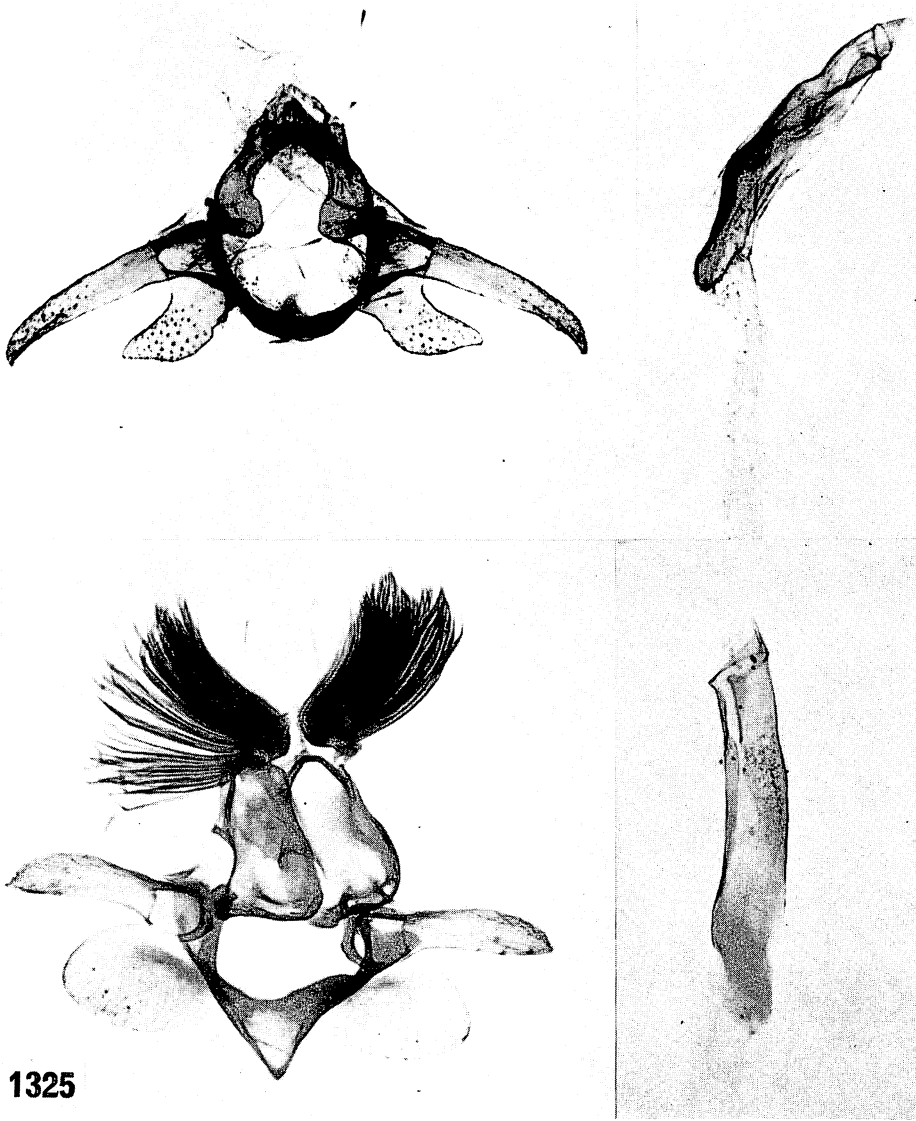


Figure 1325—Male genitalia of *Aristoteliodes* and *Merimnetria*. Top, *Merimnetria (Aristoteliodes) nigriciliella* (Walsingham), the type-species of *Merimnetria (Aristoteliodes)*; holotype (BM slide 4200); Kilauea, Hawaii. Bottom, *Merimnetria (Merimnetria) flaviterminella* Walsingham, the type-species of *Merimnetria*; holotype (BM slide 1859); Hilo, 2,000 feet, Hawaii.

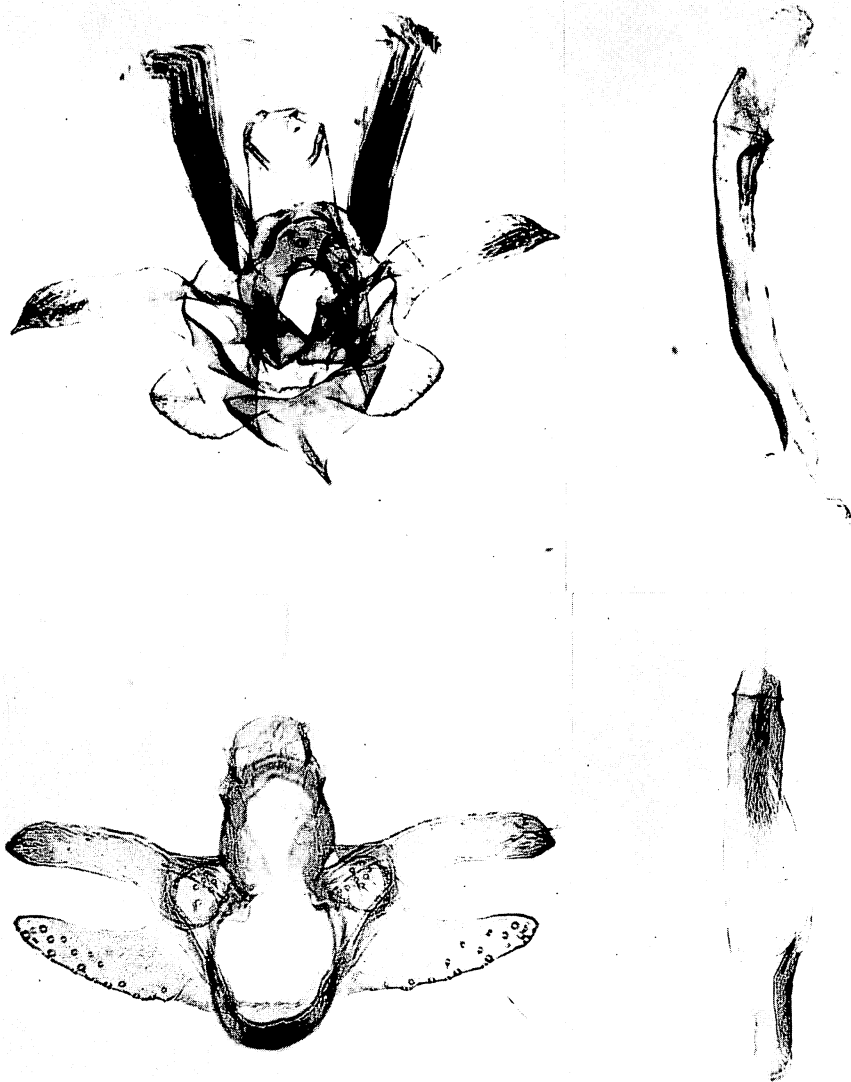
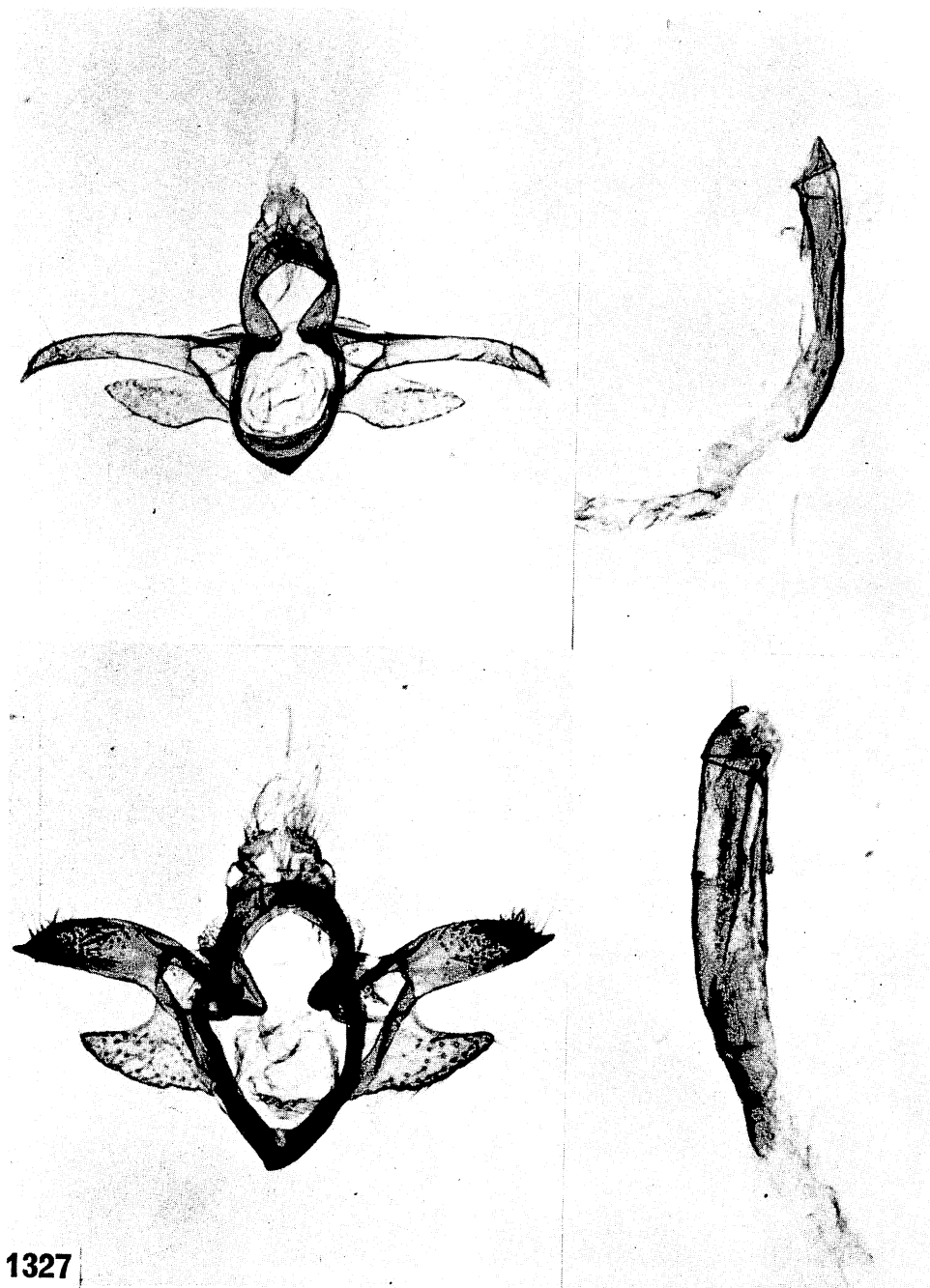
**1326**

Figure 1326—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, a specimen of new species 2 from the Walsingham collection collected by Blackburn, evidently on Maui, and wrongly named *nigriciliella* (BM slide 15882). Bottom, *thurifera* (Meyrick), an undesignated paratype from Mt. Tantalus, Oahu from Meyrick's collection (BM slide 15868).



1327

Figure 1327—Male genitalia of *Merimnetria* (*Aristoteliodes*). Top, new species 1 from the specimen labeled species 11 in the *Fauna Hawaiiensis* collection but not described; Molokai, above 3,000 feet (BM slide 15891; Walsingham specimen 26348). Bottom, *xylospila* (Meyrick); Mt. Kaala, Oahu; undesignated paratype in the Meyrick collection (BM slide 15866).



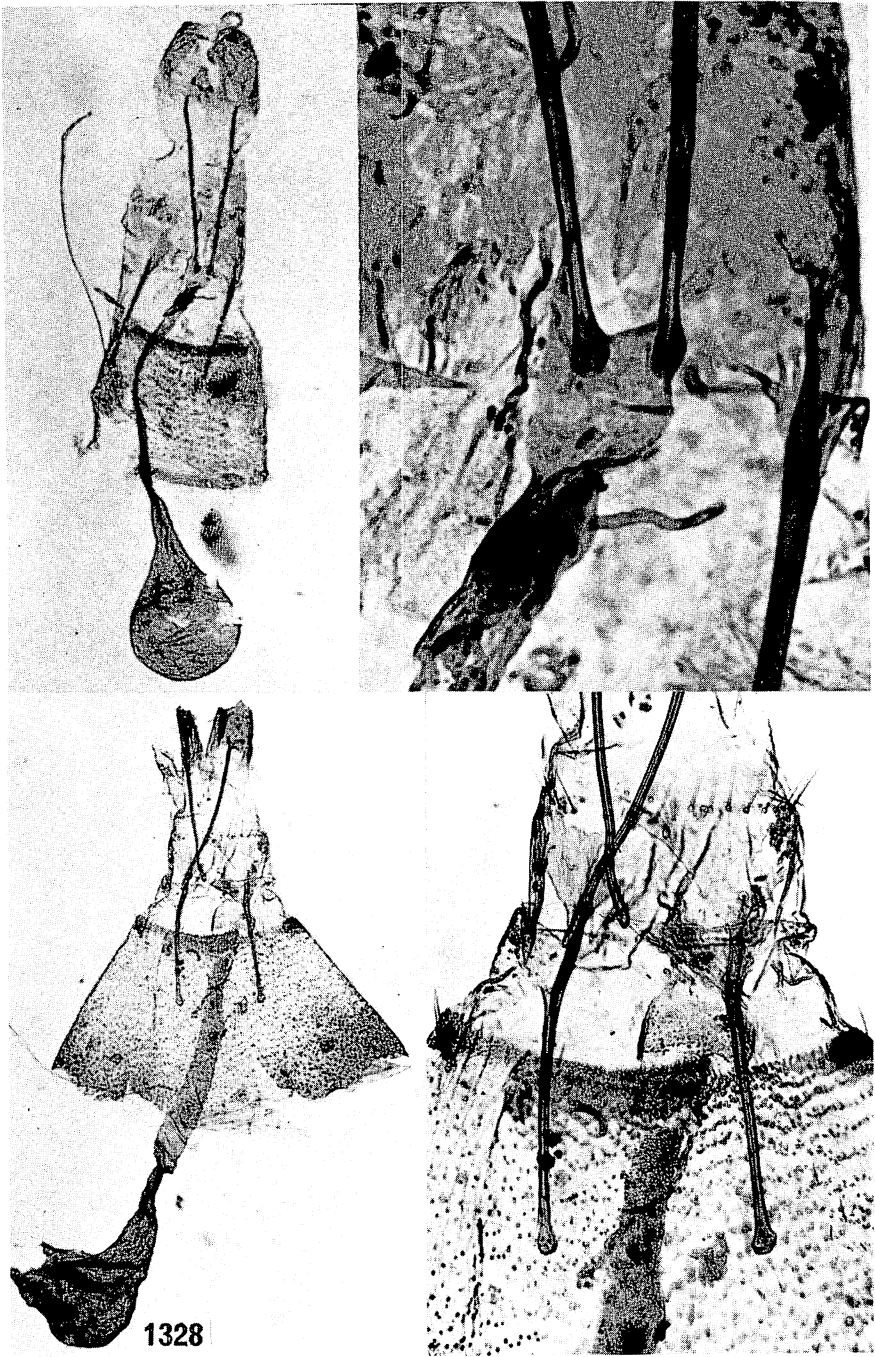


Figure 1328—Female genitalia of *Merimnetria* (*Aristoteliodes*). Top, *arcuata* (Walsingham); Kalihi, Oahu (slide Z-XII-19-62-13). Bottom, *homoxyla* (Meyrick); Lulumahu, Oahu, ex *Gouldia* (slide Z-XII-19-62-12). These specimens were determined by Dr. Swezey.

The recorded distribution of the species of *Aristoteliodes* indicates lack of collecting and does not reflect the true situation. The distribution by island as it is now known of the species is as follows:

Kauai (2 species)

*epermeniella* (Walsingham)

*mendax* (Walsingham)

Oahu (8 species)

*arcuata* (Walsingham)

*compsodelta* (Meyrick)

*elegantior* (Walsingham), + Hawaii?

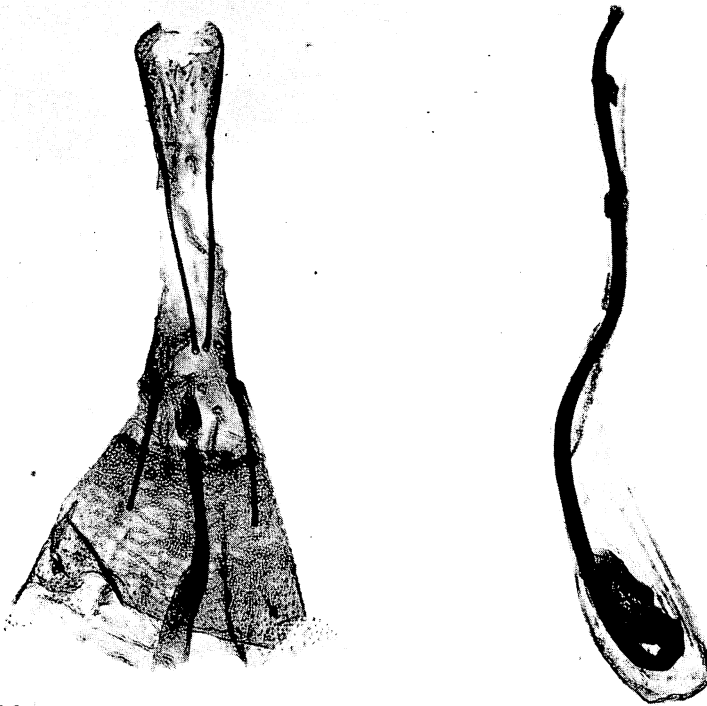
*gratula* (Meyrick)

*homoxyla* (Meyrick)

*multiformis* (Meyrick), + Hawaii?

*thurifica* (Meyrick)

*xylospila* (Meyrick)



1329

Figure 1329—Female genitalia of *Merimnetria* (*Aristoteliodes*) *compsodelta* (Meyrick); Mt. Tantalus, Oahu (BM slide 5528). Note the spermatophore in the separated bursa at right.

Molokai (3 species)  
*ichthyochroa* (Walsingham)  
*notata* (Walsingham)  
new species 1

Lanai (1 species)  
*lanaiensis* (Walsingham)

Maui (1 species)  
new species 2

Hawaii (6 species)  
*elegantior* (Walsingham)?, + Oahu (type)  
*gigantea* (Swezey)  
*maculaticornis* (Walsingham)  
*multiformis* (Meyrick)?, + Oahu (type)  
*nigriciliella* (Walsingham)  
new species 3

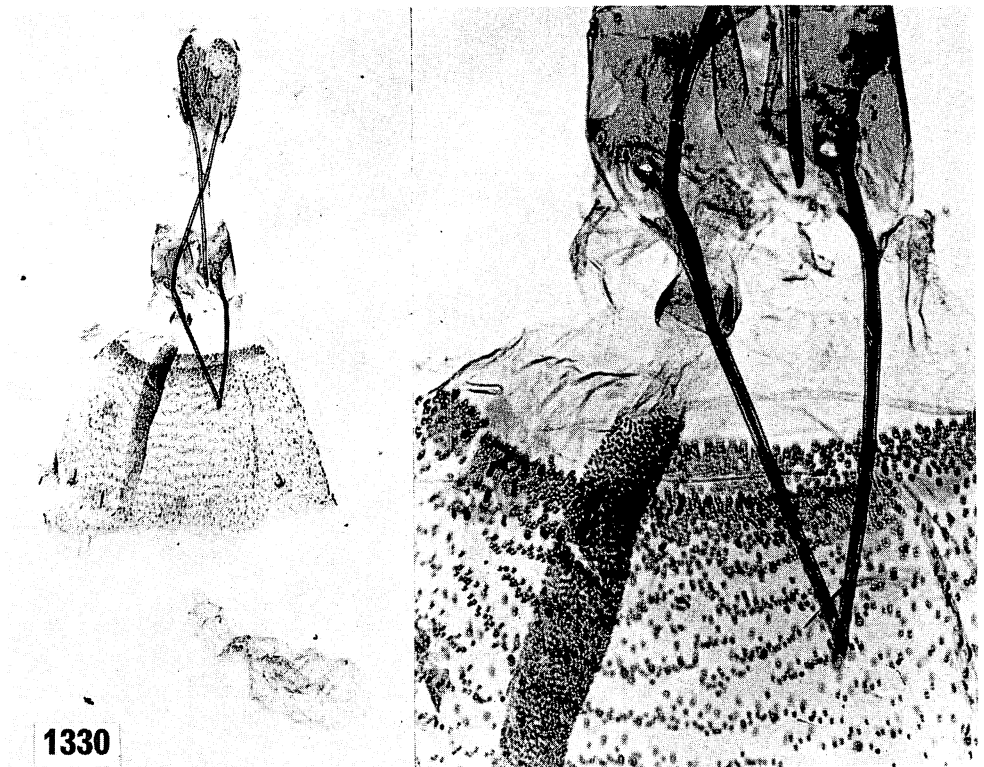


Figure 1330—Female genitalia of *Merimnetria* (*Aristoteliodes*) *elegantior* (Walsingham); Pauoa, Oahu (slide Z-XII-23-65). Determined by Dr. Swezey.

I cannot explain why so few species have been found outside of Oahu and Hawaii, but it must be only because of the lack of adequate collecting. There has, of course, been far more collecting done on Oahu than on any other island, and it is probably only a reflection of this fact that Oahu has more species recorded from it than any of the other islands.

The known hostplants of *Aristoteliodes* are three genera of Rubiaceae: *Gouldia*, *Hedyotis* (= *Kadua*), and *Psychotria* (= *Straussia*). The larvae of two species are known to form stem galls on *Gouldia* (*homoxyla*, *xylospila*). Two species are leaf miners in *Gouldia* (*arcuata*, *multiformis*). One mines the leaves of *Hedyotis* (*thurifica*), and one mines the leaves of *Psychotria* (*gratula*). Three allied species, *compsodelta*, *elegantior*, and *lanaiensis* feed on the fruits and seeds of *Gouldia* (*elegantior*, *lanaiensis*) and *Hedyotis* (*compsodelta*).

I have examined the pupal cases of four species of *Aristoteliodes* and have discovered major differences in them. In fact, the differences are so great that I would have expected that more than one genus is represented. The differences observed, moreover, are correlated with the kind of larval habit. Two of the species are known to be stem gall formers, and they have one type of pupal case. The other two species examined are leaf miners, and they have distinctly different pupal cases. The latter type is similar to that of *Merimnetria* (*Merimnetria*) *straussiella* which is also a leaf miner.

*Aristoteliodes homoxyla* and *xylospila* form stem galls on *Gouldia*. On their pupal cases the antenna- and wingsheaths reach, in the case of *homoxyla*, or slightly surpass, in the case of *xylospila*, the apex of the abdomen. On each side of the apex of the tenth abdominal segment, and meeting on the midline, there is a large padlike area of dense, recurved, hooked setae. These species lack a dorsal caudal protuberance.

In contrast to the two gall-forming species, *multiformis* is a leaf miner in *Gouldia*, and *thurifica* is a leaf miner in *Hedyotis*. On neither of these two species do the wingsheaths reach the apex of the abdomen nor do they have anything resembling the pads of dense, hooked setae on the tenth abdominal segments which are found on the gall-forming species. These two species have a dorsal caudal protuberance. Some additional details of these two groups of species are summarized as follows:

#### STEM-GALL-FORMING SPECIES

*homoxyla*. Wingsheaths densely microgranular, not pilose, extending to the apex of the abdomen and antennae a little longer. Tenth (caudal) abdominal segment usually with four long, hooked dorsal setae on each side (laterals and ventrals undetermined, perhaps variable) and apex with a large pad of many long, hooked setae on each side—these masses are closely approximated on the medial line and thus appear to form a sub-crescent-shaped caudal pad or mass.

*xylospila*. Wingsheaths densely microgranular, not pilose, extending to the apex of the abdomen and antennae of similar length. Tenth abdominal segment with four long, hooked, dorsal setae on each side, evidently with one lateral seta on each side and up to four similar ventrals, but evidently variable, and with a large caudal mat of many hooked setae on either side of the apex as on *homoxyla*.

## LEAF-MINING SPECIES

*multiformis*. Wingsheaths obviously pilose, extending to the apex of the sixth abdominal segment or on to the seventh. Antennae extending to the apex of the abdomen. Tenth abdominal segment with a prominent, upturned, hooked, middorsal, caudal process on each side of which there are two long hooked setae and below these there is a group of three similar long, hooked, lateral setae. The ventral setae are small.

*thurifica*. Wingsheaths rather indistinctly pilose, appearing minutely granular and extending to the apex of the seventh abdominal segment. Antennae extending to the apex of the abdomen. The tenth abdominal segment with a small, conical, upturned, medial process on each side of which there are two long hooked setae with three similar lateral setae on each side.

As noted above, these last two pupae share their basic characters with *Merimnetria* (*Merimnetria*) *straussiella*.

Text continued on page 1789.

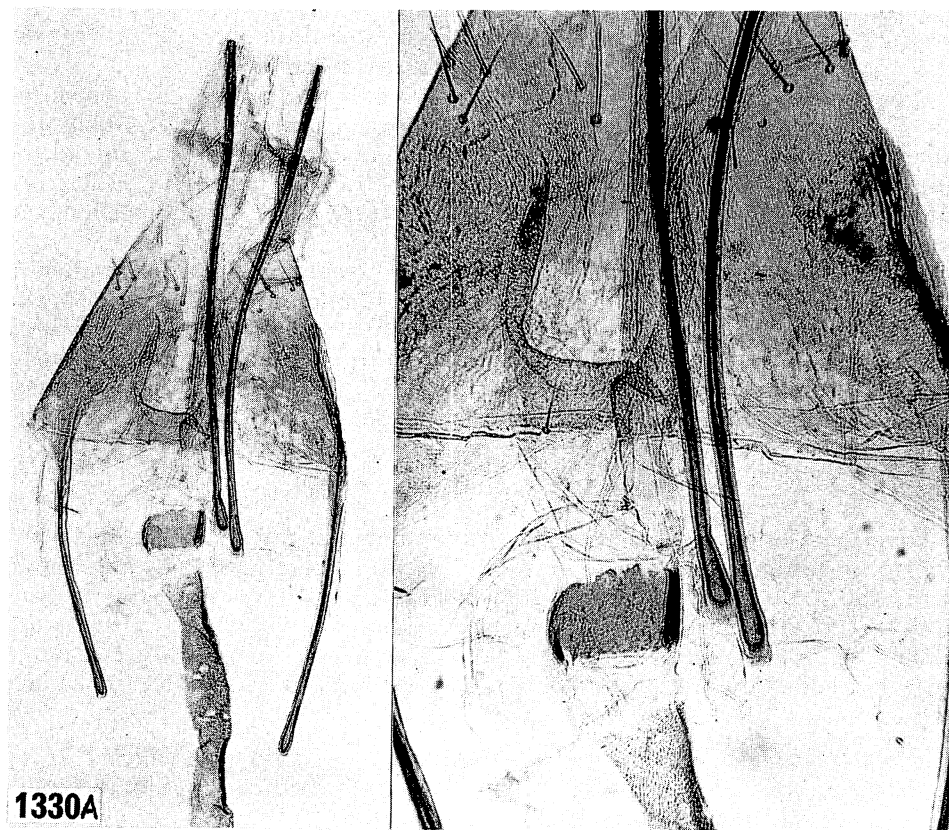


Figure 1330-A—Female genitalia of *Merimnetria* (*Aristoteliodes*) *gigantea* (Swezey); Kilauea, Hawaii; holotype (BM slide Sattler 707). The apical part of the ovipositor has been lost.

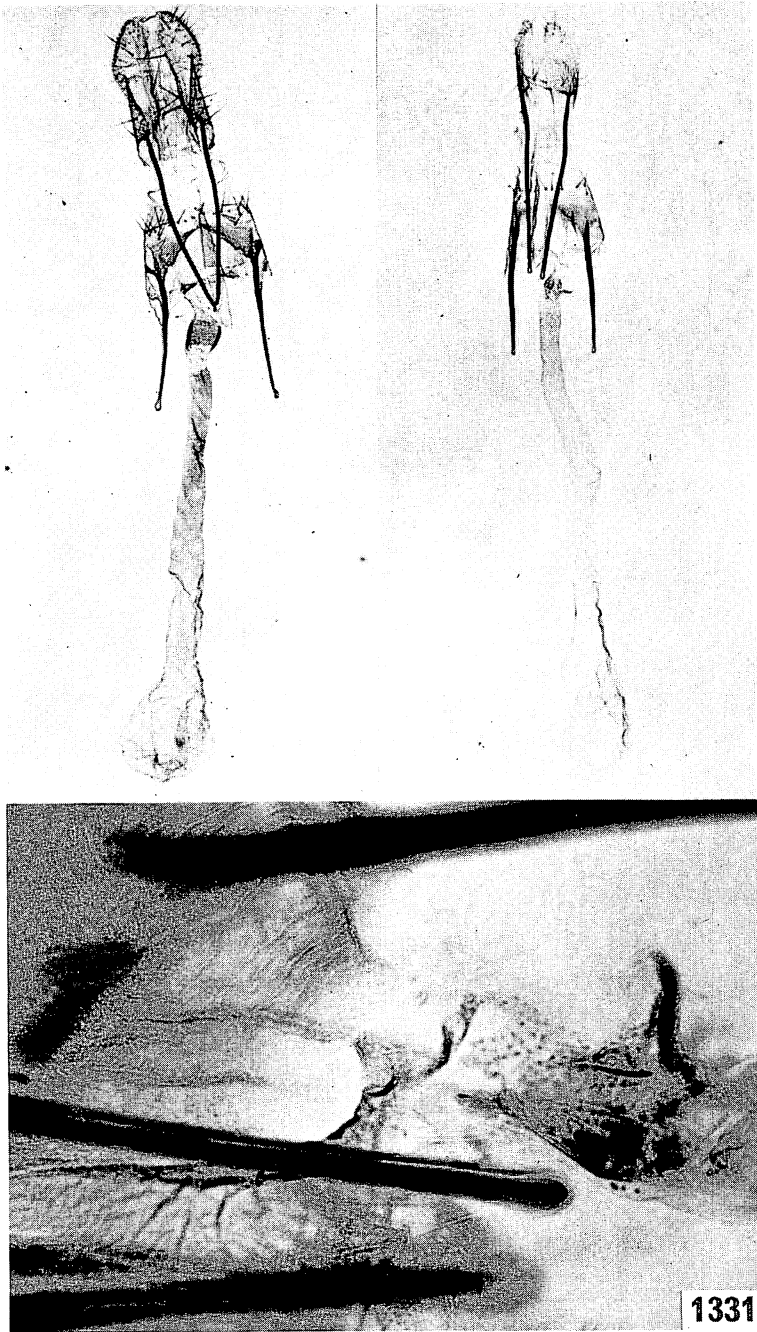


Figure 1331—Female genitalia of *Merimnetria* (*Aristoteliodes*). Top left, *homoxyla* (Meyrick); Kaumuahona, Oahu (BM slide 15856). Top, right and bottom, *mendax* (Walsingham); Halemanu, 4,000 feet, Kauai, paratype (BM slide 15890). The bottom figure is an enlargement of the ostium and basal sclerotization of the ductus bursae.

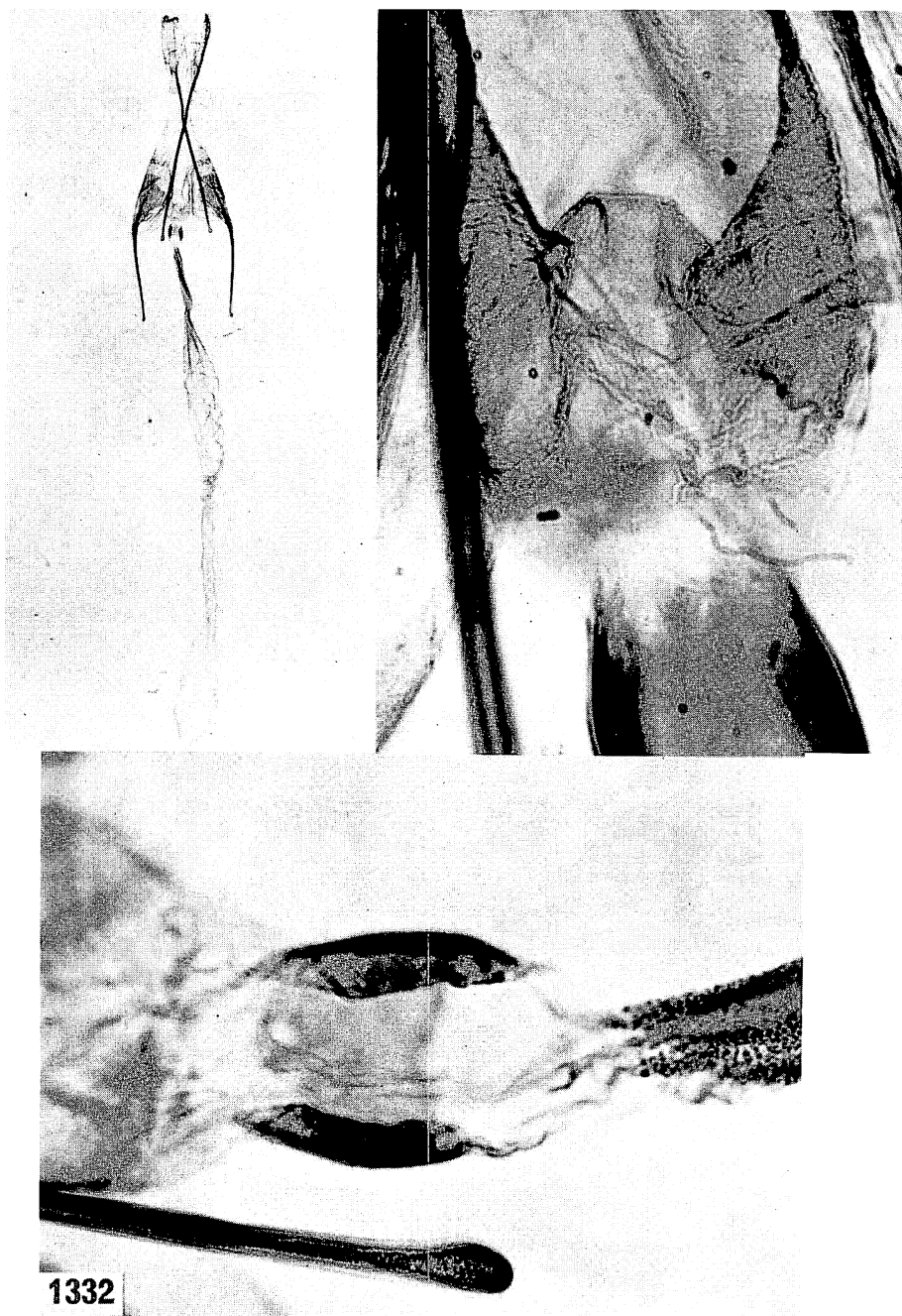


Figure 1332—Female genitalia of *Merimnetria* (*Aristoteliodes*) *nigriliella* (Walsingham); Kilauea, Hawaii; allotype (BM slide 15823). At top right and at bottom are enlargements of the ostium and basal sclerotizations of the ductus bursae.



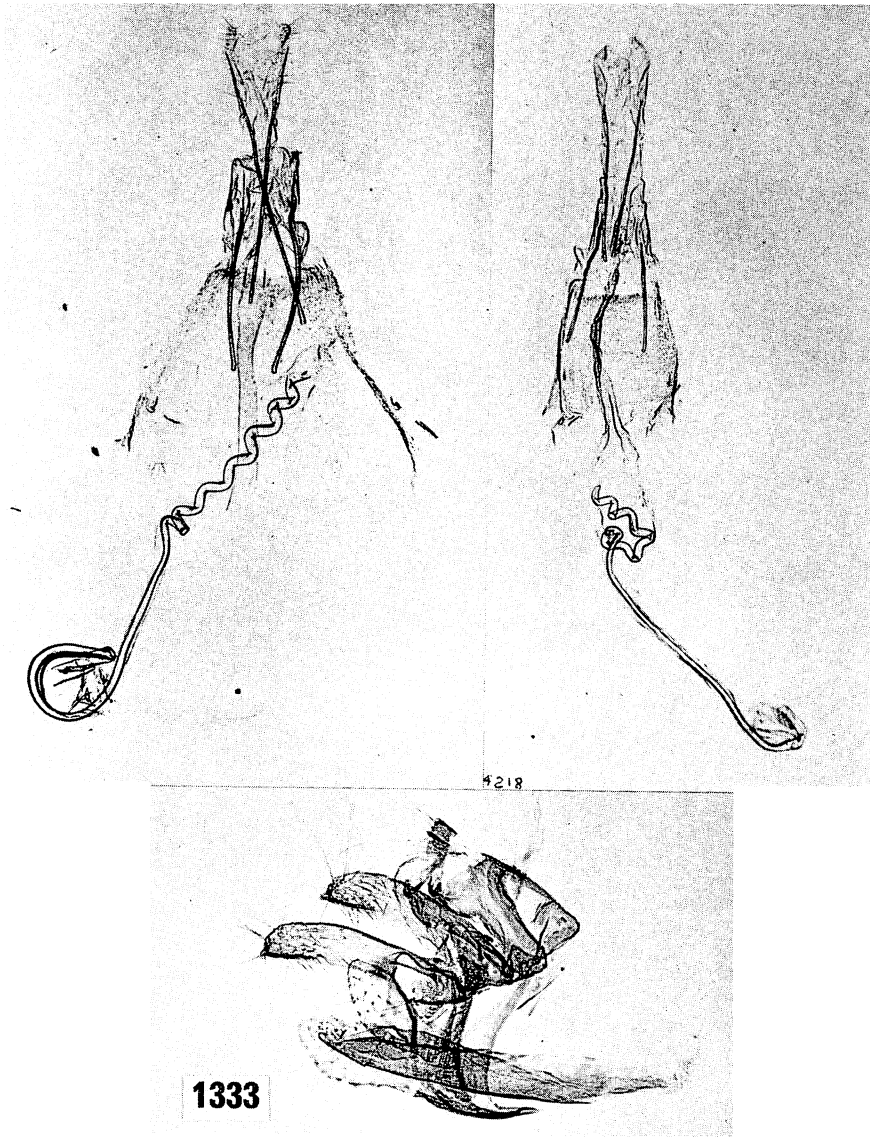


Figure 1333—Genitalia of *Merimnetria* (*Aristoteliodes*). Top left, *maculaticornis* (Walsingham), female holotype (BM slide 4217); Kilauea, Hawaii. Top right, *notata* (Walsingham), female holotype (BM slide 4218); Molokai, above 3,000 feet. These two female abdomens were partly decomposed. Note the spermatophore in each bursa copulatrix. Bottom, lateral aspect of the male genitalia of *elegantior* (Walsingham), determined by Dr. Swezey (Busck slide 125); Oahu, ex *Gouldia* fruit; see figure 1322 for a caudal view of the spread genitalia.



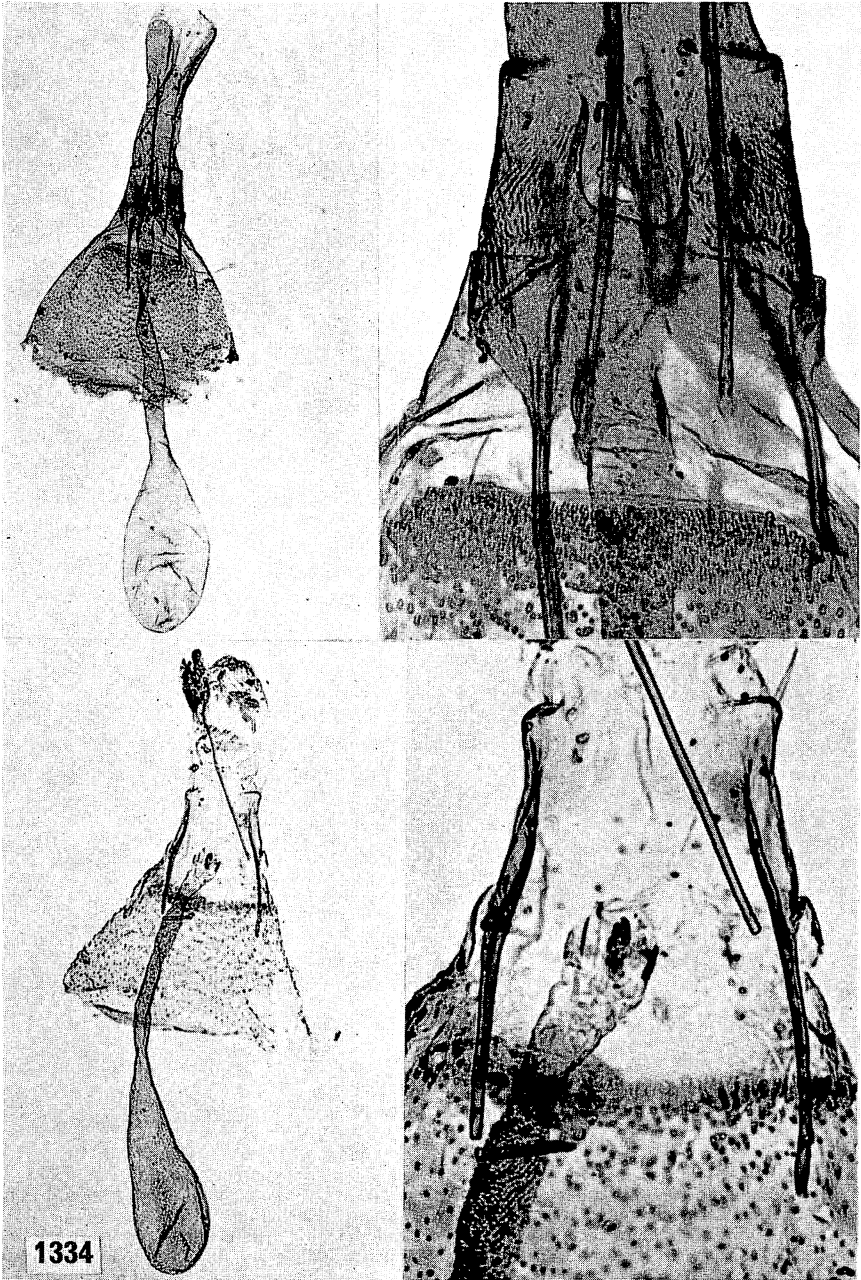


Figure 1334—Female genitalia of *Merimnetria* (*Aristoteliodes*). Top, *multiformis* (Meyrick), Mt. Olympus, Oahu; ex *Gouldia* (slide Z-XII-19-62-7). Bottom, *thurifica* (Meyrick), paratype (slide Z-XII-19-62-10); Mt. Tantalus, Oahu; ex *Hedyotis* (= *Kadua*).

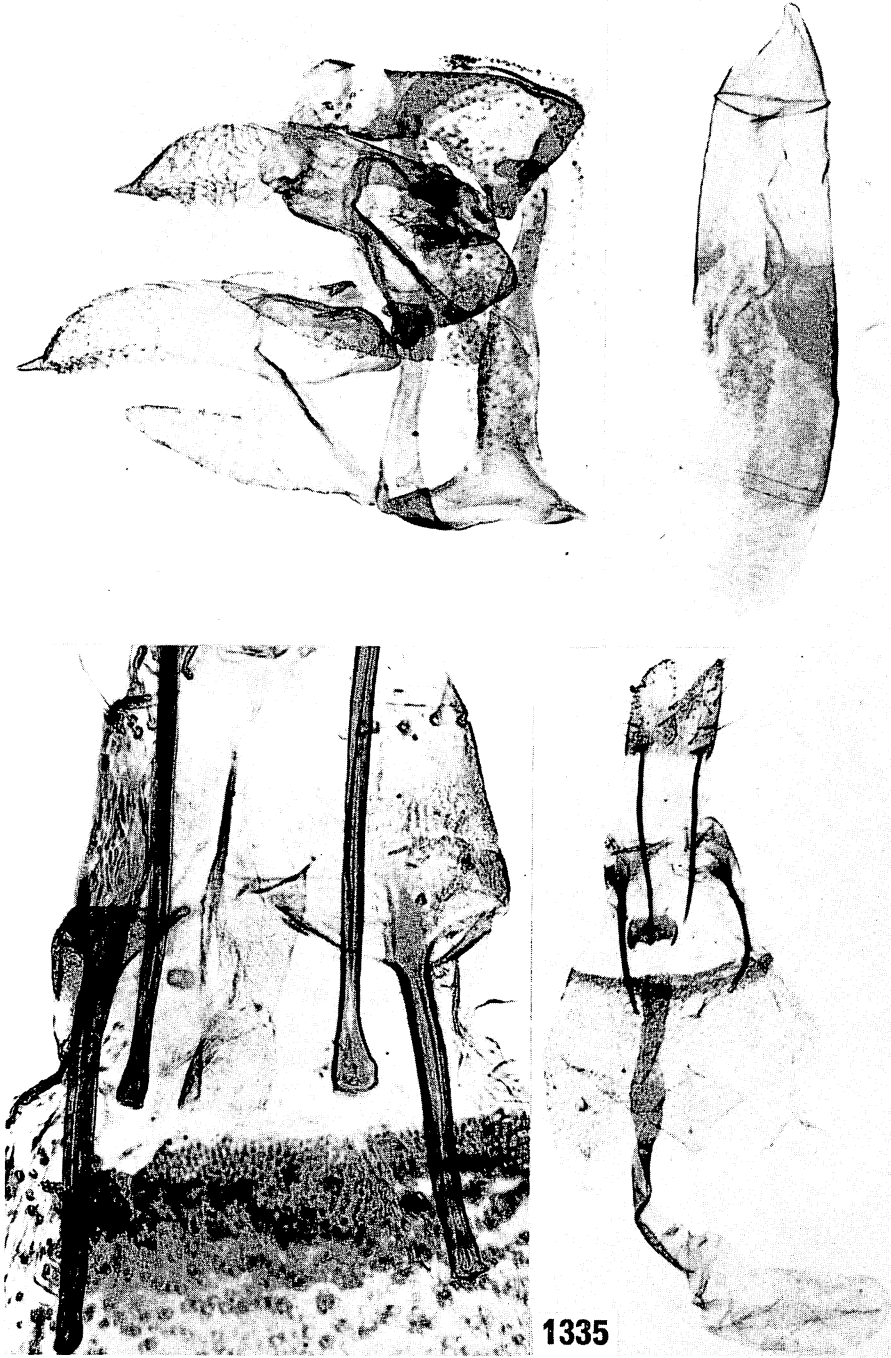


Figure 1335—Top, male genitalia of *Merimnetria* (*Aristoteliodes*) *xylospila* (Meyrick), paratype (Busck slide 206); Mt. Kaala; ex *Gouldia* stem gall. Bottom left, female genitalia of *Merimnetria* (*Merimnetria*) *strausiella* (Swezey), holotype (slide Z-XII-19-62-9); Mt. Olympus, Oahu; ex *Psychotria* (= *Straussia*). Bottom right, *Merimnetria* (*Aristoteliodes*) *xylospila* (Meyrick), paratype (Busck slide 202); Mt. Kaala, Oahu; ex *Gouldia* stem gall.



Figure 1336—Female genitalia of *Merimnetria* (*Aristoteliodes*). Top left, a specimen (new species 3) collected by Perkins; Hilo, 2,000 feet, Hawaii (BM slide 15893; Walsingham specimen 28602); designated species 10 in the *Fauna Hawaïensis* collection by Walsingham but not mentioned in the text. Right and bottom, *thurifica* (Meyrick); Mt. Tantalus, Oahu; undesignated paratype in Meyrick's collection (BM slide 15867); at bottom is an enlargement of the base of the ductus bursae. The ostial area is artificially folded, thus giving a misleading picture.

**Merimnetria (Aristoteliodes) arcuata** (Walsingham), **new combination**  
(figs. 1312, moth; 1319, male genitalia; 1328, female genitalia).

*Aristotelia arcuata* Walsingham, 1907b:482, pl. 13, fig. 25.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Hostplant: the larvae mine the leaves of *Gouldia*.

**Merimnetria (Aristoteliodes) compsodelta** (Meyrick), **new combination**  
(figs. 1312, moth; 1320, 1321, male genitalia; 1329, female genitalia).

*Aristotelia compsodelta* Meyrick, 1928c:99.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: *Hedyotis* (= *Kadua*) *acuminata* capsules.

This species is quite similar to *elegantior*. It differs in that the markings on the forewings are more sharply defined, and the front of the head is flatter and lacks the small median protuberance of *elegantior*.

The holotype is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) elegantior** (Walsingham), **new combination**  
(figs. 1312, moth; 1322, 1333, male genitalia; 1330, female genitalia).

*Aristotelia elegantior* Walsingham, 1907b:481, pl. 13, fig. 23. Swezey, 1954:95.

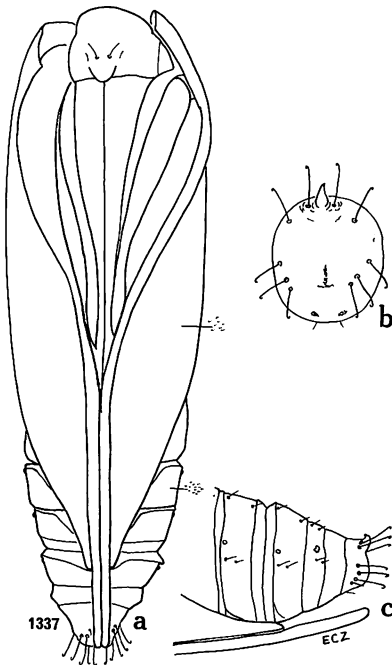


Figure 1337—Cast pupal skin of *Merimnetria (Aristoteliodes) multiformis* (Meyrick); Mt. Tantalus, Oahu; length 6 mm. *a*, ventral aspect; *b*, direct caudal aspect of anal segment; *c*, left lateral aspect of caudal end of abdomen.

Endemic. Oahu (type locality: near the head of Kawailoa Gulch, Koolau Mountains), Hawaii?

Hostplant: *Gouldia macrocarpa* fruits.

Parasites: *Atrometus* species, *Eupelmus peles* Perkins, *Eupelmus* species, *Phygadeuon* species, *Pristomerus hawaiiensis* Perkins, *Sierola aristoteliae* Fullaway, *Sierola flavocollaris* Ashmead.

The Hawaii record is from specimens determined by Dr. Swezey, and I am not sure that they belong to this species. They might apply to the rather similar *lanaiensis*. It is possible, also, that more than one species of moth is confused in the parasite records.

This species is rather similar to *compsodelta* and *lanaiensis* except that in the type the front of the head is convex with a small tubercle in the middle of a line drawn between the antennae. The other species have flatter faces which lack the median tubercle.

**Merimnetria (Aristoteliodes) epermeniella** (Walsingham), **new combination** (fig. 1313, moth).

*Aristotelia epermeniella* Walsingham, 1907b:480, pl. 13, fig. 20.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Only the female holotype is known, and it has lost its abdomen.

**Merimnetria (Aristoteliodes) gigantea** (Swezey), **new combination** (figs. 1313, moth; 1330-A, female genitalia; col. pl. 8:7-8).

*Aristotelia gigantea* Swezey, 1913f:274.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

This is the largest described species of *Aristoteliodes*—wing expanse is 28 mm. It is known only from the female holotype in the Bishop Museum.

**Merimnetria (Aristoteliodes) gratula** (Meyrick), **new combination** (fig. 1313, moth).

*Aristotelia gratula* Meyrick, 1928c:101.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: the larva is a leaf miner of *Psychotria (Straussia) kaduana*.

The holotype, which lacks its abdomen, is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) homoxyla** (Meyrick), **new combination** (figs. 1310, wing venation; 1314, moth; 1320, male genitalia; 1328, 1331, female genitalia).

*Aristotelia homoxyla* Meyrick, 1928c:101. Swezey, 1954:95.

Endemic. Oahu (type locality: Pacific Heights).

Hostplant: *Gouldia coriacea*.

Parasite: *Sierola tantalea* Fullaway.

The attacks of the larvae make large galls on the new stems of the hostplant as does the Waianae Mountains species, *xylospila*. Dr. Swezey's 1910f:138 notes, mistakenly placed under *ichthyochroa*, belong to this species.

The holotype is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) ichthyochroa** (Walsingham), **new combination** (figs. 1314, moth; 1322, male genitalia).*Aristotelia ichthyochroa* Walsingham, 1907*b*:479, pl. 13, fig. 19.

Endemic. Molokai (type locality: above Pelekunu).

Hostplant: unknown.

Only the male holotype is known. In 1910*f*:138, Swezey confused *homoxyla* with this species.**Merimnetria (Aristoteliodes) lanaiensis** (Walsingham), **new combination** (figs. 1314, moth; 1323, male genitalia).*Aristotelia lanaiensis* Walsingham, 1907*b*:481, pl. 13, fig. 22.

Endemic. Lanai (type locality: 2,000 feet).

Hostplant: unknown.

Dr. Swezey (1954:96) reported rearing this species from *Gouldia* fruits and seeds at Kilauea, Hawaii. I have deleted this record in the belief that a possible error in determination was made.**Merimnetria (Aristoteliodes) maculaticornis** (Walsingham), **new combination** (figs. 1315, moth; 1333, female genitalia).*Aristotelia maculaticornis* Walsingham, 1907*b*:478, pl. 13, fig. 17.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

The female holotype is the only specimen known.

**Merimnetria (Aristoteliodes) mendax** (Walsingham), **new combination** (figs. 1315, moth; 1321, 1323, male genitalia; 1331, female genitalia).*Aristotelia mendax* Walsingham, 1907*b*:481, pl. 13, fig. 24.

Endemic. Kauai (type locality: Kaholuanano, 4,000 feet).

Hostplant: unknown.

Although only the male is mentioned in the original description, there is in the British Museum a female paratype from the "Kauai Mts.", 3,000 to 4,000 feet and a female paratype from Halemanu, 4,000 feet. The Halemanu specimen may not be the same species.

Dr. Swezey's references to this species (1913*d*:221; 1915*g*:103) are based upon misidentifications and belong to *multiformis*.**Merimnetria (Aristoteliodes) multiformis** (Meyrick), **new combination** (figs. 1315, moth; 1324, male genitalia; 1334, female genitalia; 1337, pupa).*Aristotelia multiformis* Meyrick, 1928*c*:101. Swezey, 1913*d*:221; 1954:95.

Endemic. Oahu (type locality: Mt. Olympus), Hawaii?

Hostplants: *Gouldia coriacea* and *macrocarpa*.Parasite: *Eupelmus* species.In 1913*d*:221, Dr. Swezey misidentified this species as *mendax*. He said: "The larvae of this moth mine the leaves of *Gouldia*. I have often found the leaves of very small young plants of this tree all mined, so as to fall off, leaving

the plant defoliated. The mine is at first slender and serpentine. As the larva becomes nearly full-grown, it eats out the whole parenchyma of the leaf and sometimes eats down through the petiole of the leaf to the stem, and sometimes also migrates to another leaf. It emerges from the leaf to form its cocoon on the surface of a leaf, or other suitable situation." I have not compared specimens from Hawaii with specimens from Oahu so that I cannot confirm the report that it is also found on Hawaii. The hostplant and parasite records apply to Oahu specimens.

The holotype is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) nigriciliella** (Walsingham), **new combination** (figs. 1309, head, wing venation; 1316, moth; 1325, male genitalia; 1332, female genitalia).

*Aristotelia nigriciliella* Walsingham, 1907b:479, pl. 13, fig. 18.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown. The Swezey notes, 1910:138, on the hostplant refer to *multiformis*.

**Merimnetria (Aristoteliodes) notata** (Walsingham), **new combination** (figs. 1316, moth; 1333 female genitalia).

*Aristotelia notata* Walsingham, 1907b:480, pl. 13, fig. 21. Swezey, 1954:95.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: unrecorded, but possibly a *Gouldia* leaf miner. Dr. Swezey said (1954) that he had found leaf mines in *Gouldia* on Molokai which he assumed to belong to this species. He was unsuccessful in rearing moths from the leaves he collected.

**Merimnetria (Aristoteliodes) thurifica** (Meyrick), **new combination** (figs. 1309, wing venation; 1317, moth; 1326, male genitalia; 1334, 1336, female genitalia).

*Aristotelia thurifica* Meyrick, 1928c:102.

Endemic. Oahu (type locality: Palolo).

Hostplant: a leaf miner in *Hedyotis* (*Kadua*) *acuminata*.

Parasite: *Euderus metallicus* (Ashmead).

The holotype is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) xylospila** (Meyrick), **new combination** (figs. 1311, wing venation; 1317, moth; 1327, male genitalia; 1335, male and female genitalia).

*Aristotelia xylospila* Meyrick, 1928c:100, figure of galls. Swezey, 1954:95, fig. 20, the same figure of the galls.

Endemic. Oahu (type locality: Mt. Kaala).

Hostplant: the larvae form large galls on the new stems of *Gouldia coriacea*.

The species appears to be the Waianae Mountain representative of the Koolau *homoxyla*. The pupae of the two forms are similar.

The holotype is now in the Bishop Museum.

**Merimnetria (Aristoteliodes) new species 1** (fig. 1327, male genitalia).

Endemic. Molokai (above 3,000 feet).

Hostplant: unknown.

A male specimen (Walsingham specimen number 26348; BM slide 15891) represents an undescribed species. It was designated as *Aristotelia* species number 11 in Walsingham's manuscript work but not recorded in *Fauna Hawaiiensis*. The genitalia are similar to those of *nigriciliella* and *multiformis*, but the moths are externally distinctive.

**Merimnetria (Aristoteliodes) new species 2** (fig. 1326, male genitalia).

Endemic. Maui (probably from Haleakala).

Hostplant: unknown.

A specimen collected by Blackburn in 1899, and bearing his line code for Maui and the number 148, was contained in the Walsingham collection. It bears a label wrongly naming it *nigriciliella*. This specimen (BM slide 15882) was inexplicably not mentioned by Walsingham in *Fauna Hawaiiensis*. If I have interpreted the locality code correctly, then it is the only record we have for a species of *Aristoteliodes* from Maui. Surely, however, several species of the genus must occur on Maui. As can be seen from an examination of the illustrations of the male genitalia, this species is not *nigriciliella*.

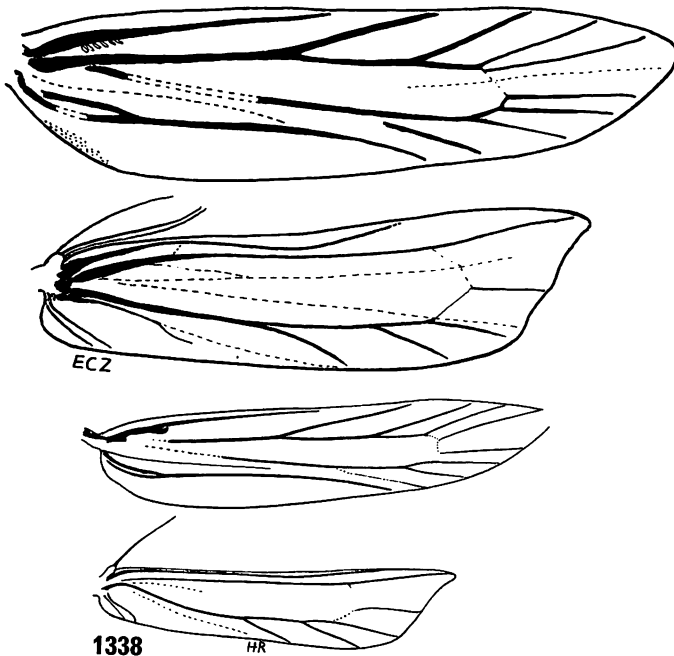


Figure 1338—Wing venations of *Merimnetria* (*Merimnetria*). Top, *straussella* (Swezey); paratype from Mt. Olympus, Oahu (slide Z-70-9). Bottom, *flaviterminella* Walsingham, the type-species; Hilo, 2,000 feet, Hawaii; holotype (BM slide 1859).



**Merimnetria (Aristoteliodes) new species 3** (fig. 1336, female genitalia).

Endemic. Hawaii (above Hilo, 2,000 feet).

Hostplant: unknown.

This specimen, not mentioned in *Fauna Hawaiiensis*, was designated *Aristotelia* species 10 in Walsingham's manuscript work (BM slide 15893; Walsingham specimen number 28602).

Subgenus **MERIMNETRIA** Walsingham *sensu stricto*

*Merimnetria* Walsingham, 1907b:482. Type-species: *Merimnetria flaviterminella* Walsingham, by original designation and monotypy.

Walsingham was in error when he described the wing venation of *Merimnetria*. He said that the forewing has 11 veins and the hindwing 8 veins, but, as my illustration demonstrates, there are only 10 veins in the forewing and 7 in the hindwing. The genitalia are similar to those of *Aristoteliodes*—*Merimnetria* is only a local, specialized derivative of *Aristoteliodes*. Walsingham's remarks on its possible relationships are worthless, because he did not examine or realize the value of the characters of the male genitalia.

# KEY TO THE SPECIES OF MERIMNETRIA SENSU STRICTO

1. Fore- and hindwings dark fuscous, both pairs of wings appearing almost black to the unaided eyes or under low magnification (but forewings seen to be flecked with yellowish and orange-colored scales under higher magnification); known distribution: above Hilo, 2,000 feet, Hawaii. . . . . **flaviterminella** Walsingham.
2. Forewings mostly conspicuously brownish orange with dark marginal maculation; hindwings pale; known distribution: southeast Koolau Mountains, Oahu. . . . . **straussiella** (Swezey).

**Merimnetria (Merimnetria) flaviterminella** Walsingham (figs. 1325, male genitalia; 1339, moth; 1338, wing venation).

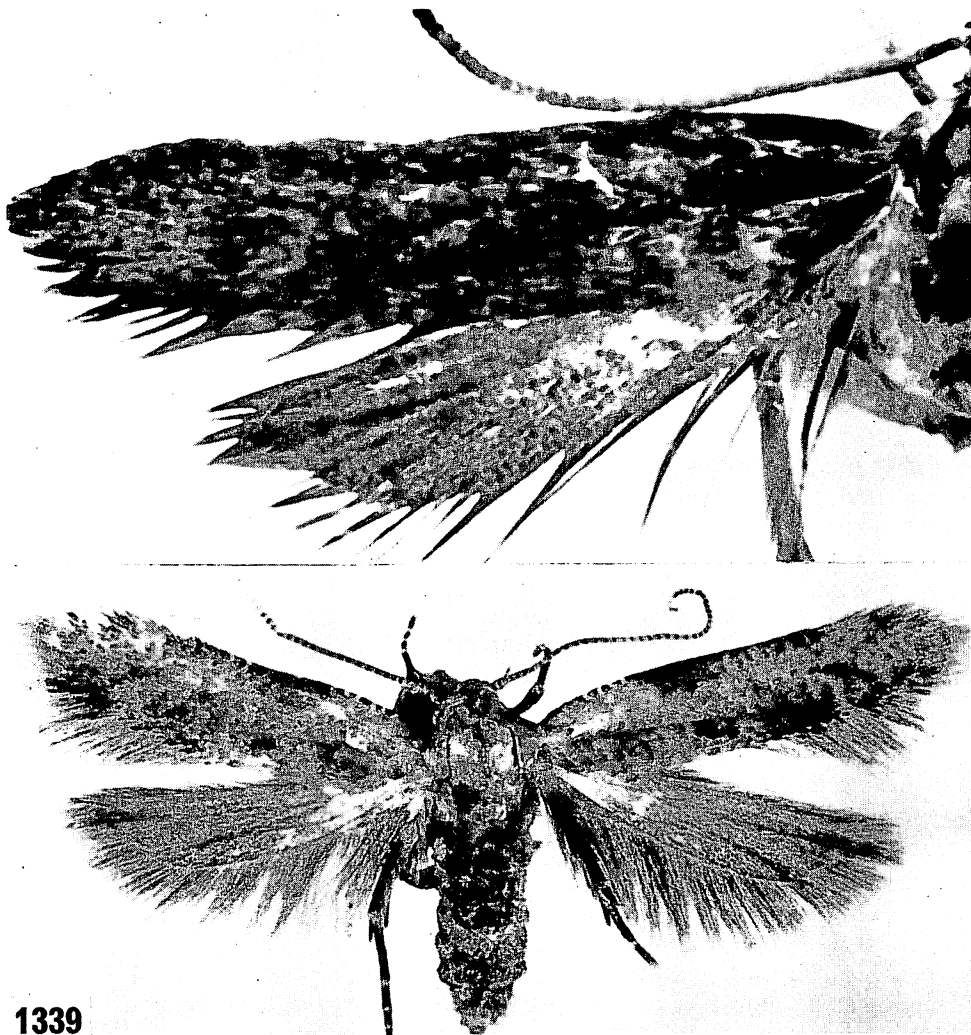
*Merimnetria flaviterminella* Walsingham, 1907b:482, pl. 13, fig. 26.

Endemic. Hawaii (type locality: Hilo, 2,000 feet).

Hostplant: unknown (perhaps a leafminer in *Hedyotis*).

Only the male holotype in the British Museum is known. Although the palpi are shown in Walsingham's *Fauna Hawaiiensis* illustration, they are now missing; it is believed that they were lost during the course of illustrating the species.

This is a particularly dark colored little moth, and the very dark hindwings are especially noteworthy.



1339

Figure 1339—*Merimnetria* (*Merimnetria*). Top, *flaviterminella* Walsingham, holotype male (BM slide 1859); Hilo, 2,000 feet, Hawaii; forewing=5 mm.; brownish fuscous with a sprinkling of yellow and orange squamae; fuscous hindwings. The moth appears nearly black to the unaided eyes or under low magnification. Bottom, *straussiella* (Swezey), paratype female; forewing expanse 10 mm.; Mt. Olympus, Oahu; ex *Psychotria* (= *Straussia*). The forewings are conspicuously orange with dark maculae; the hindwings comparatively pale.

**Merimnetria (Merimnetria) straussiella** (Swezey), **new combination**  
(figs. 1339, moth; 1324, male genitalia; 1335, female genitalia).

*Aristotelia straussiella* Swezey, 1953:23.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: the larvae mine the leaves of *Psychotria* (= *Straussia*) *kaduana* and *mariniana*.

As will be noted from the illustrations, the male genitalia of this species are closely similar to those of *flaviterminella*. The moths are, however, distinctively colored—the predominantly orange-colored forewings and the pale hindwings of this species contrast strongly with those of *flaviterminella*. Upon close examination, it is revealed that there are orange-colored scales, which resemble those of *straussiella*, scattered over the forewings of *flaviterminella*.

The pupa of *straussiella* is similar to the *Aristoteliodes multiformis* and *thurifica* type. The wing cases are conspicuously pilose. The wings and antennae are of similar length, and together they reach only to the apex of the sixth abdominal segment. The tenth (caudal) abdominal segment has a sharp-pointed, dorsal, caudalike process which is only slightly curved dorsad. There are two long setae on each side of the caudal process. One of each pair of these setae is on the caudal process, but the other seta is more cephalad and is at the side of the base of the cauda. There is one long and one short (the short one usually inconspicuous) lateral seta on each side of the tenth segment. All of these setae are fine and hairlike and their apices are only slightly hooked. There are no dorsal setae, and the ventral setae are inconspicuous.

### Tribe **AUTOSTICHINI** (LeMarchand), **new status**

*Autostichinae* LeMarchand, 1947:153.

*Gelechiadae* Group 9, Meyrick, 1925*b*:252.

In 1911, Meyrick proposed the new “family” Metachandidae for his Indian Ocean genera *Metachanda*, *Chanystis*, and *Ancylometis*, which lack veins 7 in the forewings and 6 in the hindwings (Meyrick, 1911*d*:275. Hampson, 1918:386. T. B. Fletcher, 1929:ii). Meyrick also suggested that *Autosticha* belonged to the Metachandidae, although *Autosticha* has vein 6 present in the hindwings. The cluster of genera related to *Metachanda* do form a distinctive group, but I doubt that they should be called a separate family. I suggest that they tentatively be called the tribe Metachandini, **new status**, within the Gelechiinae.

In his volume on the Gelechiidae for *Genera Insectorum*, however, Meyrick (1925*b*:252) erected a new section which he entitled “Group 9 (*Autosticha* type)”. Although he used *Autosticha* as the type-genus, he said nothing about his having previously thought that *Autosticha* belonged in association with *Metachanda*. Meyrick said of his “Group 9”:

In this group are included a small number of early genera characterized by the absence of vein 7 and stalking of veins 2 and 3 of forewings, together with the remnants of those ancestral forms from which they and the rest of the family appear to have been derived, approaching the *Oecophorid* type. The cubital pecten is absent in hindwings. The larvae appear to have the primitive habit of feeding on vegetable refuse, lichens, etc. Geographically the group appears to be primarily Indian, yet with a representative branch in America, and small colonies in Africa and Australia.

Meyrick's "Group 9" appears to be compound. It remains to be determined whether such genera as *Autosticha* and *Stoeberhinus* belong to a group different from that which includes *Metachanda* and its allies. For the present, however, we may use Autostichini for the representatives in Hawaii.

Genus **AUTOSTICHA** Meyrick

*Autosticha* Meyrick, 1886*b*:281. Type-species: *Automola pelodes* Meyrick, by monotypy.

*Automola* Meyrick, 1883*a*:34, homonym, not Loew, 1873, Diptera.

*Epicharma* Walsingham, 1897*a*:38.

*Epicoenia* Meyrick, 1906*b*:140.

*Prosomura* Turner, 1919:147.

Meyrick erroneously allied this genus to *Thyrocopa* in the Xyloryctinae when he described it. *Autosticha* is a rather large genus distributed from Africa to Fiji with the largest number of described species in India and Ceylon. One immigrant species represents the genus in Hawaii.

***Autosticha pelodes*** (Meyrick) (figs. 1340, head, wing venation; 1341, moth, male genitalia; 1342, moth, larva, pupa; 1343, male genitalia; 1344, male, female genitalia; 1345, pupa.

*Automola pelodes* Meyrick, 1883*a*:34.

*Autosticha pelodes* (Meyrick) Meyrick, 1886*b*:281. Walsingham, 1907*b*:487, pl. 14, fig. 1. Swezey, 1909*d*:21, pl. 4, figs. 1–3. Williams, 1931:158.

Oahu (type locality: Honolulu).

Immigrant. This species is known also from Java, Celebes, New Hebrides, Samoa, the Austral Islands, and the Marquesas. It has been dispersed by man.

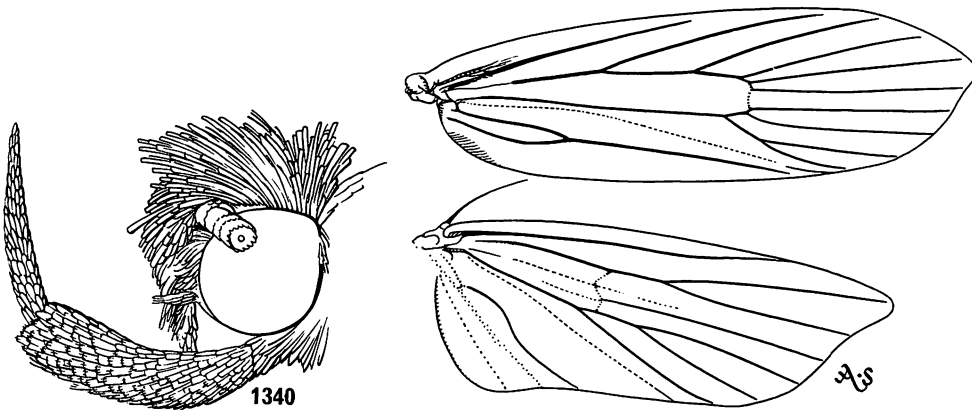


Figure 1340—*Autosticha pelodes* (Meyrick), head and wing venation of a paratype (BM slide 9512); Honolulu.

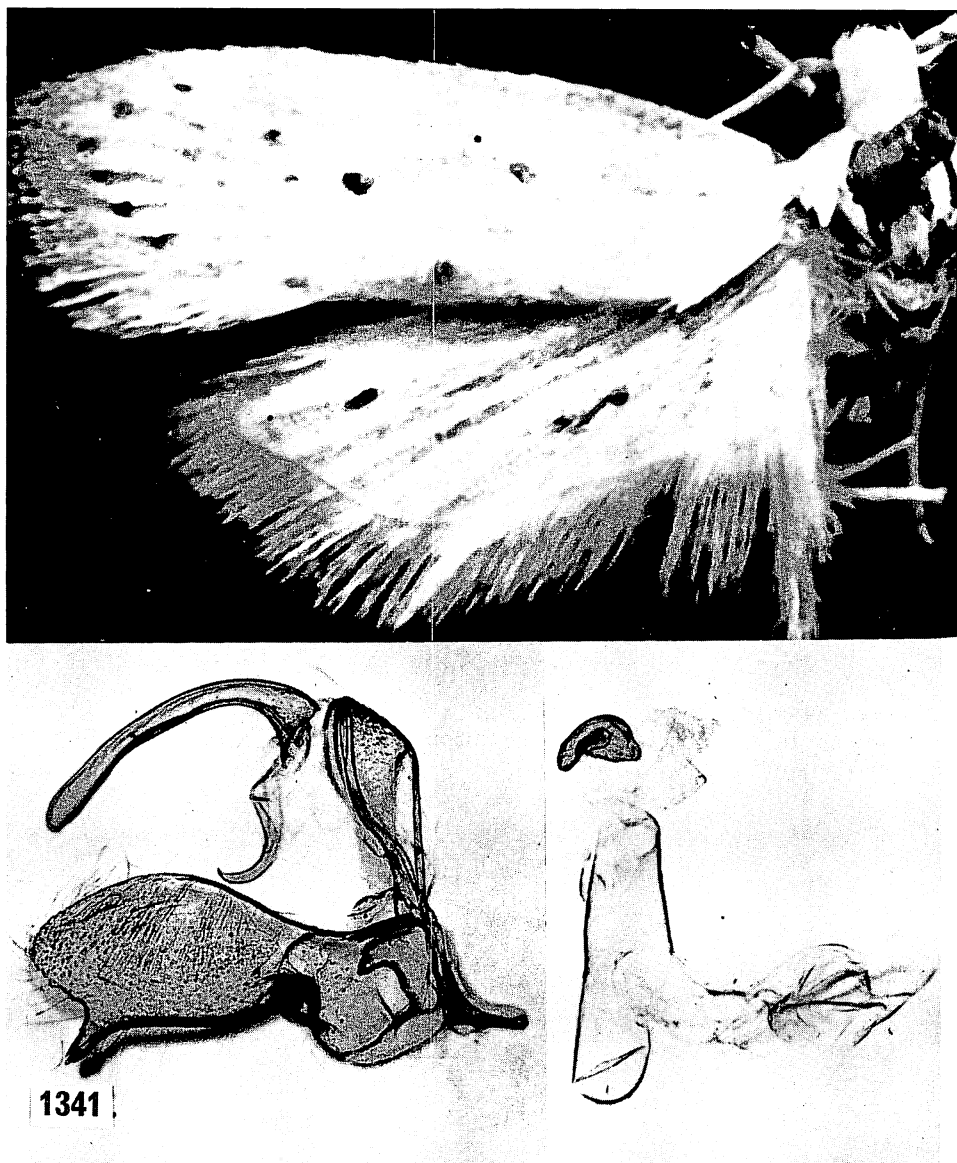


Figure 1341—*Autosticha pelodes* (Meyrick); forewing=8 mm. Male genitalia of the holotype (BM slide 9179), lateral aspect. Specimens collected in Hawaii (Honolulu?) by Blackburn.

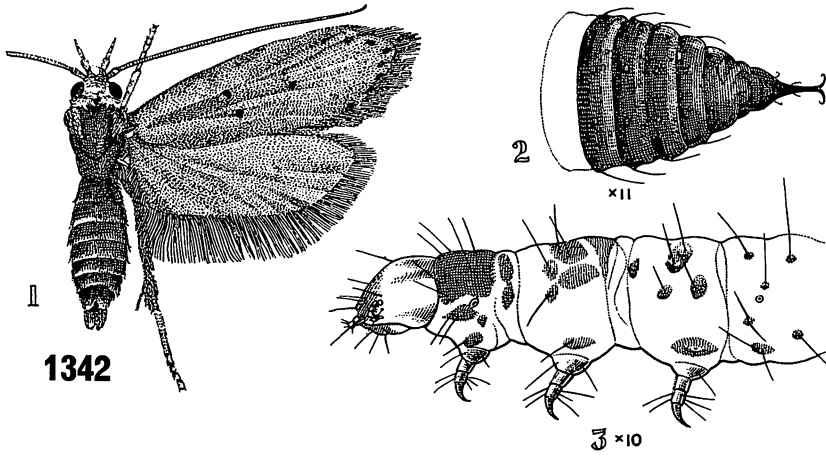


Figure 1342—*Autosticha pelodes* (Meyrick); 2, caudal part of a pupa; 3, anterior part of a larva. The chaetotaxy is in part erroneous and should be ignored. (After Swezey, 1909.)

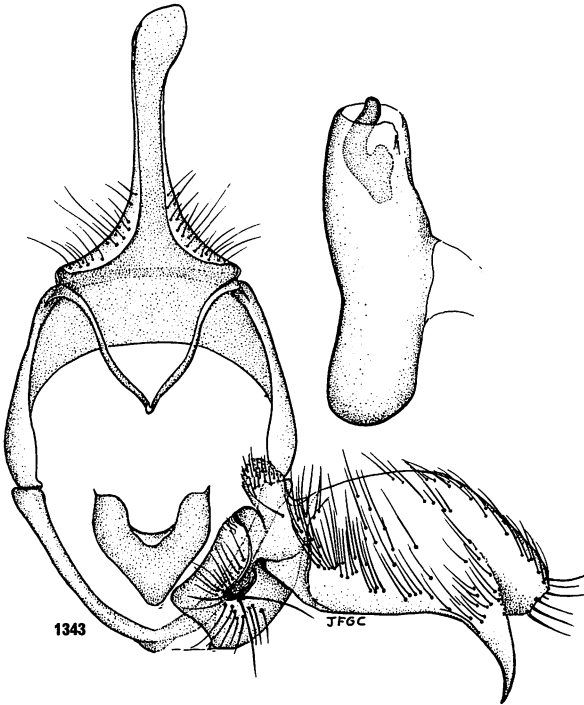


Figure 1343—Male genitalia of *Autosticha pelodes* (Meyrick) (slide USNM 3878 Clarke).

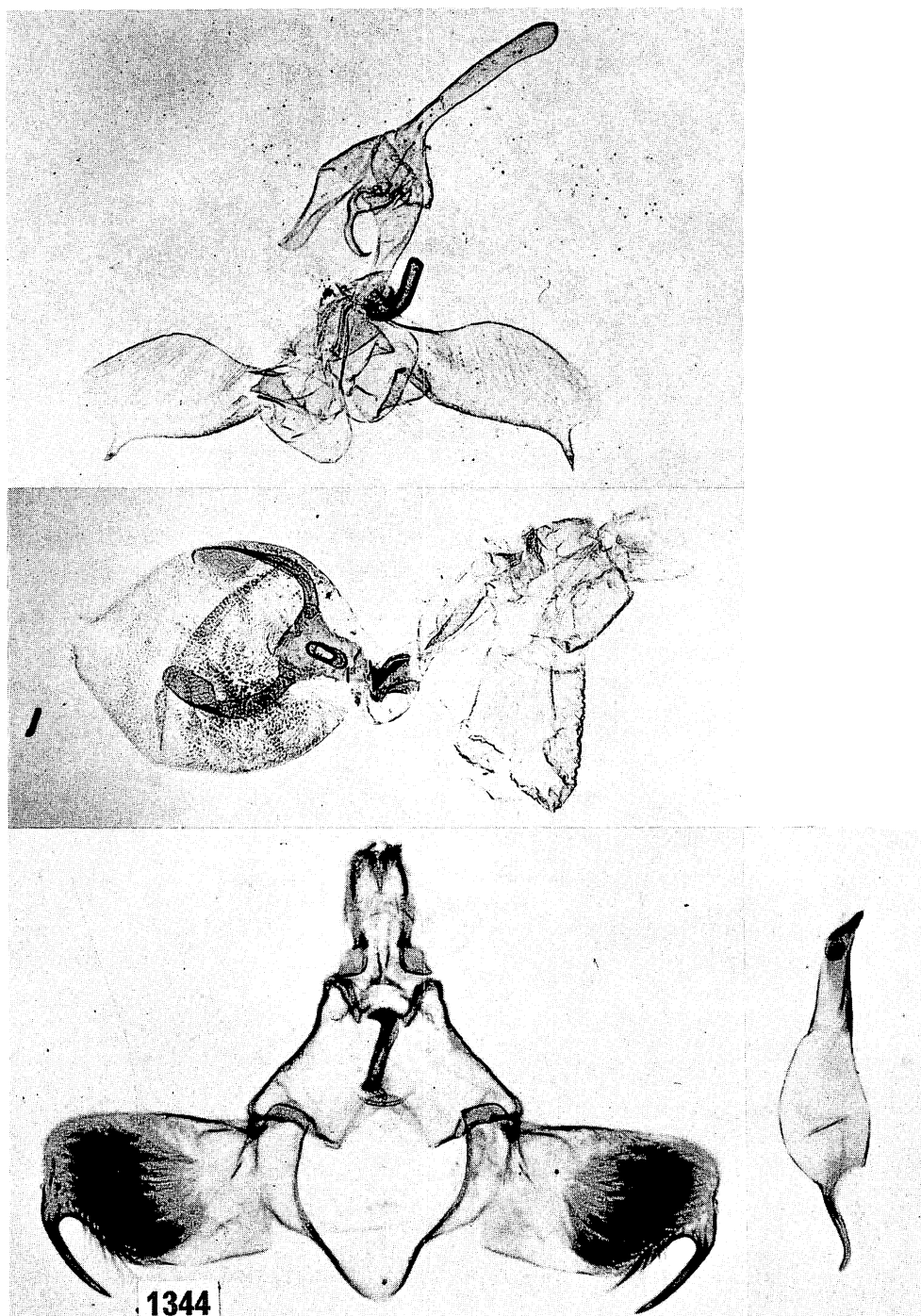


Figure 1344—Genitalia of *Autosticha* and *Sitotroga*. Top, male genitalia of *Autosticha pelodes* (Meyrick); Tutuila, Samoa (Busck slide 247). Middle, female genitalia of the same species; Waialua, Oahu (Busck slide 134). Bottom, male genitalia of *Sitotroga cerealella* (Olivier) (BM slide 2312); see also figure 1295.

It was first collected in Hawaii by Blackburn and recorded in literature by Butler (1877:50) when it was misidentified and called the Australian *Depressaria convictella* Walker.

Hostplants: a general feeder in decaying vegetable matter. The larvae have been found beneath dead leaf sheaths of sugarcane, in fibrous material at the bases of palm fronds, in old *Ipomoea* capsules, in dead twigs and sticks of *Araucaria*, *Lantana*, and *Ricinus*.

Parasite: *Agathis hawaiiicola* (Ashmead).

"It rests with the foreparts much elevated, and thereby has a very distinctive appearance, quite unlike *Stoeberhinus*, some varieties of the female of which it much resembles in superficial appearance." (Perkins, 1913:clxiv.)

This is another moth whose larva is sometimes associated with bud worms in the cane. They are much less numerous, however, and distinctly larger [than the species of Tineidae], and probably do no injury. . . .

The larva (Plate IV, Fig. 3) of this species is large and distinctly different from the bud worm [*Neodecadarchis flavistriata*]. When full-grown it is about 20 mm. in length; cylindrical, head and two following segments

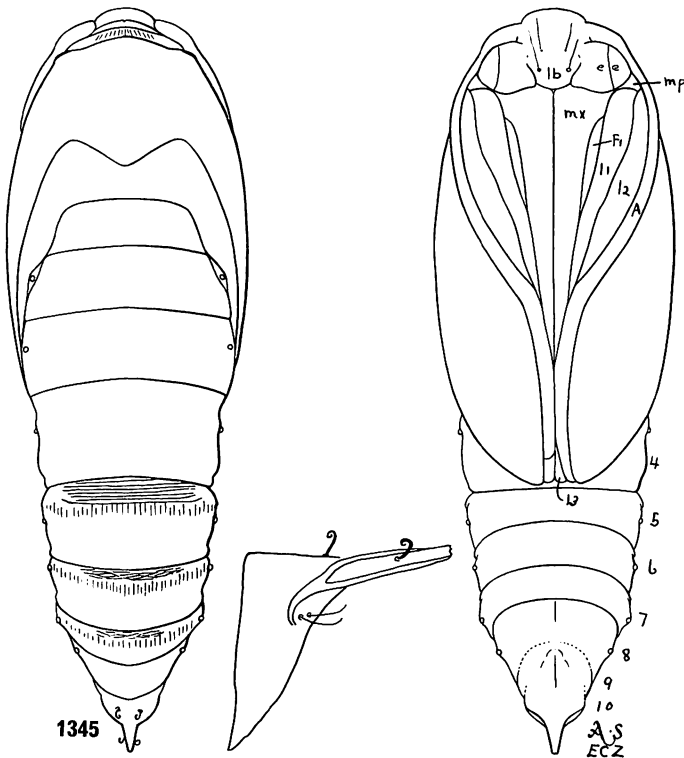


Figure 1345—Pupa of *Autosticha pelodes* (Meyrick), female; length 7.5 mm.; Honolulu, ex old *Ipomoea* pods. A sketch of the cauda (with its apex broken off) in left lateral aspect is inserted. Setae omitted. A, antenna; e, eye; fl, profemora; lb, labrum; l1, l2, l3, legs; mp, maxillary palpi; mx, galea of maxilla (proboscis).



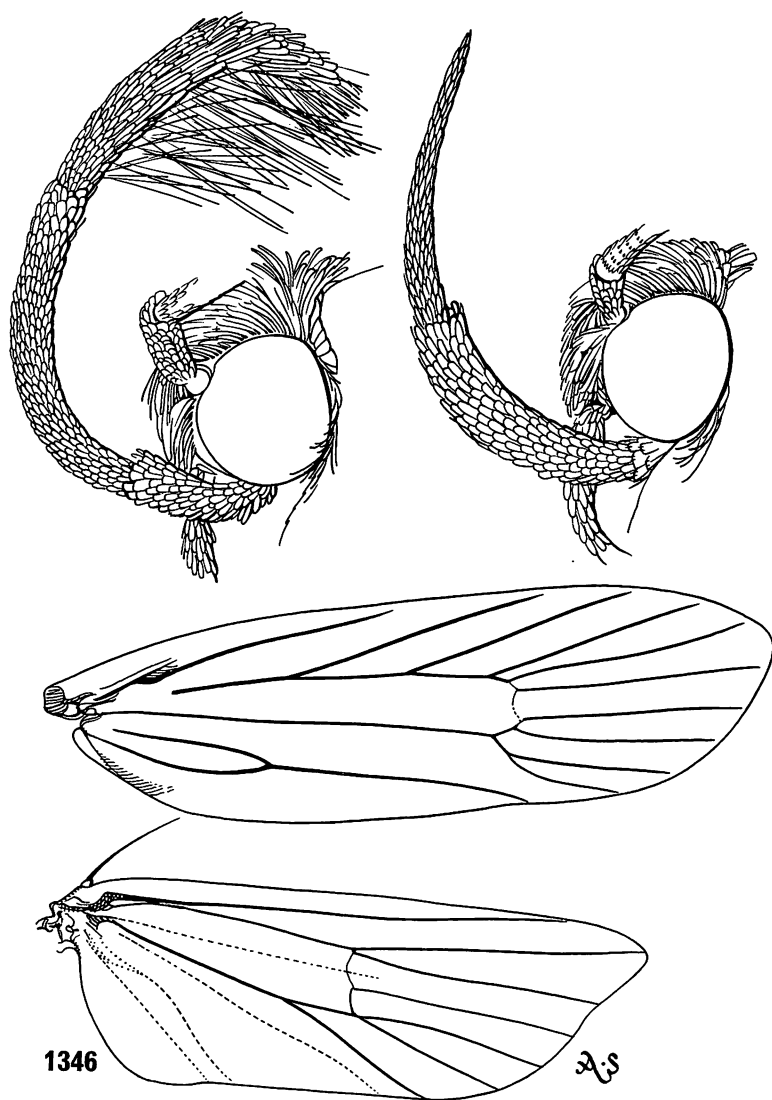


Figure 1346—Heads and wing venation of *Stoeberhinus testaceus* Butler. Top left, male head (note the extraordinary labial palpi); New Hebrides. Top right, female head; Kona, 1,500 feet, Hawaii. Bottom, wings of an Hawaiian male (BM slide 4043).

narrower than rest of body; head bright reddish-brown, eyes black; cervical shield blackish-brown; segments three to six blackish, becoming paler posteriorly; remaining segments more or less fuscous with somewhat of a purplish tinge; tubercles i, ii, and iii, large, circular, slightly convex, a dark dot at base of hairs; other tubercles smaller; hairs long, reddish; spiracles dark with pale centers, those on segments three to eleven, minute.

The pupa (Plate IV, Fig. 2) is formed in a slight cocoon of white silk where the larva has lived. It is about 7 mm. long; uniform, medium brown; antenna- and wing-cases extending to near the apex of fourth abdominal segment; on dorsum of fifth abdominal segment is a band near the base, having longitudinal striations; cremaster flattened dorsiventrally, abruptly contracted to a median spine which has a double hook at the tip fastened into the silk of the cocoon. The pupal period is thirteen to fifteen days. Other details of its life history are not known. (Swezey, 1909d: 21-22.)

The larval mandibles, viewed from above, have long, nearly straight internal cutting edges and only the dorsal apical tooth is visible; frons is short and does not reach the level of the P1 setae; there are six ocelli, and seta O1 is inside the ocellar group and near ocellus 3; prothoracic prespiracular L setae are in a subhorizontal row; abdominal segments one to eight have the SD1 setae above the spiracles and the L1 and L2 setae are in a subhorizontal row; the crochets are biordinal; the procoxae are contiguous, or nearly so, and the protrochanter has an ental gibbosity.

The pupa has the profemora exposed, and this character is shared in the Hawaiian Gelechiidae by *Blastobasis*, *Thyrocopa*, and *Stoeberhinus*.

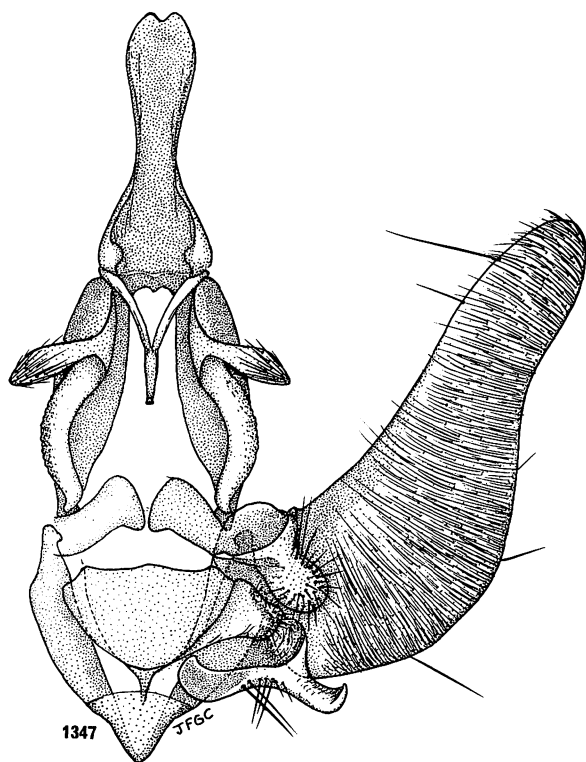


Figure 1347—*Stoeberhinus testaceus* (Butler). Male genitalia (aedeagus removed).

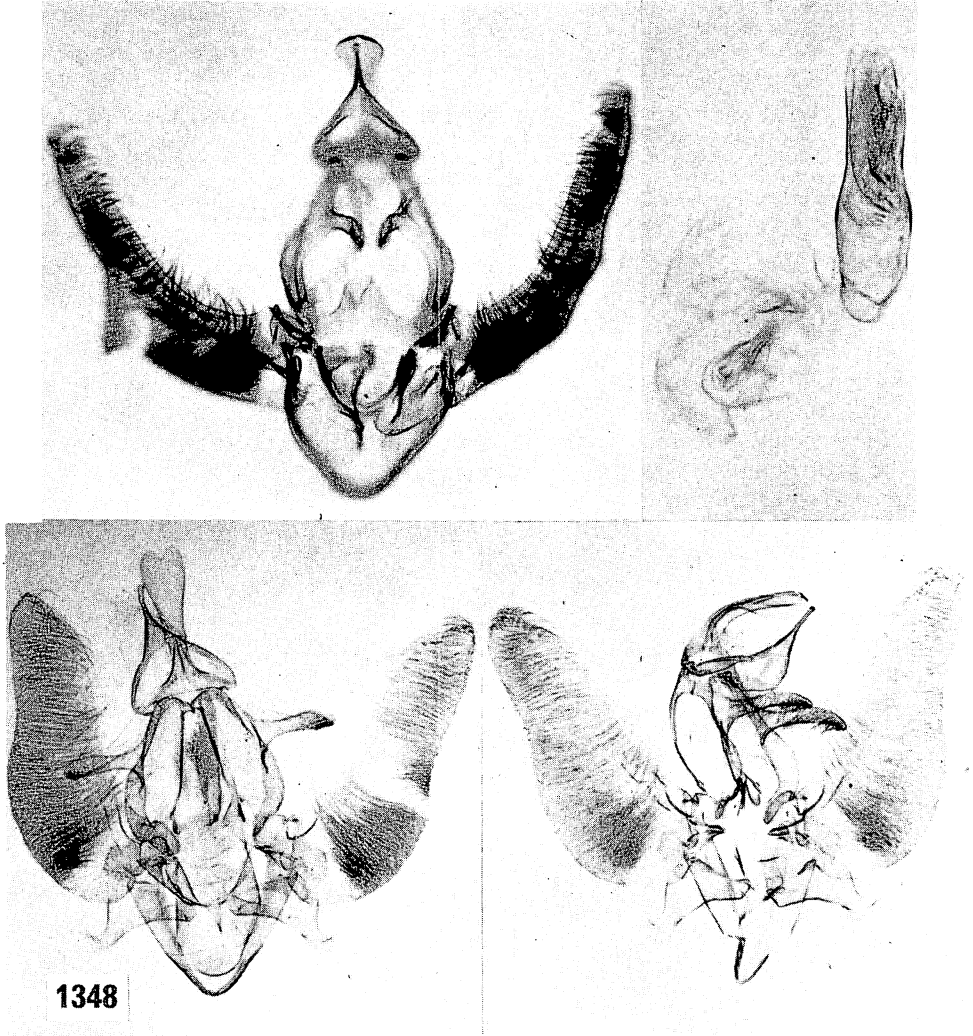


Figure 1348—Male genitalia of *Stoeberhinus testaceus* Butler. Top, the holotype (BM slide 4043); Honolulu. Bottom left, Honolulu (Busck slide 229). Bottom right, Honolulu (Busck slide 96). The preparation of the genitalia of the holotype is not opened out and not flattened as are the other two preparations; it thus presents a different appearance.

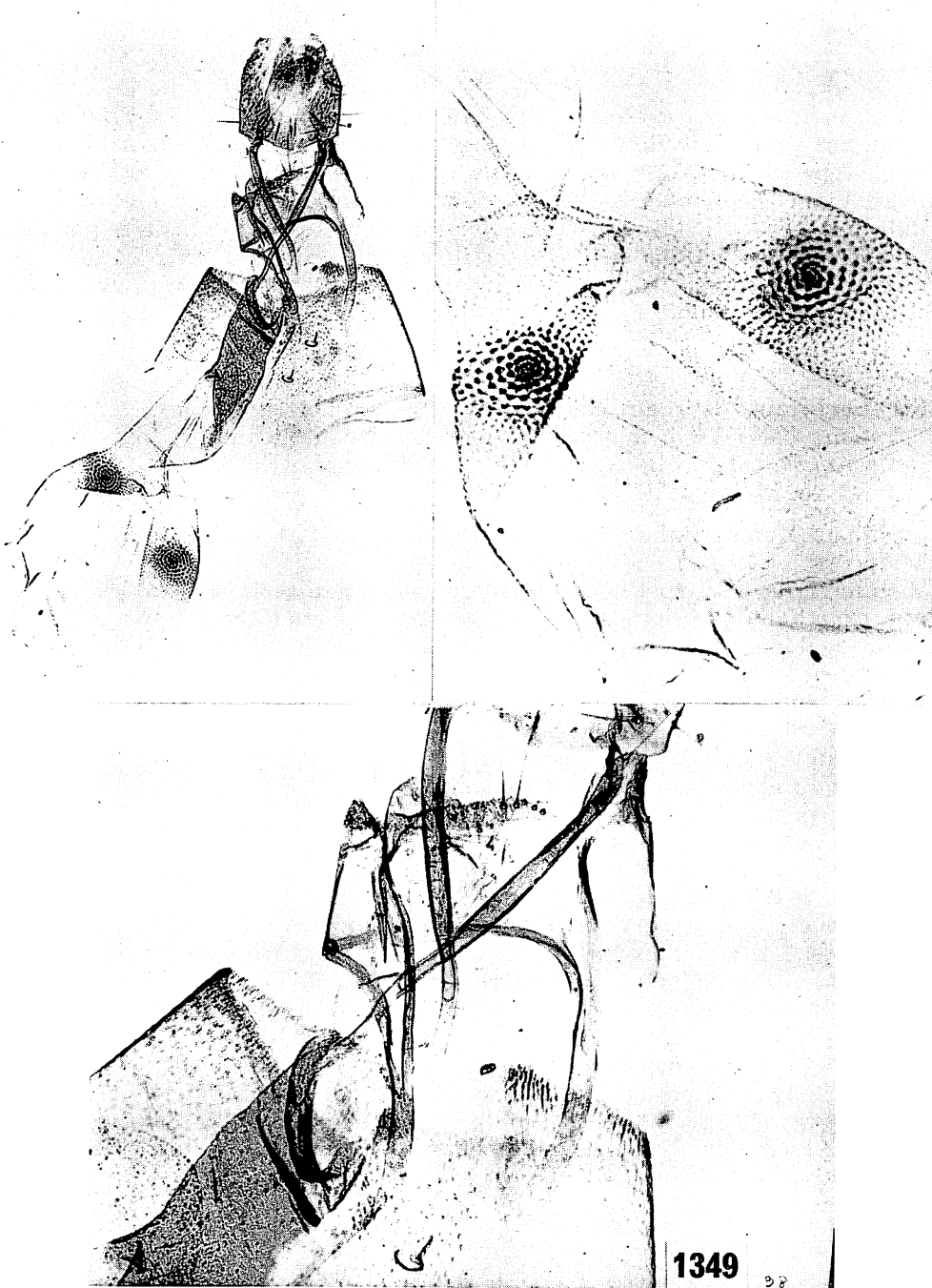


Figure 1349—Female genitalia of *Stoeberhinus testaceus* Butler, Honolulu (Busck slide 98).

Genus **STOEBERHINUS** Butler

*Stoeberhinus* Butler, 1881:402. Type-species: *Stoeberhinus testaceus* Butler, by monotypy.

In the literature, *Stoeberhinus* is considered as a monotypic genus, but there are other (non-Hawaiian) species now confused in the genus *Autosticha*. A single representative of a new species was taken from an airplane at Hickham Field, Oahu, September 7, 1946, by Samuel Biller. The male genitalia are on slide J. F. G. C. 4348 in the U.S. National Museum. The uncus is pointed instead of apically broadened, the gnathus is different, and other features are distinct from *testaceus*. It is not known to be established in Hawaii. The same species has been found on Guam.

**Stoeberhinus testaceus** Butler (figs. 1299, moth; 1346, heads, wing venation; 1347, 1348, male genitalia; 1349, female genitalia; 1350, pupa). *Stoeberhinus testaceus* Butler, 1881:402. Walsingham, 1907*b*:486, 733, pl. 13, fig. 28. Meyrick, 1927*c*:84.

Niihau, Kauai, Oahu (type locality: Honolulu), Molokai, Maui, Hawaii, Midway.

Immigrant. This species is widespread in Oceania: Java, New Hebrides, Fiji, from Samoa to the Austral and Marquesas Islands, and supposedly also in the Galapagos. It was described from Hawaiian specimens collected by Blackburn.

Hostplants: the larvae feed in silken tunnels among decaying leaves of many plants, including dead grasses; "ex rotting leaves of pigeon peas".

Parasites: *Agathis hawaiiicola* (Ashmead), *Orgilus swezeyi* Fullaway, *Phanerotoma hawaiiensis* (Ashmead), *Stomatoceras pertorvum* Girault (misidentified as *Hockeria* sp.?).

This is one of the most common moths in Hawaii, and was perhaps the most abundant species attracted to lights in lowland areas during my years of residence in Hawaii. It is very common in Honolulu. The males have unusually long labial palpi which recurve over the thorax and have a distal brush of long hairs. They are thus quite different in appearance from the females whose palpi are not so elongated. The long palpi of the males make them easy to determine at a glance. The genitalia are very distinctive in the Hawaiian fauna.

Although this is such a common species, little is known about it. I have always thought it unusual that Dr. Swezey did not write a detailed report on its biology.

The pupa has exposed profemora. This character is shared in the Hawaiian Gelechiidae only by *Blastobasis*, *Thyrocopa*, and *Autosticha*.

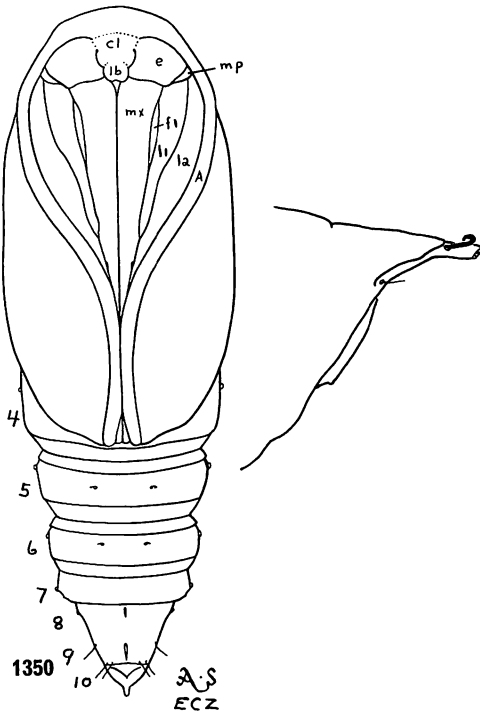


Figure 1350—Pupa of a female *Stoeberhinus testaceus* Butler in ventral aspect with an enlargement of the cauda in left lateral aspect (the apex is broken off); length 7.5 mm.; Honolulu. The dorsum of the thorax of this specimen is broken away and lost, and the dorsal side is thus not illustrated. The abdominal tergites are decorated with conspicuous, longitudinal, raised lines. *A*, antenna; *cl*, clypeus; *e*, eye; *fl*, profemora; *lb*, labrum; *l1*, *l2*, legs; *mp*, maxillary palpi; *mx*, galea of maxilla (proboscis).

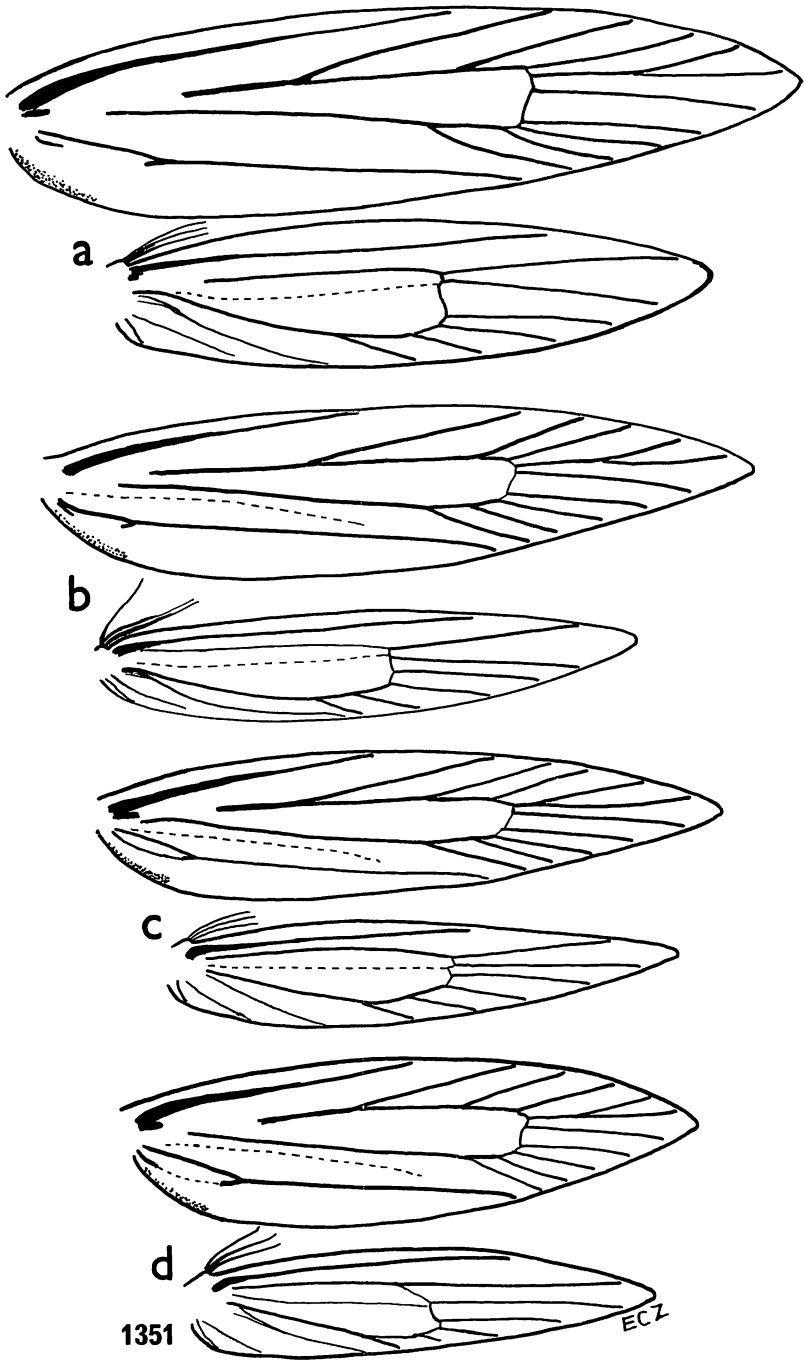


Figure 1351—Wing venations of *Hyposmocoma* (*Hyposmocoma*). *a*, *genitalis* Walsingham; Olinda, 4,000 feet, Maui; allotype (BM slide 8544); left wings drawn reversed. *b*, *fractinubella* Walsingham; Olinda, 4,000 feet, Maui; allotype (BM slide 7942); compare male on figure 835. *c*, *paradoxa* Walsingham; Kauai, 3,000 to 4,000 feet; allotype (BM slide 8003); left wings drawn reversed. *d*, *metrosiderella* Walsingham; Halemanu and Kaholuamano, 4,000 feet, Kauai; allotype (BM slide 8004)

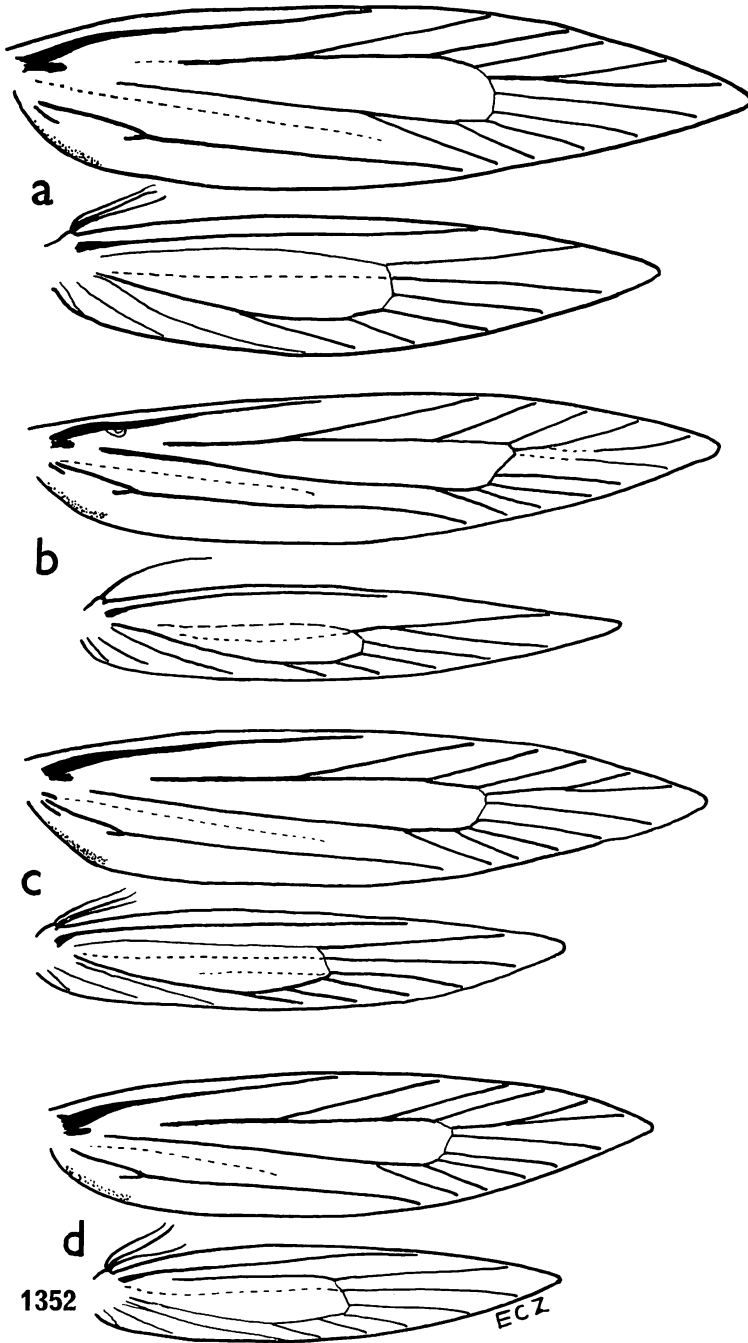


Figure 1352—Wing venations of *Hyposmocoma* (*Hyposmocoma*). *a*, *somatodes* Walsingham; Kona, 4,000 feet, Hawaii; allotype (BM slide 8019). *b*, new species 33, from a "paratype" of *thiatma* Meyrick; Olinda, Maui (slide Z-70-23). *c*, *thoracella* Walsingham; Lanai, 2,000 feet; allotype (BM slide 7914). *d*, *sideritis* Walsingham; Olinda, 4,000 feet, Maui; allotype (BM slide 7997); left wings drawn reversed.



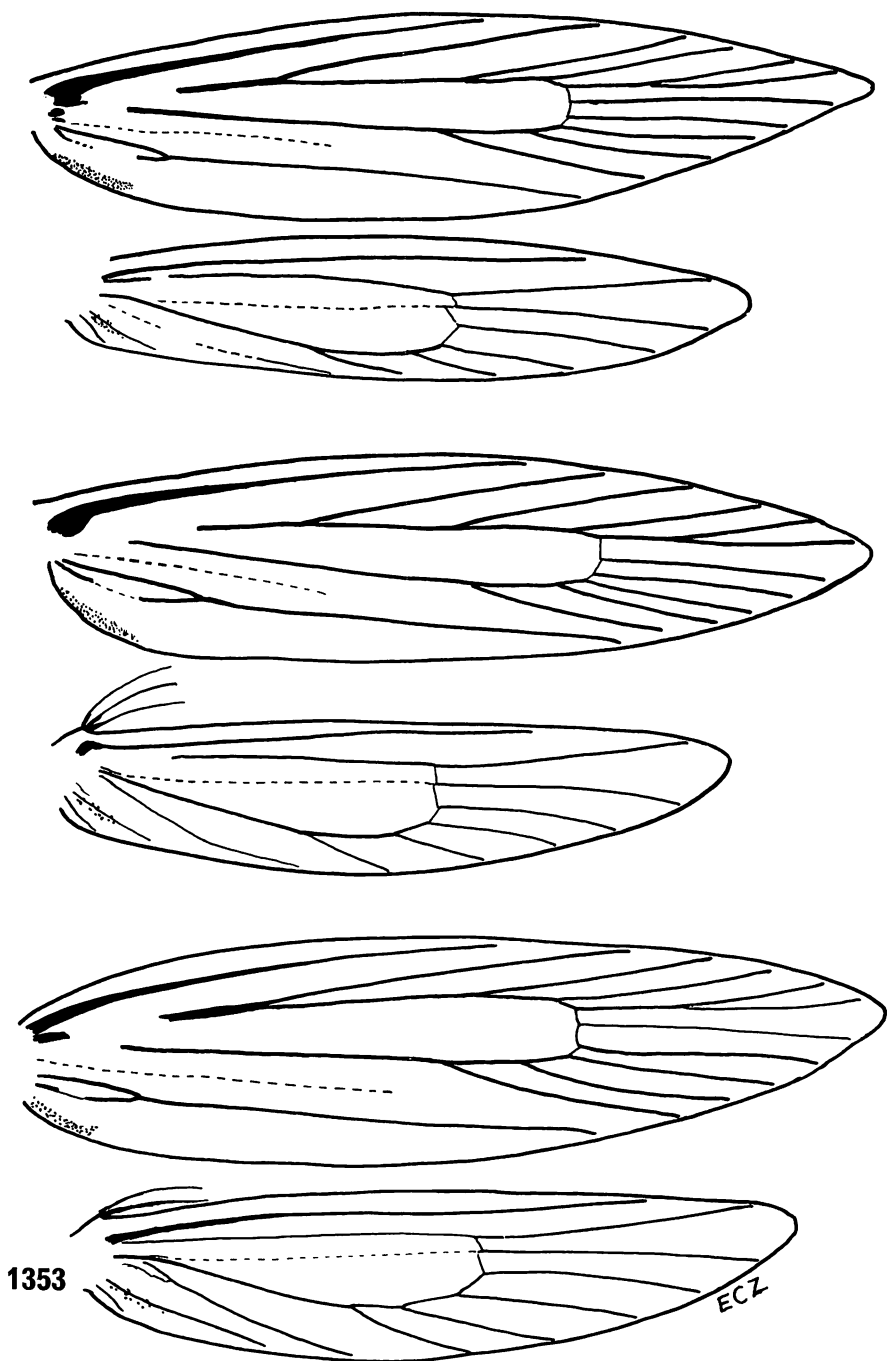


Figure 1353—Wing venations of *Hyposmocoma* (*Euperissus*). Top, *phantasmatella* Walsingham; Kaholua-mano, 4,000 feet, Kauai; allotype female (BM slide 7956); left wings drawn reversed. Middle, *quadripunctata* Walsingham; Kauai, 3,000 to 4,000 feet; allotype (BM slide 7974); left wings drawn reversed. Bottom, (*"Hyperdasylella"*) *unicolor* (Walsingham); above Pelekunu, Molokai; allotype (BM slide 7226); left wings drawn reversed.

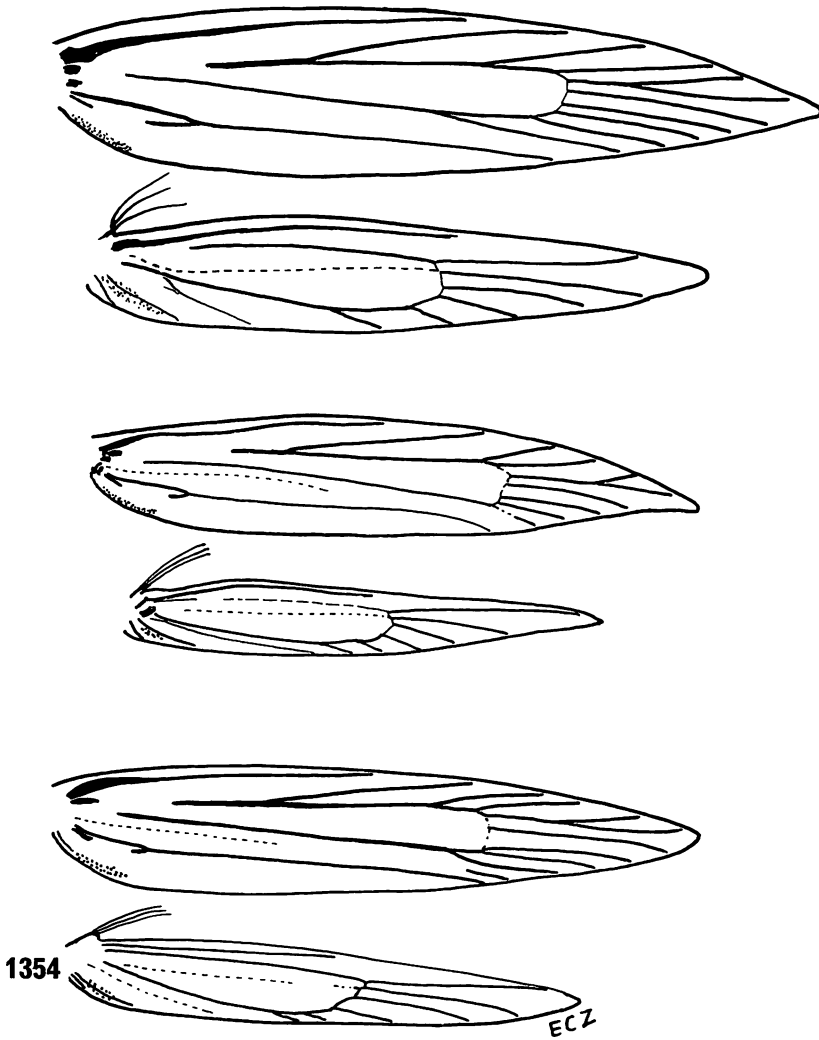


Figure 1354—Wing venations of *Hyposmocoma* (*Euperissus*). Top, *longitudinalis* Walsingham; Kaawaloa, 2,000 feet, Kona, Hawaii; allotype (BM slide 8028). Middle (*“Neelysia”*) *ningorella* (Walsingham); Haleakala, 5,000 feet, Maui; allotype (BM slide 7720). I found no trace of vein 2 in the forewing. Bottom (*“Neelysia”*) *palmifera* (Meyrick); Pauoa Flats, Oahu (BM slide 16350).

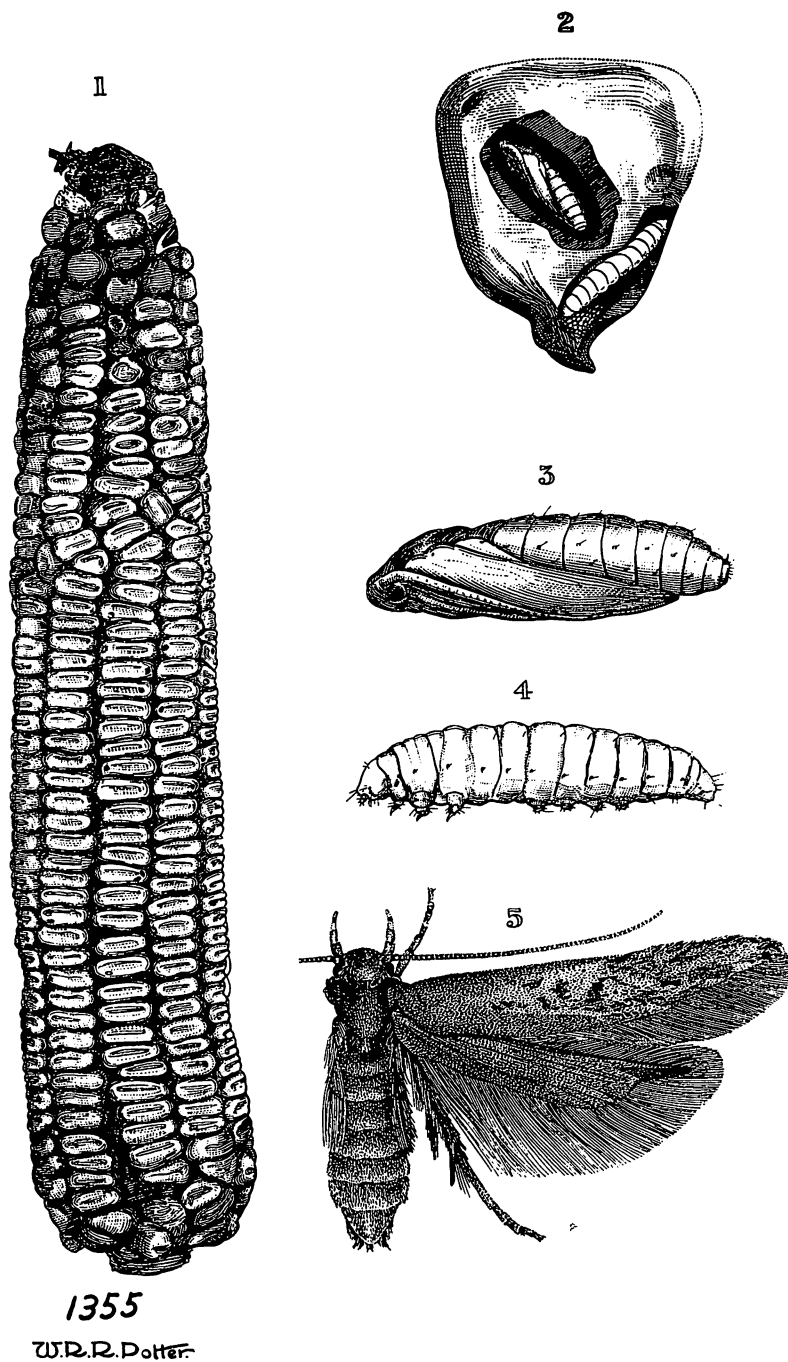


Figure 1355—Details of *Sitotroga cerealella* (Olivier), the Angoumois grain moth. 1, ear of infested maize showing exit holes in various kernels; 2, a kernel cut open to show a larva and a pupa within; 3, pupa; 4, larva; 5, moth. (After Swezey, 1910g.)

## LITERATURE CONSULTED

This is the combined lists of literature consulted during the writing of my volumes on the Hawaiian Lepidoptera. In addition to the literature on the Microlepidoptera, it includes corrections and new or supplementary references to the Macrolepidoptera and Pyraloidea. With the exception of only one or two obscure works, I personally have been able to consult each of the references cited.

I am deeply indebted to the British Museum (Natural History) and the Museum of Comparative Zoology, Harvard University, whose great libraries were generously placed at my disposal during the research on the Hawaiian Lepidoptera.

I wish especially to thank the members of the staff of the Entomological Library of the British Museum (Natural History) who, for more than 25 years, have given this project so much assistance. The library in their charge is the greatest entomological library in the world, and it is incomparably curated.

To introduce students to some of the literature in various categories other than taxonomy (details of which are incorporated under the specific and supraspecific headings), the following author lists, segregated according to subject, may be found helpful. It must be understood that the lists include only some of the papers and monographs available on the respective subjects and are far from complete. They are presented here only to introduce the reader to the various subjects. Those who wish to pursue advanced studies of the Lepidoptera will gain much from a careful reading of the Bibliography.

EGGS: Döring, 1955.

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PUPAE: Butt and Cantu, 1962; Chapman, 1893, 1900*c*; Hinton, 1946*b*, 1946*c*, 1949*a*, 1949*b*; Maddox, 1969; Mosher, 1916 (most detailed monograph); Poulton, 1890–1891; Shierbeek, 1917; Solomon, 1962.

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My wish and judgment about the affair has always been this: that I should much prefer that some one of those, more skilful than myself, had undertaken it; but still it is better even I should undertake it, than it be left undone.

Newman, Grammar of Entomology, 1835

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Let no man who writes a book presume to say when he will have finished.  
 When he imagines that he is drawing near his journey's end, Alps rise on Alps,  
 and he continually finds something to add and something to correct.

Gibbon